

Article

Deaths related to volatile substances, helium and nitrogen in England and Wales: 2001 to 2020 registrations

Deaths related to volatile substances, helium and nitrogen in England and Wales from 2001 to 2020, by cause of death, sex, age, region and substances involved in the death.

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1 . Main points

- Between 2001 and 2020, there were 716 deaths related to volatile substances registered in England and Wales, with an average of 36 deaths each year.
- There were 25 deaths related to volatile substances registered in 2020; this is the same as 2019 and has remained broadly stable over time.
- Between 2001 and 2020, most deaths related to volatile substances registered were among males (77.9%).
- Fuels were the most common volatile substances mentioned on the death certificate, involved in 59.5% of deaths between 2001 and 2020, with butane (involved in 324 deaths) and propane (123 deaths) being the most frequently specified substances.
- Nitrous oxide was the third most mentioned substance on the death certificate after butane and propane, with 56 deaths registered between 2001 and 2020, and 45 of those having been registered since 2010.
- The most common causes of death were mental and behavioural disorders and accidental poisoning.
- Between 2001 and 2020, there were 646 deaths registered involving helium and 103 deaths involving nitrogen in England and Wales.

Because of changes in methodology, figures for 2001 to 2016 have been revised since the last publication of deaths related to volatile substances. For more information see [Section 8: Data sources and quality](#).

2 . Volatile-substance-related deaths in England and Wales

Volatile substance abuse (VSA) is defined by the [European Monitoring Centre for Drugs and Drug Addiction \(EMCDDA\)](#) as “the deliberate inhalation of volatile compounds to produce psychoactive effects”.

Volatile substances include, but are not limited to:

- fuel gases
- aerosol propellants
- some types of industrial glues
- nitrous oxide
- alkyl nitrites (known as “poppers”)
- some anesthetics

This report describes trends in deaths involving volatile substances registered between 2001 and 2020 in England and Wales. Although helium and nitrogen are both inert gases and not volatile substances, the latter sections of this report describe trends in deaths related to these substances.

Between 2001 and 2020, there were 716 deaths related to volatile substances registered in England and Wales. This represents an average of 36 registered deaths each year. The number of deaths range from 25 deaths registered in 2008, 2019 and 2020, to 60 deaths registered in 2002.

The mortality rate for deaths related to volatile substances has remained broadly similar during the period 2001 to 2020, with an annual average of 0.6 deaths registered per million people. The only statistically significant difference was found in 2002, when the rate of one death per million was significantly higher than the rates for 2008, 2009, 2012, 2019 and 2020.

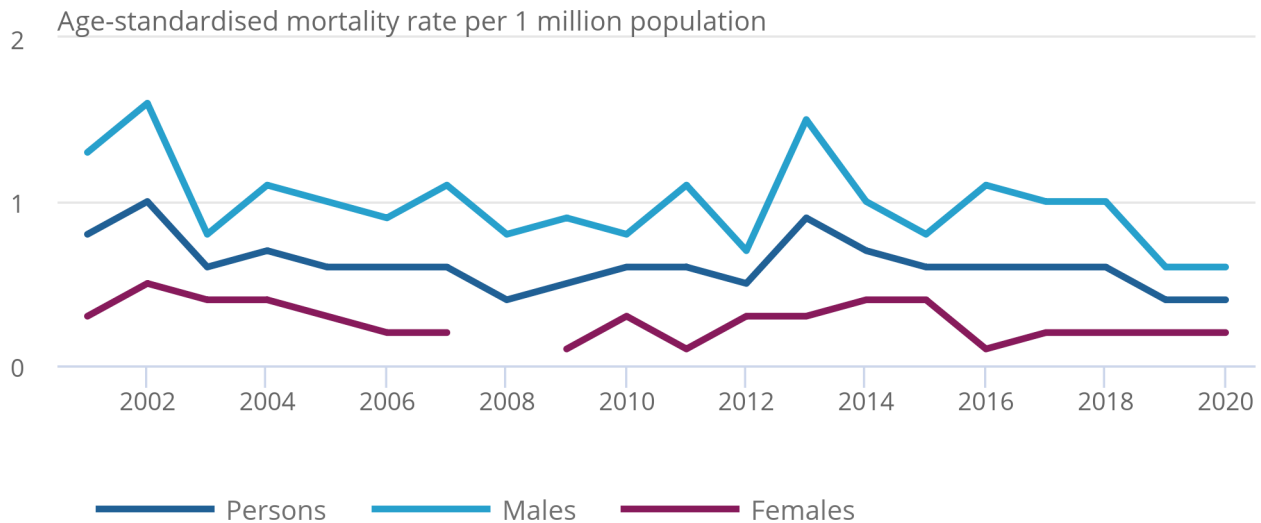
Most deaths related to volatile substances were among males. There was a total of 558 male deaths registered between 2001 and 2020 (77.9% of all deaths), with an average of 28 deaths per year or one death per one million males per year. There were 158 female deaths registered during the same time period. This is approximately eight deaths per year, and an average rate of 0.3 deaths per million females.

