Health Survey for England 2018

Asthma

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This report covers the prevalence of asthma and the management and control of its symptoms in adults and children. It compares the prevalence of symptoms and of controlled and uncontrolled asthma in different population groups by age, sex, household income, area deprivation, cigarette smoking status and e-cigarette use, exposure to other people's smoke, and residence in urban or rural areas.

Key findings

- In 2018, 17% of men and 18% of women had ever had asthma diagnosed. A higher proportion of younger adults reported diagnosed asthma (21% of adults aged 25 to 34) than those in older age groups (13% of adults aged 75 and over).
- More women than men had current asthma (11% and 9% respectively). This includes 8% of women and 5% of men who reported that they had experienced symptoms of asthma in the last 12 months (uncontrolled asthma) and 4% of women and 3% of men who reported that their asthma symptoms were controlled by medication in that period (controlled asthma).
- The proportion of adults with current asthma varied by income, especially among women. Those in the lowest income households were more likely to have current asthma (10% of men and 15% of women) than those in the highest income households (9% of men and 8% of women).
- Among women with current asthma, those in lower-income households, those reporting any exposure to other people's smoke, and those with some reported health problems were more likely to have uncontrolled asthma, after other factors were accounted for.
- More boys than girls had diagnosed asthma (12% and 7% respectively). Older children were more likely than younger children to have diagnosed asthma (16% of children aged 10 to 12 and 14% of children aged 13 to 15, compared with 7% of children aged 0 to 9).
- The proportion of children aged 0 to 15 with diagnosed asthma decreased by 10 percentage points from 20% in 2001/02 to 10% in 2018.

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This report may be of interest to members of the public, policy officials, people working in public health and to commissioners of health and care services to see the prevalence of asthma and its symptoms among adults and children in England.

Introduction

Contents

This report covers the prevalence of asthma and the management and control of asthma symptoms in adults and in children. Prevalence of asthma symptoms and of controlled and uncontrolled asthma in the last 12 months are presented by age and sex. Prevalence of controlled and uncontrolled asthma are also presented by household income, area deprivation, cigarette smoking status and e-cigarette use, exposure to other people's smoke, and urban/rural residence. Among adults with current asthma, the factors associated with having uncontrolled asthma are presented. Among children the factors associated with diagnosed asthma are presented.

Background

Introduction

Asthma is a common long-term respiratory disease that can affect people of any age. It is an inflammatory disease of the airways that leads to short term and sometimes very marked variations in airflow. Symptoms, which are often worse at night or in the early morning, include wheezing, cough, chest tightness, and shortness of breath. Asthma is more common in people with an atopic disorder (eczema or allergic rhinitis ('hay fever') or a family history of these). New onset asthma in adults may be due to occupational exposure.

Exposure to various substances can trigger acute exacerbations of asthma. Such triggers include upper respiratory tract infections, such as a common cold, and airborne particles including pollen, dust mites, pet dander, mould spores, tobacco smoke and air pollution. Both oxides of nitrogen (NO_x) and particulates have been linked to new asthma onset as well as exacerbating existing asthma,[1,2] with lower incidence where pollutant levels fall.[3] In adults, other triggers include use of beta-blockers and non-steroidal anti-inflammatory medicines (such as aspirin and ibuprofen).

Why asthma is important

In 2018/19 in England, there were 3,591,392 patients (aged 8 years or older) on GPs' registers with diagnosed asthma, giving a national prevalence of 6.0%.[4] Lifetime prevalence of patient-reported, clinician-diagnosed asthma in England in 2010/11 was

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[1] Guarnieri M, Balmes JR. *Outdoor air pollution and asthma*. The Lancet. 2014;**383**:1581-92. https://doi.org/10.1016/S0140-6736(14)60617-6.

[2] Royal College of Physicians, Royal College of Paediatrics & Child Health. *Every breath we take: the lifelong impact of air pollution.* RCP, London, 2016. https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution

[3] Garcia E, Berhane KT, McConnell R et al. *Association of changes in air quality with incident asthma in children in California, 1993-2014.* JAMA. 2019;**321**:1906-15. doi: 10.1001/jama.2019.5357

[4] NHS Digital. *Quality and Outcomes Framework, Achievement, prevalence and exceptions data – 2017-18 [PAS].* Leeds, 2019. https://digital.nhs.uk/data-and-information/publications/statistical/quality-and-outcomes-framework-achievement-prevalence-and-exceptions-data/2018-19-pas) To be on the asthma register, patients need a diagnosis of asthma and a prescription for an asthma drug within the year.

estimated to be 16%, with annual prevalence of 9% of the population having patient-reported clinician diagnosed and treated asthma.[5] Asthma care costs in England were estimated as £894 million per year, of which £799 million were NHS costs.[5]

Asthma can be mild: some people seldom have any asthma symptoms except when they have a cold or during their 'hay fever' season, when they are exposed to a particular pollen to which they are allergic. However, asthma can be fatal. In the three years 2015-17, there were 3,625 deaths in England from asthma.[6] Almost three-quarters of asthma deaths occur in people aged 75 and over and nearly one quarter occur in adults aged 35 to 74 years.[6] In 2015-17, death rates ranged from 0.06 per 100,000 population aged 1 to 4 years to 19.77 per 100,000 among people aged 75 and over.[6] During that period there were 8,273 years of life lost (YLL) due to asthma before the age of 75 among males and 11,708 YLL among females in England.[7,8] YLL is a measure of premature mortality. Both the numbers of asthma deaths and the age-standardised death rates in England fell considerably in males and females from 1997 to 2007 but have fluctuated a little since then.[6] Recent research suggests persistent social inequalities in asthma related hospital admissions and mortality.[9] The Global Atlas of Asthma suggests that low socioeconomic status families are more likely to be exposed to environmental pollutants (for example, particles from diesel), indoor allergens (for example mould and dust) and other respiratory irritants such as tobacco smoke that adversely affect asthma.[10]

What are the key policy initiatives?

In 2017, the National Institute for Health and Clinical Excellence (NICE) published its guideline on the diagnosis, monitoring and management of chronic asthma in adults, young people and children.[11] Similar guidelines were published in 2016 by the British Thoracic Society (BTS) in conjunction with the Scottish Intercollegiate Guidelines Network (SIGN). An updated version of the BTS/SIGN guidelines was published in July 2019. [12,13]

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[5] Mukherjee M, Stoddart A, Gupta RP et al. *The epidemiology, healthcare and societal burden and costs of asthma in the UK and its member nations: analyses of standalone and linked national databases.* BMC Medicine. 2016;**14**:113.

[6] NHS Digital. *Compendium – Mortality from respiratory disease.* Leeds, 2019. https://digital.nhs.uk/data-and-information/publications/clinical-indicators/compendium-of-population-health-indicators/compendium-mortality/current/mortality-from-respiratory-diseases

[7] NHS Digital. *Compendium – Years of life lost.* Leeds, 2019. https://digital.nhs.uk/data-and-information/publications/clinical-indicators/compendium-of-population-health-indicators/compendium-mortality/current/years-of-life-lost.

[8] These figures are equivalent to 1.10 and 1.56 YLL per 10,000 males and females respectively.

[9] Gupta RP, Mukherjee M, Sheikh A, et al. *Persistent variations in national asthma mortality, hospital admissions and prevalence by socioeconomic status and region in England*. Thorax 2018;**73**;706-712.

[10] European Academy of Allergy and Clinical Immunology (EAACI). *Global Atlas of Asthma. 2013.*

http://www.eaaci.org/GlobalAtlas/Global_Atlas_of_Asthma.pdf

[11] National Institute for Health and Clinical Excellence. *Asthma: diagnosis, monitoring and chronic asthma management. NG80.* NICE, London, 2017. https://www.nice.org.uk/guidance/ng80

[12] The BTS Guideline production process is accredited by NICE, most recently in 2017. Accreditation is valid for all BTS Guidelines published from July 2010 onwards, valid until November 2021.

[13] British Thoracic Society / Scottish Intercollegiate Guidelines Network. *BTS/SIGN British Guideline on the management of asthma.* London/Edinburgh, BTS & SIGN, 2016, revised 2019. https://www.brit-thoracic.org.uk/quality-improvement/guidelines/asthma/

Asthma is treated in most cases by inhaled medicines. Beta-agonists are bronchodilators that relax the airways and relieve symptoms; steroids prevent constriction. These can be complemented by additional medicines to improve control.

Management includes self-management education, which should be offered to all patients with asthma, or their parents or carers, as appropriate. NICE is currently updating their guidance on self-management for children and young people when asthma control deteriorates.[14] In 2014, the Department of Health published guidance on the use of emergency beta-agonist inhalers in schools.[15] This allowed UK schools to buy a salbutamol inhaler without a prescription for use in emergencies when a child with asthma cannot access their own inhaler.