Figure 1: Deaths involving volatile substances have remained stable over time

Age-standardised mortality rates for deaths related to volatile substances, by sex, England and Wales, registered from 2001 to 2020

Figure 1: Deaths involving volatile substances have remained stable over time

Age-standardised mortality rates for deaths related to volatile substances, by sex, England and Wales, registered from 2001 to 2020



Source: Office for National Statistics

Notes:

1. Age-standardised mortality rates per 1 million population, standardised to the 2013 European Standard Population.
2. Cause of death was defined using the International Classification of Diseases, Tenth Revision (ICD-10).
3. Figures are for deaths registered, rather than deaths occurring in each calendar year.
4. Rates are not calculated where there are fewer than three deaths, as rates based on such low numbers are susceptible to inaccurate interpretation.

The number of deaths related to volatile substances among younger age groups has fallen over the past 20 years, while increasing slightly in older age groups. For the period 2001 to 2005, there was an average of 26 deaths per year among people aged under 30 years, while 2016 to 2020 saw an average of 10 deaths per year among the same age group. The equivalent figures for those aged 30 to 49 years increased from 14 deaths per year (2001 to 2005) to 15 deaths (2016 to 2020).

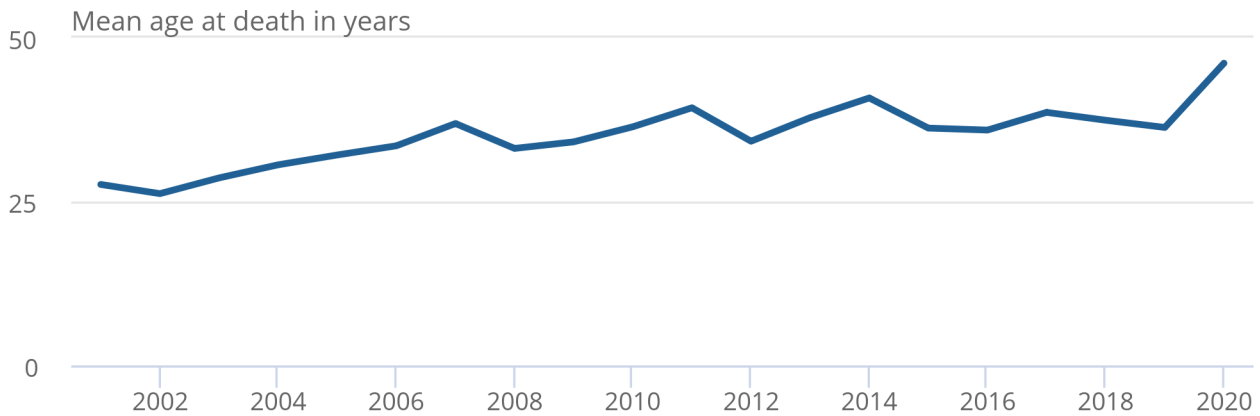
The mean average age at death for deaths related to volatile substances increased from 27.6 years in 2001 to 46.1 in 2020. These trends in the typical age of volatile substance deaths are similar to those that seen for [drug-related deaths](#).

Figure 2: The average age at death has risen from 27.6 years in 2001 to 46.1 years in 2020

Mean age at death for deaths related to volatile substances, England and Wales, registered between 2001 and 2020

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Mean age at death for deaths related to volatile substances, England and Wales, registered between 2001 and 2020



Source: Office for National Statistics

Notes:

1. Cause of death was defined using the International Classification of Diseases, Tenth Revision (ICD-10).
2. Figures are mean average of age at death, for deaths registered, rather than deaths occurring, in each calendar year.

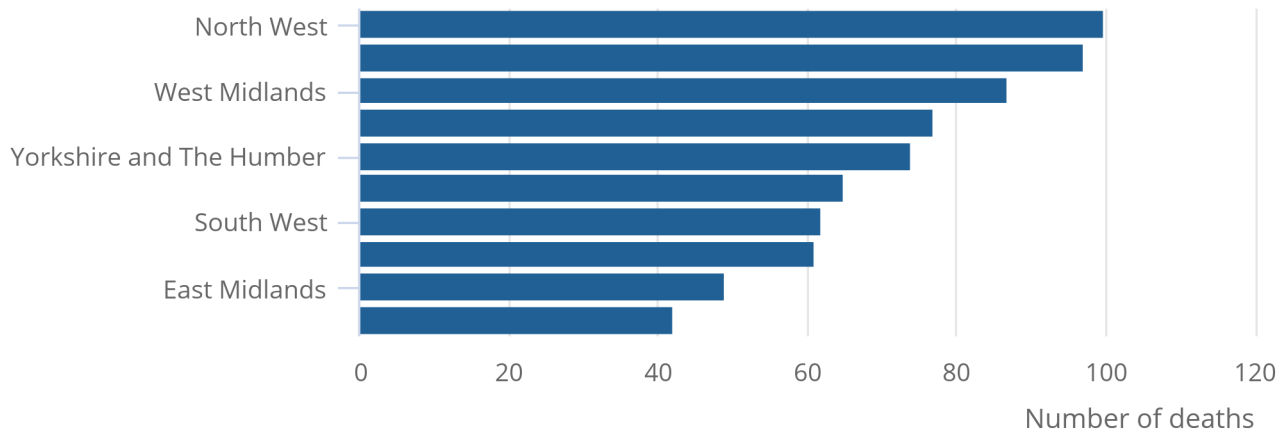
Between 2001 and 2020, there were 672 deaths related to volatile substances registered in England, and 42 in Wales. The English region with the highest number of deaths was the North West (100 deaths) and the lowest was the East Midlands (49 deaths).

Figure 3: The North West had the highest number of deaths involving volatile substances

Numbers of deaths related to volatile substances, by regions of England and Wales, registered between 2001 and 2020

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Numbers of deaths related to volatile substances, by regions of England and Wales, registered between 2001 and 2020



Source: Office for National Statistics

Notes:

1. Cause of death was defined using the International Classification of Diseases, Tenth Revision (ICD-10).
2. Figures are for deaths registered, rather than deaths occurring in each calendar year.
3. Figures for England, its regions and Wales exclude deaths of non-residents and are based on November 2021 postcode boundaries.

3 . Volatile-substance-related deaths by selected substances

Fuels

Broad groups of volatile substances are shown in Table 1. Between 2001 and 2020, the most common type of volatile substance mentioned on the death certificate was fuel, with 426 volatile-substance-related deaths involving at least one fuel (59.5%). In 11.9% of cases, the volatile substance was not specified on the death certificate.