For people with existing asthma, avoidance of triggers (other than exercise) can be important where it is feasible but there is no good evidence that reducing exposure in utero or in early life prevents the development of asthma.[16] Measures to reduce house dust mite levels in the home are ineffective in preventing asthma but weight-loss programmes for overweight and obese children and avoiding exposure to tobacco smoke are important.[16]

Hospital admissions for childhood asthma in Scotland fell after smoke free legislation was implemented.[17] Government policies to reduce air pollution, for example the *Clean Air Strategy 2019,*[18] should lead to fewer exacerbations of asthma and potentially also to reduced asthma incidence.

A government interactive online website provides information on air pollutant levels and exceedances of objectives for local authorities and regions.[19]

Methods and definitions

Methods

This report is based on answers to questions asked during the HSE 2018 interviews. As in HSE 2001 and HSE 2010, questions were asked both of adults aged 16 and over and for children aged 0 to 15. In 2002, respiratory health questions were asked of children and young people aged 0 to 24. Interviews for children aged 0 to 12 were carried out with a parent; children aged 13 to 15 were interviewed directly. In HSE 2018, the respiratory health question module was shorter than in HSE 2010, so there

[14] National Institute for Health and Clinical Excellence. https://www.nice.org.uk/guidance/ng80/resources/2018-exceptional-surveillance-of-asthma-diagnosis-monitoring-and-chronic-asthma-management-nice-guideline-ng80-6599448397/chapter/Surveillance-decision?tab=evidence

[15] Department of Health. *Guidance on the use of emergency salbutamol inhalers in schools.* London, 2014. https://www.gov.uk/government/publications/emergency-asthma-inhalers-for-use-in-schools

[16] British Thoracic Society / Scottish Intercollegiate Guidelines Network. *Quick reference guide QRG 153*. London/Edinburgh, BTS & SIGN, 2016, updated 2019. https://www.sign.ac.uk/assets/qrg158.pdf

[17] Mackay D, Haw S, Ayres JG, et al. *Smoke-free legislation and hospitalizations for childhood asthma.* New England Journal of Medicine. 2010;**363**:1139–45.

[18] Department for Environment, Food & Rural Affairs. *Clean air strategy 2019.* London, 2019. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf

[19] Department of Environment, Food & Rural Affairs. *Annual and exceedance statistics.* London, 2019. https://uk-air.defra.gov.uk/data/exceedence

is no information about chronic obstructive pulmonary disease (COPD), nor were any spirometry measurements made in HSE 2018.

On this, as in previous sweeps of the HSE, questions asked about wheezing and asthma have been used extensively and validated according to accepted criteria. More detail on the development of respiratory questionnaires and their use in HSE is provided in the HSE 2010 report.[20]

Definitions

Wheezing

Questions were asked about wheezing or whistling in the chest, either now, or in the past. Those who reported experience of wheezing were asked whether they had ever had wheezing or whistling in the chest when they did not have a cold, and were also asked whether they had wheezing or whistling in the chest in the last 12 months.

Diagnosed asthma

Self-reported diagnosed asthma is used for this report. Participants (or their parents or guardians) were asked if they had ever been told by a doctor or nurse that they had asthma.

Current asthma

Participants with diagnosed asthma were also asked if they had any symptoms of asthma in the last 12 months, or whether their symptoms were controlled by medication. Current asthma was ascribed to participants who reported any symptoms of asthma in the last 12 months, or who were taking medication to control symptoms in the last 12 months. No guidance was given in the question about what symptoms should be considered.

For the purpose of this report, participants were classified as having 'controlled asthma' if they reported being diagnosed with asthma and their asthma symptoms had been controlled by medication in the last 12 months.[21] Participants with diagnosed asthma who reported symptoms of asthma in the last 12 months were defined as having uncontrolled asthma.

Age-standardisation

Adult data within this report have been age-standardised to allow comparisons between groups after adjusting for the effects of any differences in their age distributions. When different sub-groups are compared in respect of a variable on which age has an important influence, any differences in age distributions between these sub-groups are likely to affect the observed differences in the proportions of

[20] Hall J, Mindell J. *Adult respiratory symptoms* in Craig R, Mindell J (eds.) Health Survey for England 2010. Volume 1. Respiratory health. Leeds, The NHS Information Centre for Health and Social Care, 2011.

[21] Complete control of asthma is defined in the BTS/SIGN guidance (see notes 13 and 16) as all of the following: no daytime symptoms; no night time awakening due to asthma; no need for rescue medication; no asthma attacks; no limitations on activity including exercise; normal lung function; and minimal side effects from medication. It was not possible to ascertain this in full using the HSE 2018 questionnaire.

interest. For information about the method used, see Section 8.6 of the HSE 2018 Methods report.

About the survey estimates

The HSE, in common with other surveys, collects information from a sample of the population. The sample is designed to represent the whole population as accurately as possible within practical constraints, such as time and cost. Consequently, statistics based on the survey are estimates, rather than precise figures, and are subject to a margin of error, also known as a 95% confidence interval. For example, the survey estimate might be 24% with a 95% confidence interval of 22% to 26%. A different sample might have given a different estimate, but we expect that the true value of the statistic in the population would be within the range given by the 95% confidence interval in 95 cases out of 100.

Where differences are commented on in this report, these reflect the same degree of certainty that these differences are real, and not just within the margins of sampling error. These differences can be described as statistically significant.[22]

Confidence intervals are quoted for key statistics within this report and are also shown in more detail in the Excel tables accompanying this report. Confidence intervals are affected by the size of the sample on which the estimate is based. Generally, the larger the sample, the smaller the confidence interval, and hence the more precise the estimate.

[22] Statistical significance does not imply substantive importance; differences that are statistically significant are not necessarily meaningful or relevant.

Prevalence of wheezing or whistling in the chest in adults

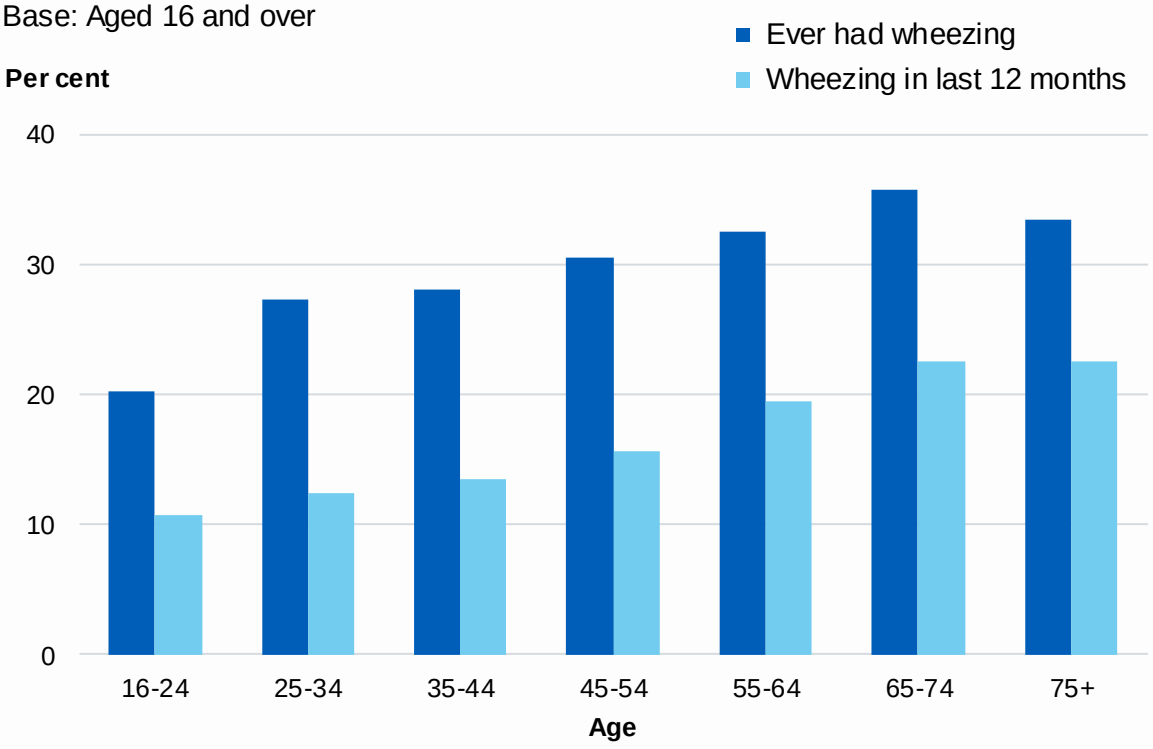
A similar proportion of men and women aged 16 and over had ever had any wheezing or whistling in the chest (30% and 29% respectively). Survey estimates are subject to a margin of error, and it is likely that the prevalence of wheezing or whistling in the chest in men was between 28% and 32%, and the prevalence of wheezing or whistling in the chest in women was between 27% and 30%.[23] This proportion increased with age for both sexes, from 20% of adults aged 16 to 24 to 36% of adults aged 65 to 74, and 33% of adults aged 75 and over.

A broadly similar pattern was found for the proportion of adults aged 16 and over reporting wheezing or whistling in the chest in the last 12 months (16% for both sexes). It is likely that the proportion reporting this in the last 12 months was between 15% and 17% in men and was between 15% and 18% in women.[23]

Figure 1, Table 1

Figure 1: Prevalence of wheezing or whistling in the chest among adults, by age

Base: Aged 16 and over



Source: NHS Digital

The proportion of adults reporting wheezing or whistling in the chest in the last 12 months decreased by four percentage points from 20% in 2001 to 16% in 2018.

[23] Confidence intervals around estimates of the prevalence of wheezing or whistling in the chest among adults are shown in more detail in Table A1.

As Table A shows, the largest decrease between 2001 and 2018 was among the younger age groups. For example, the proportion of adults aged 16 to 24 reporting wheezing in the last 12 months decreased by nine percentage points from 20% in 2001 to 11% in 2018, whereas there was little change over the same time period among adults aged 65 and over.

Table A: Wheezing or whistling in the chest in the last 12 months in adults, 2001, 2010 and 2018, by age and sex

	Age							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
	%	%	%	%	%	%	%	%
Men								
2001	18	20	18	17	26	26	25	21
2010	13	17	20	15	20	24	25	18
2018	9	13	14	16	19	24	21	16
Women								
2001	21	19	18	19	22	21	21	20
2010	15	16	18	16	21	21	21	18
2018	12	12	13	16	20	21	24	16
All adults								
2001	20	19	18	18	24	23	23	20
2010	14	16	19	16	20	23	23	18
2018	11	12	14	16	19	22	22	16

Prevalence of asthma in adults

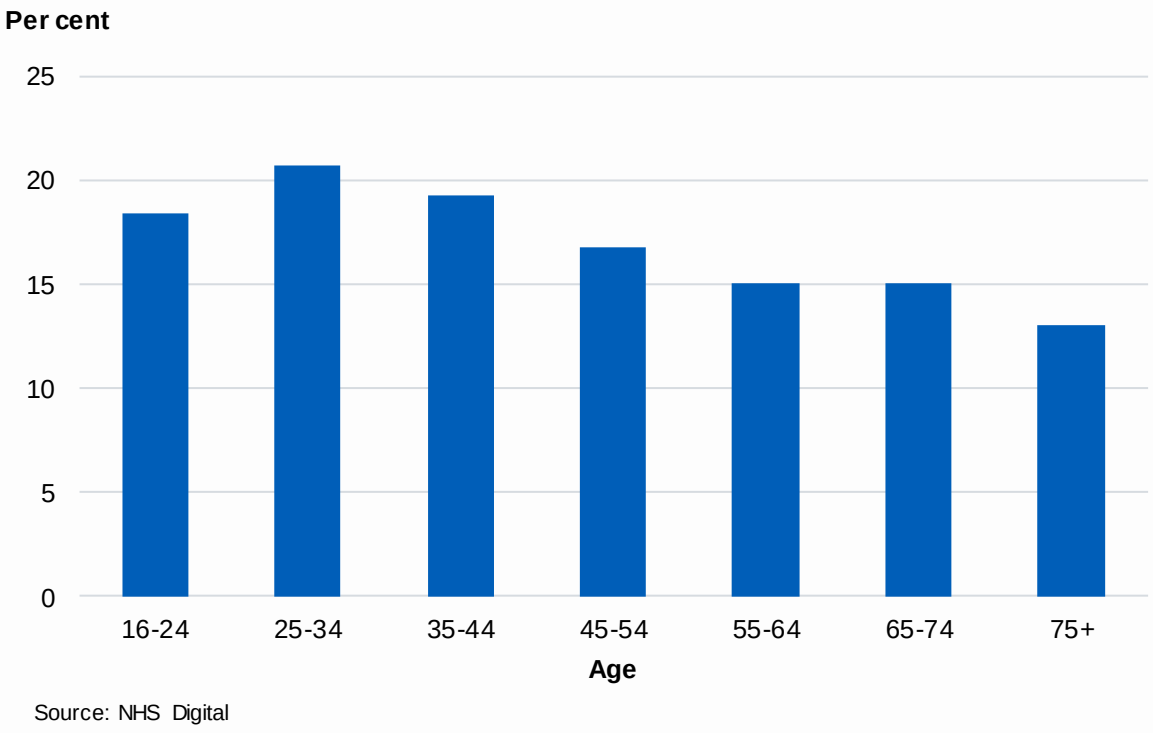
Diagnosed asthma, by age and sex

A similar proportion of men and women aged 16 and over had ever been diagnosed with asthma (17% and 18% respectively). Survey estimates are subject to a margin of error, and it is likely that the prevalence of diagnosed asthma in men was between 15% and 18%, and the prevalence of diagnosed asthma in women was between 17% and 19%.[24] A higher proportion of younger people reported diagnosed asthma (21% of adults aged 25 to 34) than those in older age groups (13% of adults aged 75 and over).

Figure 2, Table 2

Figure 2: Prevalence of diagnosed asthma among adults, by age

Base: Aged 16 and over



Source: NHS Digital

As Table B shows, the proportion of adults with diagnosed asthma in 2018 (17% of men and 18% of women) was higher than in 2001, when 13% of men and 16% of women reported this. The change in asthma prevalence between 2001 and 2018 varied by age. For example, the prevalence of diagnosed asthma among adults aged 16 to 24 declined from 24% in 2001 to 18% in 2018, whilst prevalence among adults aged 45 to 54 increased from 12% to 17%. Levels of diagnosed asthma were similar

[24] Confidence intervals around estimates of the prevalence of diagnosed asthma among adults are shown in more detail in Table A2.

in 2010 and 2018. Increased levels of awareness of asthma may be a contributing factor to the increase in asthma prevalence between 2001 and 2018.[25]

Table B: Prevalence of diagnosed asthma in adults, 2001, 2010 and 2018, by age and sex

	Age							Total
	16-24	25-34	35-44	45-54	55-64	65-74	75+	
	%	%	%	%	%	%	%	%
Men								
2001	23	15	12	10	14	10	9	13
2010	25	20	16	12	13	13	9	16
2018	18	20	19	18	13	12	11	17
Women								
2001	25	20	16	13	14	13	12	16
2010	21	20	17	16	15	16	14	17
2018	19	21	19	16	17	17	15	18
All adults								
2001	24	18	14	12	14	11	11	15
2010	23	20	17	14	14	14	12	17
2018	18	21	19	17	15	15	13	17

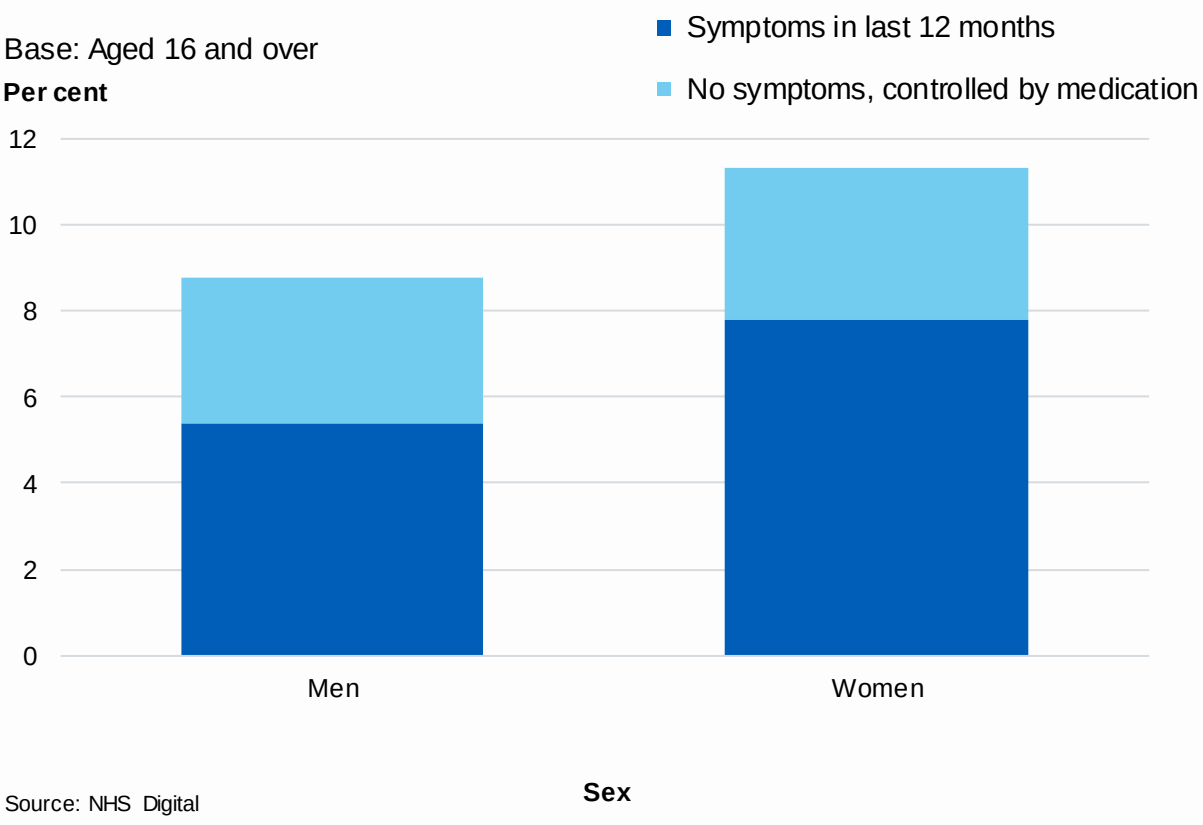
[25] Lundback B, Backman H, Lotvall J et al. *Is asthma prevalence still increasing?* Expert Review of Respiratory Medicine. 2016;**10**:39-51.