Table 2 shows a more detailed breakdown of substances. These are the substances that were recorded on death certificates by coroners. Please note that several substances listed are likely to refer to the same thing, for example “lighter fuel”, “lighter gas” and “liquefied petroleum gas (LPG)” are all likely to be a mixture of butane and propane. We have not made any assumptions beyond what was listed on the death certificate.

The most commonly specified fuels were butane (involved in 324 deaths) and propane (123 deaths). These fuels are also likely to be present in other substances mentioned, including “lighter fuel”, “lighter gas”, “LPG”, “hydrocarbon”, “petrol fumes” and some aerosols. The inhalation of butane or propane gas can lead to heart failure, commonly referred to as “sudden sniffing death syndrome”. You can [find out more about the effects of inhaling butane gas on the Re-Solve website](#).

Nitrous oxide

Nitrous oxide has become one of the [most commonly abused substances](#) in England and Wales, particularly among young people. In the year ending March 2020, 2.4% of adults aged 16 to 59 years and 8.7% of adults aged 16 to 24 years reported using nitrous oxide in the past year. This makes it the second most abused drug for those aged 16 to 24 (after cannabis) and third most abused drug among those aged 16 to 59 years (after cannabis and cocaine).

Between 2001 and 2020, there were 56 registered deaths involving nitrous oxide in England and Wales, with 45 of those having been registered since 2010. Among other health risks, inhaling nitrous oxide (through a mask) runs the risk of asphyxiation or suffocation. For further information on health risks and harm reduction for nitrous oxide and other solvents, you can [visit the Re-Solve website](#).

Table 1: Number of deaths where selected substances were mentioned on the death certificate, England and Wales, 2001 to 2020 registrations

Substance category	Number of deaths	Percentage of all volatile substance deaths
Fuels	426	59.5
Nitrous oxide	56	7.8
Aerosols	29	4.1
Specified solvents	47	6.6
Anaesthetic	42	5.9
Alkyl nitrites	25	3.5
Volatile substance, unspecified	85	11.9
Other volatile substance, specified	13	1.8

Source: Office for National Statistics

Notes

1. Counts total to more than the total number of volatile substance deaths and percentages total to more than 100% because more than one substance group can be involved in a single death.
2. Figures are for deaths registered, rather than deaths that occurred, between 2001 and 2020.
3. Figures for England and Wales include deaths of non-residents.
4. Specific substances included in each category are listed in Section 8: Data sources and quality.

Table 2: Number of deaths where specific substances were mentioned on the death certificate England and Wales, 2001 to 2020 registrations

Substance	Number of deaths where the substance was mentioned
Fuels	
Butane	324
Propane	123
Isobutane	38
Lighter fuel	27
Lighter gas	7
LPG	6
Hydrocarbon	10
Petrol fumes	5
Fuel gas	13
Other specified fuels	6
Nitrous oxide	
Nitrous oxide	56
Aerosols	
Aerosol (otherwise unspecified)	16
Deodorant	11
Other specified aerosol	2
Specified solvents	
Toluene	9
Acetone	9
White Spirit	9
Dichloromethane	10
Glue (otherwise unspecified)	3
Other specified solvents	10
Anaesthetics	
Chloroform	30
Isoflurane	7
Sevoflurane	5
Alkyl nitrates	
Alkyl nitrites	25
Other specified VSA	
Trichloroethanol	11
Chlorodifluoromethane	1
Printer cleaner	1
VSA, unspecified	
Solvent unspecified	54

Source: Office for National Statistics

Notes

1. Counts total to more than the total number of volatile substance deaths because more than one substance group can be involved in a single death.
2. Because a single death can involve more than one volatile substance, the total of the categories (for example, fuels) in Table 2 will not sum to the figures in Table 1.
3. Figures are for deaths registered, rather than deaths that occurred, between 2001 and 2020.
4. Figures for England and Wales include deaths of non-residents.
5. Other specified substances are listed in Section 8: Data sources and quality.

4 . Volatile-substance-related deaths by cause of death

Between 2001 and 2020, the majority of volatile-substance-related deaths had an underlying cause of mental and behavioural disorders or accidental poisoning. These two causes accounted for 76.1% of deaths during this time. Intentional self-poisoning and poisoning of undetermined intent were the underlying cause in 23.2% of deaths.

The National Statistics definition of suicide includes all deaths from intentional self-harm for persons aged 10 years and over, and deaths where the intent was undetermined for those aged 15 years and over. Using this definition, 23.0% of volatile-substance-related deaths were suicides. Suicide involving volatile substances was less common in women than men, accounting for 10.8% of deaths in women and 26.5% in men.

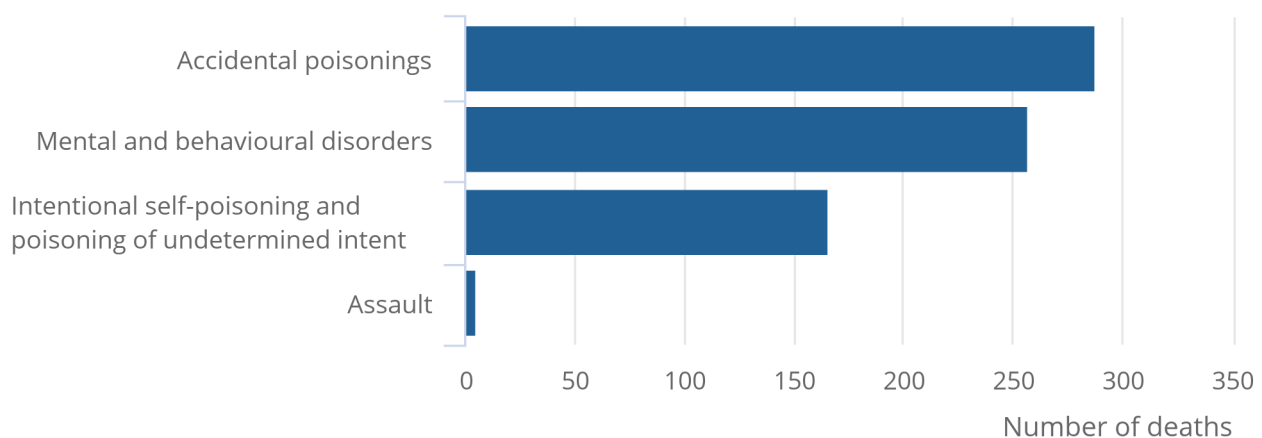
Most of the deaths in the categories of mental and behavioural disorders or accidental poisoning are likely to be the result of volatile substance abuse (the deliberate inhalation of volatile compounds to produce psychoactive effects). However, some of these deaths will have been accidents that did not involve any attempted substance abuse.

Figure 4: Accidental poisoning was the most common cause of death for deaths related to volatile substances

Numbers of deaths related to volatile substances in England and Wales, by cause of death, registered between 2001 and 2020

Figure 4: Accidental poisoning was the most common cause of death for deaths related to volatile substances

Numbers of deaths related to volatile substances in England and Wales, by cause of death, registered between 2001 and 2020



Source: Office for National Statistics

Notes:

1. Cause of death was defined using the International Classification of Diseases, Tenth Revision (ICD-10).
2. Figures are for deaths registered, rather than deaths that occurred, between 2001 and 2020.
3. Figures for England and Wales include deaths of non-residents.

5 . Deaths involving helium or nitrogen in England and Wales

This section will discuss deaths involving helium and nitrogen (both inert gases) even though they are not volatile substances. In England and Wales, there were 646 deaths involving helium between 2001 and 2020, and 103 deaths involving nitrogen.

As shown in Figure 5, deaths involving helium and nitrogen have been increasing over the past 20 years. Between 2001 and 2010, there were 87 deaths involving helium and four involving nitrogen. Between 2011 and 2020, there were 559 deaths involving helium and 99 involving nitrogen. Most deaths involving these substances registered between 2001 and 2020 were among males (83.4% of helium-related deaths and 91.3% of nitrogen-related deaths).