Current asthma, by age and sex

For the purposes of this report, participants with symptoms, or who were taking medication for asthma to control symptoms, in the last 12 months were defined as currently having asthma. Overall, women were more likely than men to have current asthma (11% and 9% respectively), either reporting that they had experienced symptoms of asthma in the last 12 months (8% of women and 5% of men), or that their asthma symptoms were controlled by taking medication for asthma in that period (4% of women and 3% of men). Levels of current asthma among adults were similar by age group in either sex.

Figure 3, Table 2

Figure 3: Prevalence of current asthma among adults, by sex



Source: NHS Digital

Among those with current asthma, 34% of adults (38% of men and 31% of women) had controlled asthma (reported not having symptoms in the last 12 months, with asthma being controlled by medication).

Table 2

Asthma, by equivalised household income

The HSE uses the measure of equivalised household income, which takes into account the number of adults and dependent children in the household as well as overall household income. Households are divided into quintiles (fifths) based on this measure. The age profile of the income quintiles have been age-standardised to account for differences in age profiles between households.

For information about how equivalised income is calculated, see Chapter 8 and Appendix B: Glossary in the HSE 2018 Methods report.

After controlling for age, the proportions of individuals who had ever been diagnosed with asthma were similar across household income quintiles.

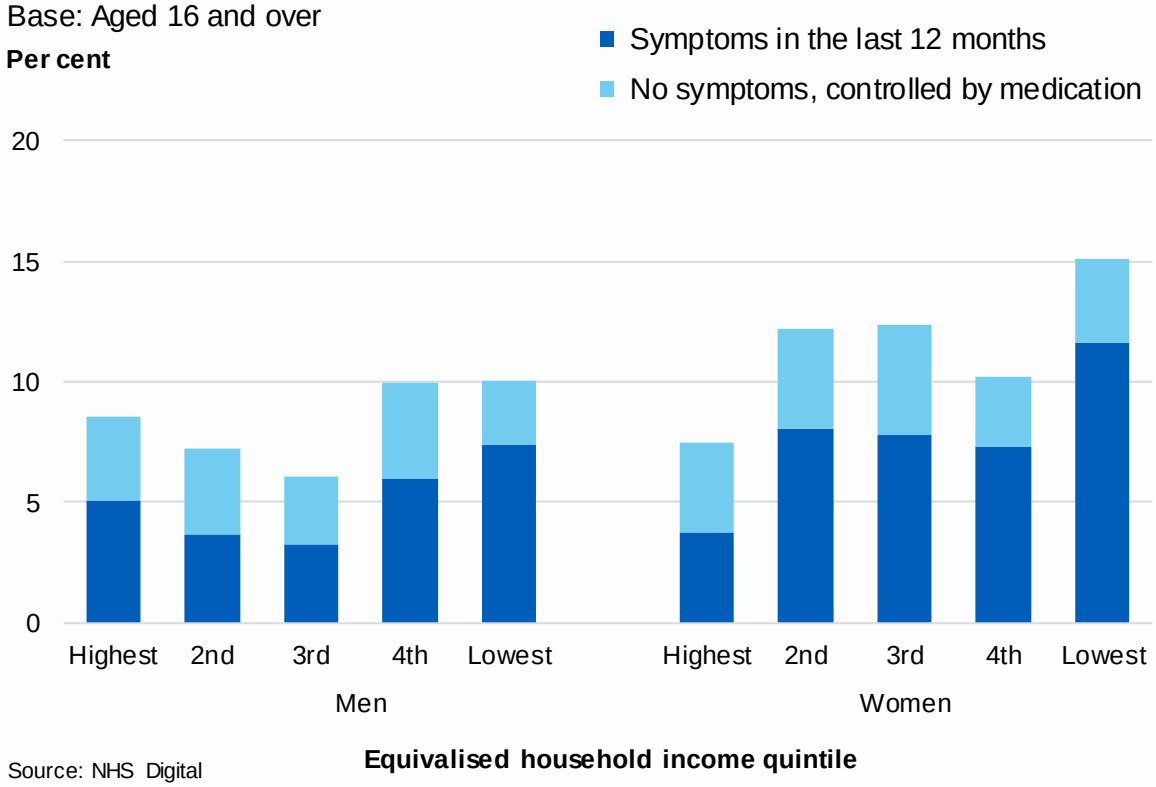
There was variation in the proportion of adults with current asthma by equivalised household income, especially among women. Those in the lowest household income quintile were more likely to have current asthma (10% of men and 15% of women) than those in the highest income quintile (9% of men and 8% of women).

This difference was most marked in the proportions of adults who had experienced symptoms of asthma in the last 12 months. 7% of men and 12% of women in the lowest household income quintile had experienced symptoms of asthma in the last 12 months compared with 5% of men and 4% of women in the highest household income quintile.

Figure 4, Table 3

Figure 4: Age-standardised prevalence of current asthma, by quintile of equivalised household income and sex

Base: Aged 16 and over



Source: NHS Digital

Asthma, by Index of Multiple Deprivation (IMD)

The English Index of Multiple Deprivation (IMD) is a measure of area deprivation, based on 37 indicators, across seven domains of deprivation.[26] IMD is a measure of the overall deprivation experienced by people living in a neighbourhood, although not everyone who lives in a deprived neighbourhood will be deprived themselves. To enable comparisons, areas are classified into quintiles (fifths). The age profile of the IMD quintiles have been age-standardised to account for different area age profiles.

For further information about the IMD, see Chapter 8 and Appendix B: Glossary in the HSE 2018 Methods report.

The proportions of adults with diagnosed asthma were similar across the quintiles of IMD, and the same was true for current asthma.

Table 4

[26] The seven domains used to calculate IMD are: income deprivation; employment deprivation; health deprivation and disability; education; skills and training deprivation; crime; barriers to housing and services; and living environment deprivation.

Asthma, by self-reported cigarette smoking status and e-cigarette use

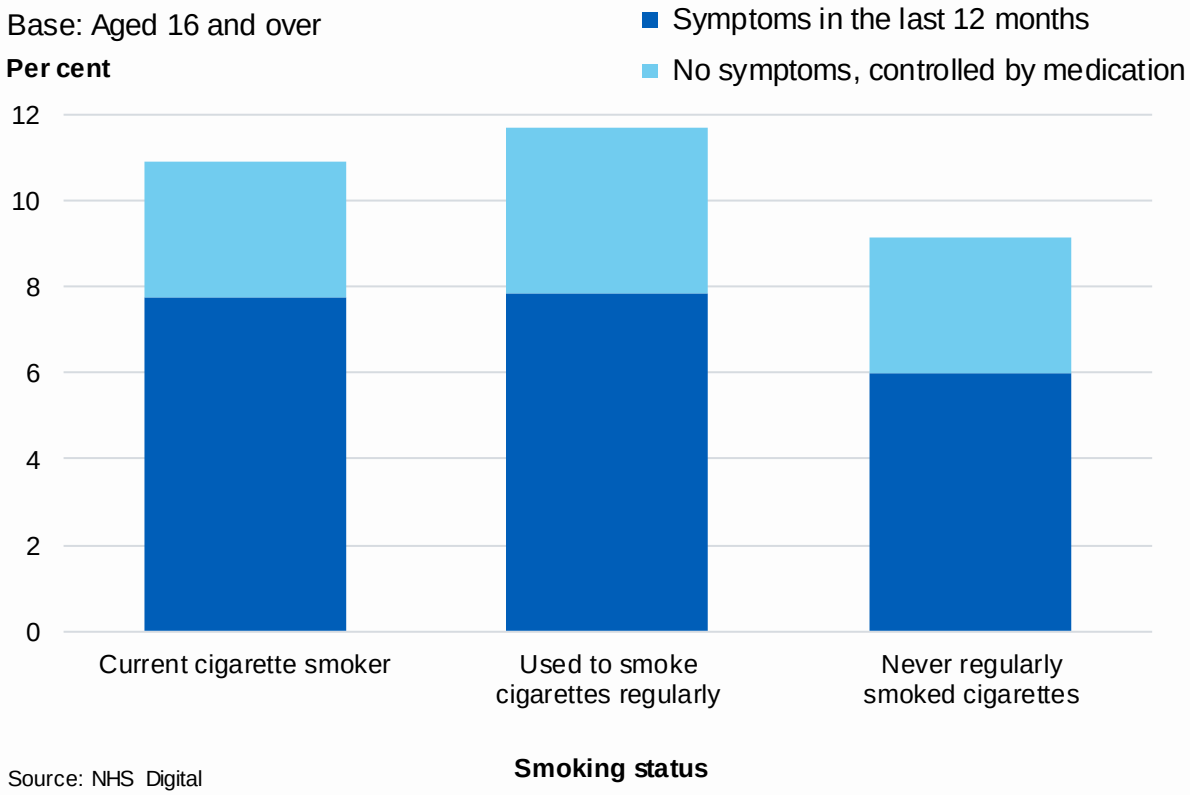
Once age was taken into account, the proportions of adults who had ever been diagnosed with asthma were similar whether or not individuals were current or ex-regular smokers or had never regularly smoked.

In contrast, the prevalence of current asthma, that is, any symptoms of asthma in the last 12 months, or the use of medication to control symptoms in the last 12 months did vary by smoking status. After age standardisation, 12% of ex-regular smokers and 11% of current smokers had current asthma, compared with 9% of adults who had never smoked regularly. 8% of current smokers and 8% of ex-regular smokers had experienced symptoms of asthma in the last 12 months compared with 6% of adults who had never smoked regularly.

Figure 5, Table 5

Figure 5: Age-standardised prevalence of current asthma, by smoking status

Base: Aged 16 and over



Source: NHS Digital

There was variation in the age-standardised prevalence of diagnosed asthma by use of e-cigarettes. 21% of adults who had tried e-cigarettes but were not currently using them had diagnosed asthma, compared with 18% of adults that were currently using e-cigarettes and 16% of adults who had never used e-cigarettes.

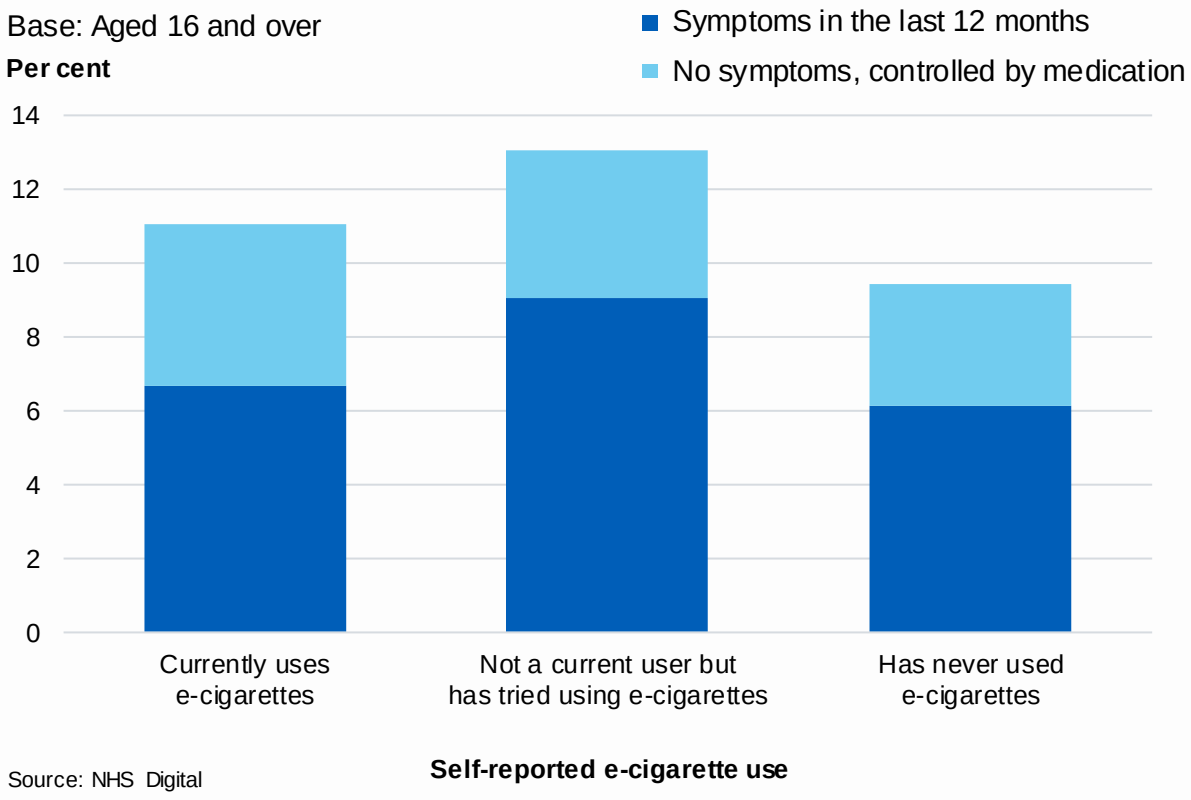
Similarly, the age-standardised prevalence of current asthma also varied by use of e-cigarettes. 13% of adults who had tried e-cigarettes but were not currently using them had current asthma, compared with 11% of adults that were currently using e-cigarettes and 9% of adults who had never used e-cigarettes. 9% of adults who had tried e-cigarettes but were not currently using them had experienced symptoms of

asthma in the last 12 months, compared with 7% of adults that were currently using e-cigarettes and 6% of adults who had never used e-cigarettes.

Figure 6, Table 5

Figure 6: Age-standardised prevalence of current asthma, by self-reported e-cigarette use

Base: Aged 16 and over



Source: NHS Digital

The HSE is a cross-sectional survey, that is, data are collected from individuals at a single point in time. As a consequence, these results cannot indicate whether asthma preceded or followed current or past smoking behaviour. People experiencing symptoms of asthma in the past may have adopted behaviours such as stopping smoking or switching to e-cigarettes to mitigate their exposure to situations that can worsen their symptoms. The BTS/SIGN guideline on the management of asthma recommends that people with asthma and parents of children with asthma should be advised about the dangers of smoking and second-hand tobacco smoke exposure, and be offered appropriate support to stop smoking.[27]

[27] British Thoracic Society / Scottish Intercollegiate Guidelines Network. *BTS/SIGN British Guideline on the management of asthma.* London/Edinburgh, BTS & SIGN, 2016, revised 2019. https://www.brit-thoracic.org.uk/quality-improvement/guidelines/asthma/

Asthma, by reported exposure to second hand smoke

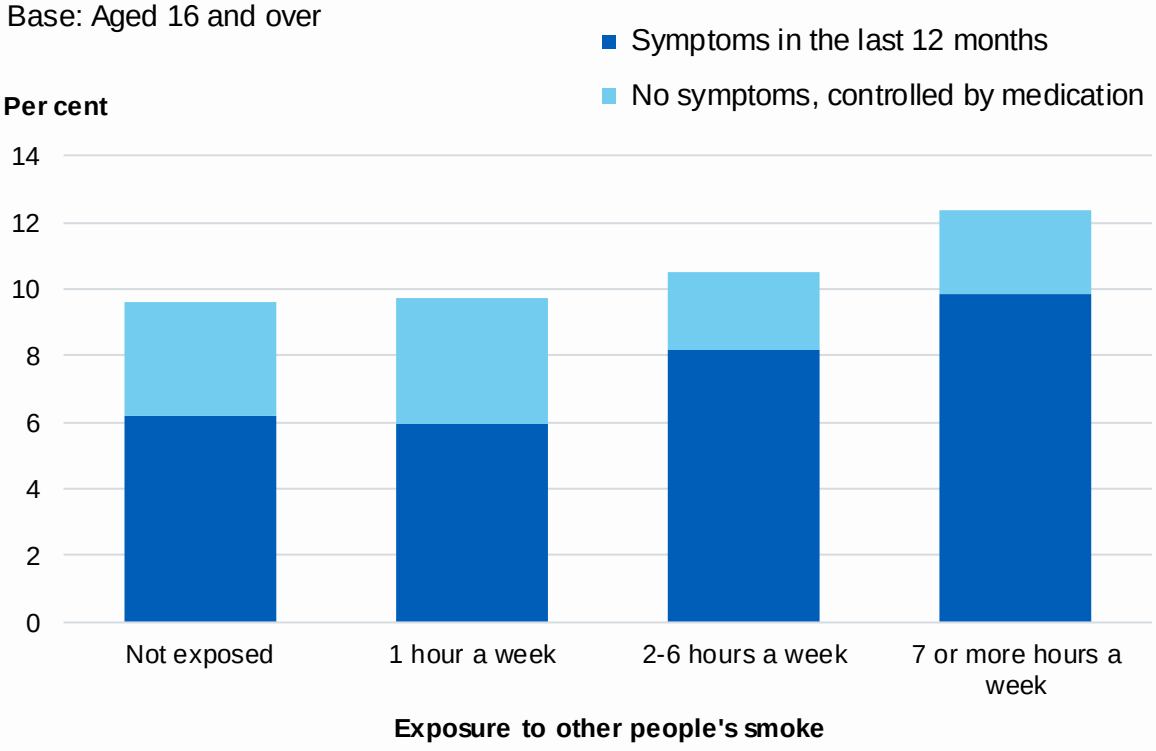
All participants aged 16 and over were asked to estimate the total number of hours a week (in most weeks) they were exposed to other people's smoke. For the purposes of this report, the total number of hours exposed to other people's smoke was grouped into the following categories to ensure sufficient numbers for analysis: no exposure, one hour per week, two to six hours per week, and seven or more hours per week.[28] The age-standardised prevalence of both diagnosed asthma and current asthma were similar across these groups.