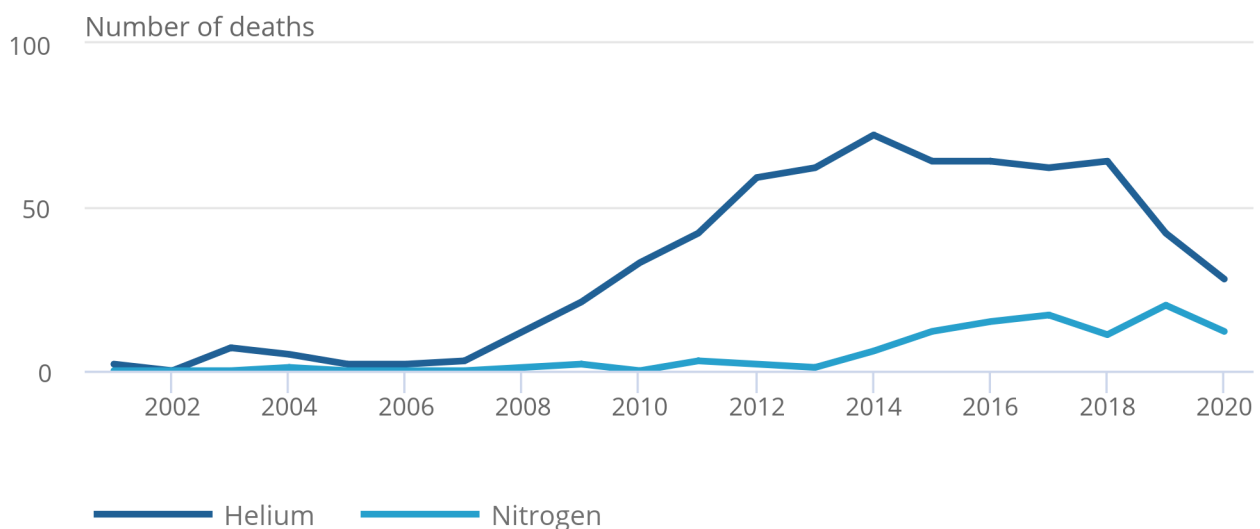
The number of deaths involving helium fell in 2019 and 2020, there were 28 deaths involving helium registered in 2020, which represents the lowest total since 2009.

Figure 5: Deaths involving helium and nitrogen rose in the second decade of the 21st century

Numbers of deaths related to helium and nitrogen, England and Wales, registered from 2001 to 2020

Figure 5: Deaths involving helium and nitrogen rose in the second decade of the 21st century

Numbers of deaths related to helium and nitrogen, England and Wales, registered from 2001 to 2020



Source: Office for National Statistics

Notes:

1. Cause of death was defined using the International Classification of Diseases, Tenth Revision (ICD-10). More details can be found in [Section 8: Data sources and quality](#).
2. Figures are for deaths registered, rather than deaths occurring in each calendar year.
3. Figures for England and Wales include deaths of non-residents.

6 . Deaths related to volatile substances, helium and nitrogen in England and Wales data

[Deaths related to volatile substance abuse, helium, and nitrogen in England and Wales](#)

Dataset | Released 28 February 2022

Deaths related to volatile substances, helium and nitrogen in England and Wales by cause of death, sex, age, region and substance(s) involved in the death.

7 . Glossary

Volatile substance abuse (VSA)

The deliberate inhalation of volatile compounds to produce psychoactive effects.

Age-standardised mortality rate

Age-standardised mortality rate in this article refers to a weighted average of the age-specific mortality rates per million people and standardised to the 2013 European Standard Population. They allow for differences in the age structure of populations and therefore allow valid comparisons to be made between geographical areas, the sexes and over time.

Age-specific mortality rate

Age-specific mortality rate is the total number of deaths per million people of a particular age group, used to allow comparisons between specified age groups.