The age-standardised proportions of adults who had experienced symptoms of asthma in the last 12 months increased with the amount of self-reported exposure to other people's smoke, from 6% of those with no exposure or less than one hour a week, to 10% of those who reported that they were exposed to second hand smoke for seven or more hours a week. This was particularly the case for women; 7% of women who reported not being exposed to other people's smoke had experienced symptoms of asthma in the last 12 months, compared with 13% of women who reported being exposed to other people's smoke for two to six hours per week and 12% of women who reported being exposed to other people's smoke for seven or more hours per week.

Figure 7, Table 6

Figure 7: Age-standardised prevalence of current asthma, by reported hours of exposure to other people's smoke

Base: Aged 16 and over



Source: NHS Digital

[28] Participants reporting exposure for less than one hour were coded as being exposed for one hour, otherwise answers were recorded to the nearest hour.

Asthma, by urban or rural area of residence

Based on their local authority district, participating households in the HSE 2018 were categorised according to the 2011 Rural-Urban Classification of Local Authority Districts in England.[29] This classification consists of six rural and four urban settlement/context combinations. To ensure sufficient numbers for analysis, participants were grouped into three types of area of residence: urban; town and fringe; and village, hamlet or isolated dwelling. The age-standardised proportions for both diagnosed and current asthma were similar across these groups.

Table 7

Estimated odds ratios for uncontrolled asthma, by associated risk factors and sex

As presented earlier in this report, among those with current asthma, 34% of adults (38% of men and 31% of women) had controlled asthma (defined as not having any symptoms of asthma in the last 12 months, with asthma being controlled by medication).[21]

Cross-sectional research based on the European wide LIAISON study (The InternationaL cross-sectIonAl and longitudinal assessment on aSthma cONtrol) showed that poor control of asthma, which was the case for over 50% of patients attending specialist settings, was associated with a worse quality of life, an increased risk of exacerbations and more consumption of healthcare resources.[30] Contributing factors of poor asthma control were found in this study to include clinical (i.e. comorbidities) and non-clinical factors (active smoking as well as passive smoking).[30]

The preceding sections have examined the relationships between asthma, including controlled asthma, and household income, area deprivation, cigarette smoking, exposure to second-hand smoke and urban or rural residence separately. For each of these analyses, sex and age have been taken into account, but not other potentially related factors, for example area deprivation when looking at cigarette smoking, or household income when looking at second-hand smoke exposure.

In order to account for the different factors that are associated with controlled asthma, multivariate logistic regression models were used to investigate the variables associated with uncontrolled asthma among adults with current asthma. Household income, area deprivation[31], urban or rural residence, current cigarette smoking status, use of e-cigarettes, reported exposure to other people's smoke, highest educational qualification, body mass index (BMI) status, and health status (assessed using the

[29] DEFRA Rural Statistics. *The 2011 Rural-Urban Classification for Local Authority Districts in England.* 2011, revised 2017. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/591464/RUCLAD_leaflet_Jan2017.pdf

[30] Braido F, Brusselle G, Guastalla D, et al. *Determinants and impact of suboptimal asthma control in Europe: The international cross-sectional and longitudinal assessment on asthma control*. Respiratory Research 2016;**17**:51.

[31] Area deprivation was classified using the Index of Multiple Deprivation (IMD), discussed elsewhere in this report.

EQ-5D[32]) were selected as independent variables.[33] Three independent variables were retained in the final model along with age: household income, having any exposure to other people's smoke, and health status.

Table 8 shows the odds ratios of uncontrolled asthma for men and women. The model estimates show the odds of uncontrolled asthma for each category of the independent variable, adjusted for the other variables in the model. The results indicate associations, not causes. Odds are expressed relative to a reference category, which is given a value of 1. In this case, odds ratios greater than 1 indicate higher odds of uncontrolled asthma, and odds ratios less than 1 indicate lower odds. 95% confidence intervals (CI) are shown; the difference from the reference category is statistically significant if the limits of the confidence interval do not include 1. For more information about logistic regression see the HSE 2018 Methods report.

The odds of having uncontrolled asthma for those who had a slight, moderate or severe problem on any EQ-5D domain were 1.9 and 1.8 times higher among men and women respectively, when compared with those who reported no problems across any of the five EQ-5D domains.

Household income and exposure to second-hand smoke were associated with increased odds of uncontrolled asthma among women but not among men. The odds of uncontrolled asthma were 1.8 times higher for women in the lowest and second-lowest income quintiles compared with those in the highest, second-highest and middle quintiles.

Women who reported some exposure to other people's smoke had 1.7 times higher odds of uncontrolled asthma compared with women who had not been exposed to other people's smoke.

Note that because the base sizes are relatively small (due to the sample being restricted to adults with current asthma) these results should be interpreted with caution.

Table 8

[32] The EQ-5D is a standardised instrument used for the measurement of a person's health status. The descriptive system consists of five dimensions: mobility, self-care, usual activities, pain or discomfort, and anxiety or depression. For each dimension, participants are asked to rate their health state 'today' according to the following scale: having no problems (1), having slight problems (2), having moderate problems (3), having severe problems (4), or having extreme problems (pain or discomfort, anxiety or depression), or being unable to perform activities such as walking about (mobility), wash or dress themselves (self-care), and do usual activities. For the purposes of this analysis participants were classed as not having any problem across all five domains (a score of 1 on each item) or as having a slight, moderate or severe problem on any domain. For further details on the EQ-5D see the HSE 2018 report on Adult health and the HSE 2018 Methods report. https://digital.nhs.uk/pubs/hse2018

[33] Categories for the independent variables were merged in a number of cases due to the small sample size.

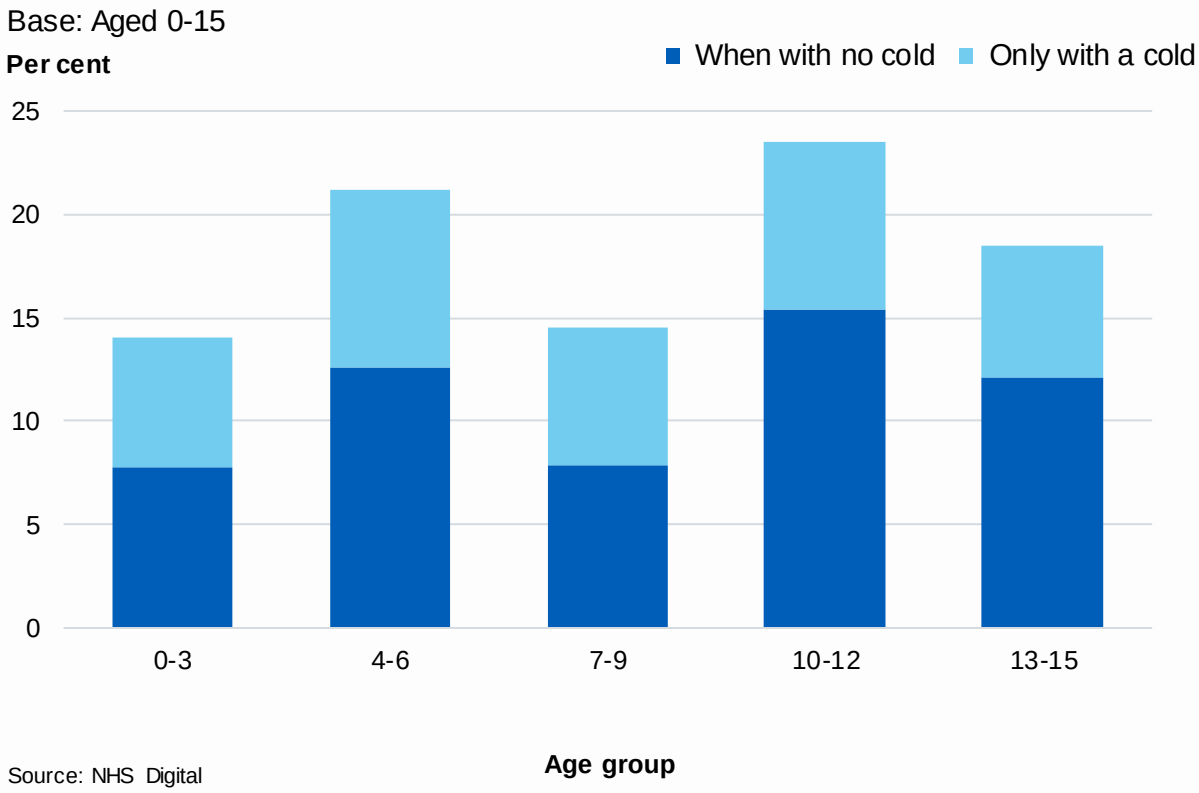
Prevalence of asthma and its symptoms in children

Wheezing, by age and sex

More boys than girls had ever had any wheezing or whistling in the chest (22% and 14% respectively). Survey estimates are subject to a margin of error, and it is likely that the prevalence of wheezing or whistling in the chest in boys was between 19% and 25%, and the prevalence of wheezing or whistling in the chest in girls was between 12% and 17%.[34] This proportion varied with age, being 14% for children aged 0 to 3, and peaking at 24% for children aged 10 to 12.

Figure 8, Table 9

Figure 8: Wheezing and its symptoms in children, by age



Source: NHS Digital

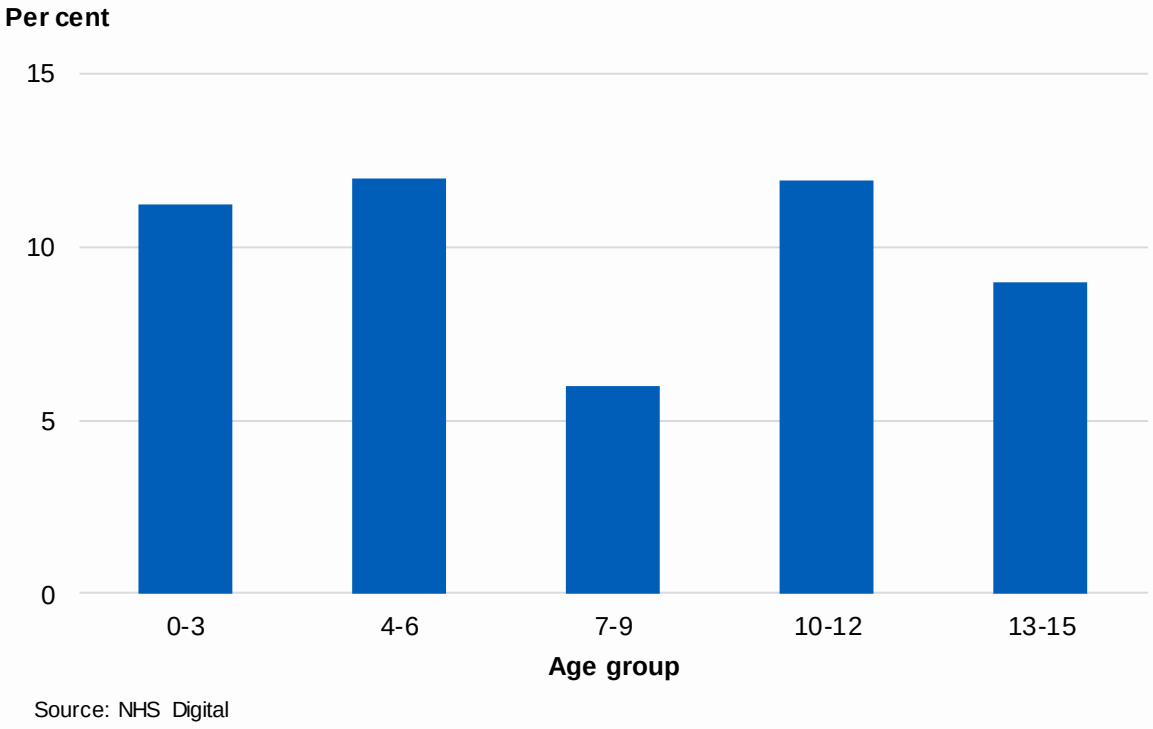
[34] Confidence intervals around estimates of the prevalence of wheezing or whistling in the chest among children are shown in more detail in Table A3.

More boys than girls had experienced wheezing or whistling in the chest in the last 12 months (12% and 8% respectively). It is likely that the proportion reporting wheezing in the last 12 months was between 10% and 14% in boys and between 6% and 10% in girls.[34] As Figure 9 shows, the prevalence of wheezing in the last 12 months varied by age with no clear pattern emerging.

Figure 9, Table 9

Figure 9: Wheezing in the last 12 months in children, by age

Base: Aged 0-15



Source: NHS Digital

As shown in Table C, the proportions of wheezing (lifetime and in the last 12 months) for both sexes were lower in 2018 than in 2001/02 and in 2010. The proportions of children aged 0 to 15 who had ever experienced wheezing decreased from 33% in 2001/2 to 18% in 2018. The prevalence of wheezing in the last 12 months among children aged 0 to 15 decreased from 18% in 2001/02 to 10% in 2018.

Table C: Prevalence of wheezing in children, 2001/02, 2010 and 2018, by sex

	Ever had wheezing			Wheezing in last 12 months		
	Boys	Girls	All	Boys	Girls	All
	%	%	%	%	%	%
2001/02	36	29	33	20	17	18
2010	30	23	27	17	13	15
2018	22	14	18	12	8	10

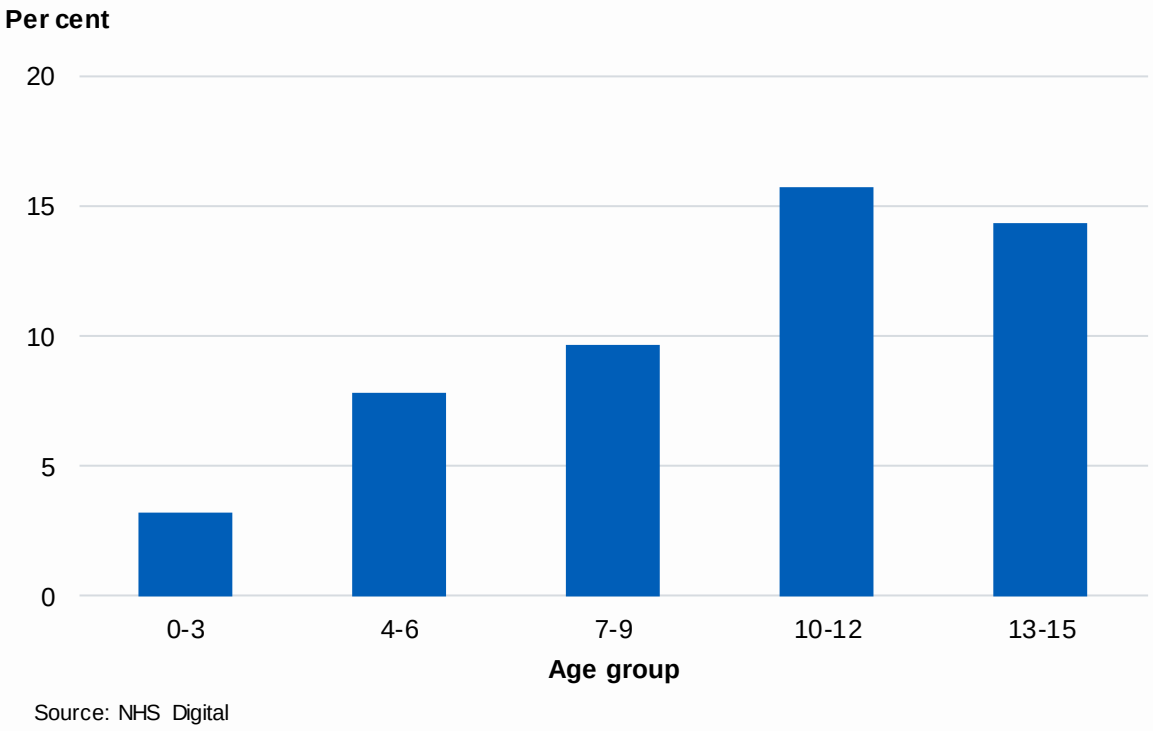
Asthma, by age and sex

More boys than girls had diagnosed asthma (12% and 7% respectively). It is likely that the prevalence of diagnosed asthma in boys was between 10% and 15%, and the prevalence of diagnosed asthma in girls was between 5% and 9%.[35] There was significant variation by age, with older children being more likely than younger children to have diagnosed asthma (16% of children aged 10 to 12 and 14% of children aged 13 to 15, compared with 7% of children aged 0 to 9).[36]

Figure 10, Table 10

Figure 10: Prevalence of diagnosed asthma in children, by age

Base: Aged 0-15



Source: NHS Digital

[35] Confidence intervals around estimates of the prevalence of diagnosed asthma among children are shown in more detail in Table A4.

[36] Low prevalence levels have a higher level of uncertainty around the estimates and so the figures for younger children should be treated with caution.

As shown in Table D, the proportions of children aged 0 to 15 with diagnosed asthma decreased by 10 percentage points from 20% in 2001/02 to 10% in 2018.