8 . Data sources and quality

Statistics on mortality are derived from the information provided when deaths are certified and registered. Quality and methodology information is available in the [Mortality statistics in England and Wales Quality and Methodology Information \(QMI\)](#), and the [User guide to mortality statistics](#).

Statistics are based on the year of death registration. Because of death registration delays, around half of these deaths will have occurred in previous years to which they were registered in, and the majority will have occurred before the coronavirus (COVID-19) pandemic in the UK.

Definition of a volatile substance, helium, or nitrogen-related death

Deaths are included where the underlying cause of death was one of those in Table 3 and at least one volatile substance (or helium or nitrogen) was mentioned in the coroner's text. They do not include all adverse effects of these substances, for example, accidents caused by an individual being under the influence of a volatile substance.

Table 3: International Classification of Diseases, Tenth Revision (ICD-10) codes used to define deaths related to volatile substances, helium, and nitrogen

Description	ICD-10 Codes
Mental and behavioural disorders due to psychoactive substance use (excluding alcohol and tobacco)	F11–F16, F18–F19
Accidental poisoning by drugs, medicaments, biological and noxious substances	X40–X44, X46–X49
Intentional self-poisoning by drugs, medicaments, biological and noxious substances	X60–X64, X66–X69
Assault by drugs, medicaments, biological and noxious substances	X85–X89
Poisoning by drugs, medicaments, biological and noxious substances, undetermined intent	Y10–Y14, Y16–Y19

Source: Office for National Statistics

Substance categories

Substances mentioned on the death certificate by substance category:

Fuel

- Butane
- Butene
- Chloroethane
- Diethyl ether
- Fuel gas
- Hydrocarbon
- Isobutan
- Isopentane
- Lighter fluid
- Lighter fuel
- Lighter gas
- Liquefied petroleum gas (LPG)
- Petrol fumes
- Propane

Aerosol

- Aerosol
- Air freshener
- Deodorant
- Fabric protection spray

Nitrous oxide

- Nitrous oxide

Anaesthetic

- Chloroform
- Isoflurane
- Sevoflurane

Alkyl nitrites

- Alkyl nitrite
- Amyl nitrate
- Isobutyl nitrate

Specified solvents

- Acetone
- Dichloromethane
- Glue
- Isopropyl alcohol
- Toluene
- Trichloroethylene
- Turpentine
- White spirit
- Xylene
- Benzene

Other volatile substance, specified

- Chlorodifluoromethane
- Printer cleaner
- Trichloroethanol

Volatile substance, unspecified

- Volatile substance
- Solvent

Changes since the previous publication

Figures for the period 2001 to 2016 have been revised since the previous release. This is because of the following changes in the methodology:

- mentions of unspecified “gas” on death certificates have now been excluded because without further context we cannot know what this refers to
- mentions of “natural gas” have been excluded because it is not a substance with the potential for psychoactive effects
- previously, nitrogen and nitrous oxide were grouped together as “nitrogen-related” and counted as volatile substances; we have now removed “nitrogen” from the volatile substance category

9 . Related links

[Deaths related to drug poisoning in England and Wales: 2020 registrations](#)

Bulletin | Released 3 August 2021

Deaths related to drug poisoning in England and Wales from 1993 to 2020, by cause of death, sex, age and substances involved in the death.

[Drug misuse in England and Wales: year ending March 2020](#)

Article | Released 9 December 2020

An overview of the extent and trends of illicit drug use for the year ending March 2020. Data are from the Crime Survey for England and Wales.

[Volatile substance abuse and helium deaths in Scotland](#)

Web page | Released 17 August 2021

Information on the National Records of Scotland website about the numbers of deaths that were caused by volatile substance abuse and by helium, 2020 and previous years.

[Deaths related to volatile substances and helium in Great Britain: 2001 to 2016 registrations](#)

Article | Release 26 March 2018

Deaths related to volatile substances and helium in England, Wales and Scotland from 2001 to 2016, by region, sex, age, substances involved and cause of death.