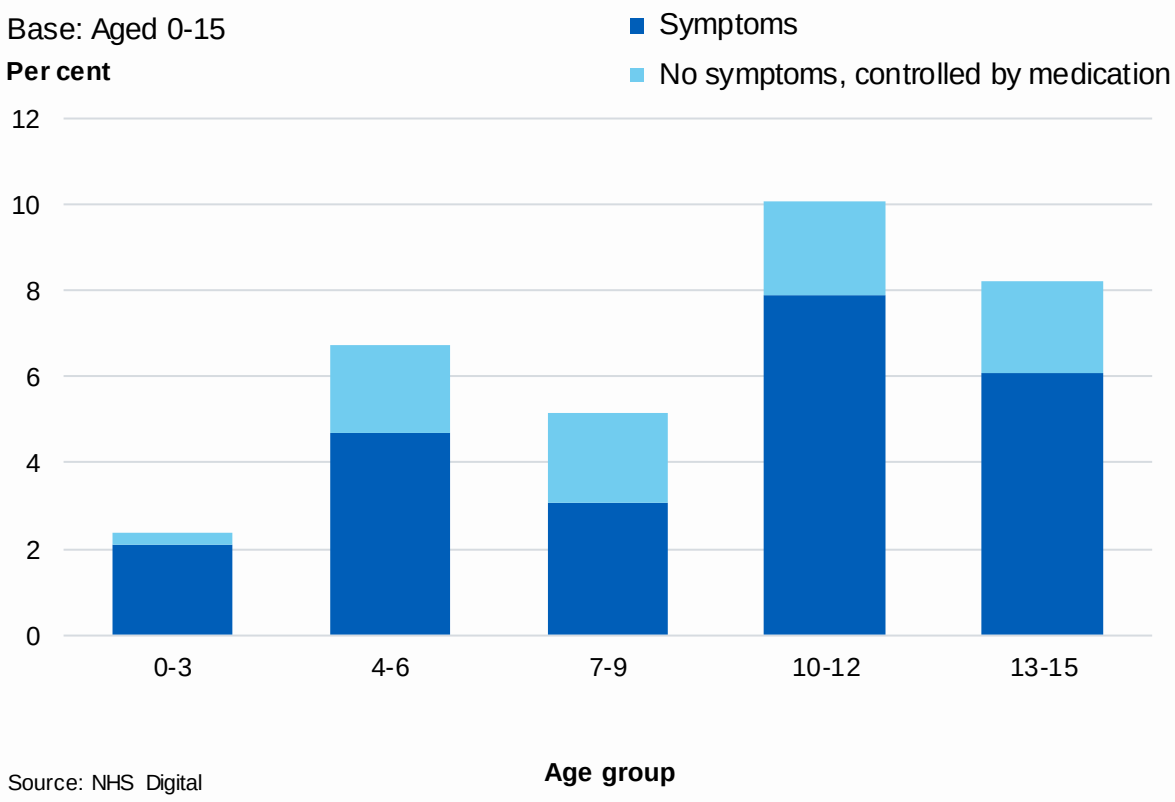
Table D: Prevalence of diagnosed asthma in children, 2001/02, 2010 and 2018, by sex

	Diagnosed asthma		
	Boys	**Girls**	**All**
	%	%	%
2001/02	23	18	20
2010	17	12	15
2018	12	7	10

Following the same pattern as diagnosed asthma, more boys than girls had current asthma (8% and 4% respectively). There were differences with age; older children were more likely than younger children to have current asthma (10% of children aged 10 to 12 and 8% of children aged 13 to 15, compared with 5% of children aged 0 to 9).[37]

Figure 11, Table 10

Figure 11: Prevalence of current asthma in children, by age



[37] Low prevalence levels have a higher level of uncertainty around the estimates and so the figures for children aged under 10 should be treated with caution.

Among those with current asthma, 26% of children (30% of boys and 18% of girls) had controlled asthma (reported not having symptoms in the last 12 months, with asthma being controlled by medication).

Table 10

Asthma, by Index of Multiple Deprivation (IMD)

The English Index of Multiple Deprivation (IMD) is a measure of area deprivation, based on 37 indicators, across seven domains of deprivation.[38] IMD is a measure of the overall deprivation experienced by people living in a neighbourhood, although not everyone who lives in a deprived neighbourhood will be deprived themselves. To enable comparisons, areas are classified into quintiles (fifths). The age profile of the IMD quintiles have been age-standardised to account for different area age profiles.

For further information about the IMD, see Chapter 8 and Appendix B: Glossary in the HSE 2018 Methods report.

Similar proportions of children had either diagnosed or current asthma across IMD quintiles.

Table 11

Asthma, by urban or rural area of residence

As noted earlier in this report, participating households were categorised according to the 2011 Rural-Urban Classification of Local Authority Districts in England.[29] For the analysis of child participants, the 'town and fringe' and 'village, hamlet and isolated dwellings' categories were combined into a non-urban category to ensure sufficient numbers for analysis. Children living in urban or non-urban areas had similar levels of diagnosed and current asthma.

Table 12

Asthma, by exposure to second hand smoke

Cotinine measurements

Cotinine, a metabolite of nicotine, provides an indicator of recent exposure to tobacco or its smoke. Cotinine is generally considered the most useful of the various biological markers that are indicators of smoking. Saliva samples were taken from children aged 4 to 15 during the nurse visit and were analysed for cotinine. The measurement of cotinine in the HSE provides an objective check on self-reported smoking behaviour. When analysed in a specialist laboratory, as is done for HSE, low levels are also a sensitive marker of exposure to other people's smoke. Cotinine has a half-life in the body of between 16 to 20 hours, so it will detect regular smoking but may not detect occasional smoking if the last occasion was several days ago. Sources of cotinine other than tobacco can, for practical purposes, be ignored.

[38] The seven domains used to calculate IMD are: income deprivation; employment deprivation; health deprivation and disability; education; skills and training deprivation; crime; barriers to housing and services; and living environment deprivation.

Cotinine levels for this survey were measured using a very sensitive method. The limit of detection is 0.1ng/ml. Levels below this indicate no or minimal exposure to tobacco smoke. In the HSE series, cotinine levels of 12ng/ml or above have been used to indicate personal smoking, while levels between 0.1ng/ml to below 12ng/ml are used to indicate exposure to second-hand smoke (SHS) among non-smokers.[39]

Cotinine validated non-smokers

Children below the age of 8 were not asked about smoking: all child participants aged 4 to 7 are assumed not to smoke currently. Those aged 8 to 15 are included as cotinine-validated non-smokers if they said that they did not currently smoke (i.e. did not smoke at least one cigarette per week; those who smoked sometimes but not every week are included as non-smokers), and this is confirmed by a cotinine level of less than 12ng/ml.

To ensure sufficient numbers for analysis we grouped children aged 4 to 15 who were cotinine-validated non-smokers into two categories: no or minimal exposure to SHS (undetectable cotinine: below 0.1ng/ml), and some exposure (detectable cotinine: between 0.1ng/ml to below 12ng/ml).

Levels of diagnosed and current asthma were similar in the two groups. 13% of cotinine-validated non-smokers aged 4 to 15 with no or minimal exposure to smoke had diagnosed asthma compared with 11% of those with some exposure; 8% of cotinine-validated non-smokers aged 4 to 15 with no or minimal exposure to smoke had current asthma compared with 9% of those with some exposure.

Note that because the base sizes are relatively small (due to the sample being restricted to children aged 4 to 15 who were cotinine-validated non-smokers) these results should be interpreted with caution.

Table 13

Estimated odds ratios for diagnosed asthma, by associated risk factors and sex

Most adult asthma first develops in childhood, and adult onset asthma often has its origins earlier in life.[40] Age, sex (with higher prevalence in boys until the age of 13 years, after which prevalence is higher in girls), parental and active smoking, obesity, unhealthy diets, sedentary behaviour, exposure to dampness and visible mould in home environments, and outdoor air pollution have been identified as some of the most important risk factors for asthma among school-age children.[41]

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[39] Jarvis M, Fidler J, Mindell J et al. *Assessing smoking status in children, adolescents and adults: cotinine cutpoints revisited*. Addiction 2008;**103**:1553-1561.

[40] Stern DA, Morgan WJ, Halonen M, et al. *Wheezing and bronchial hyper-responsiveness in early childhood as predictors of newly diagnosed asthma in early adulthood: a longitudinal birth cohort study.* Lancet. 2008;**372**:1058-64.

[41] Beasley R, Semprini A, Mitchell EA. *Risk factors for asthma: is prevention possible?* Lancet. 2015;**386**:1075-85.

The preceding sections have examined the relationships between diagnosed asthma among children and area deprivation, urban/rural residence and exposure to second-hand smoke separately. In order to account for the different factors that are associated with diagnosed asthma, multivariate logistic regression models were carried out to investigate the variables associated with diagnosed asthma among children aged 0 to 15. Age, household income tertiles (thirds), quintiles of area deprivation[42], urban/non-urban residence, body mass index (BMI) status, reported exposure to other people's smoke, the presence of a smoker inside the home on most days, and the current smoking status of their mother were selected as independent variables. Two independent variables were retained in the final model along with age: quintiles of area deprivation and mother's current cigarette smoking status.[43]

Table 14 shows the odds ratios of diagnosed asthma for boys and girls. The model estimates show the odds of diagnosed asthma for each category of the independent variable, adjusted for the other variables in the model. The results indicate associations, not causes. Odds are expressed relative to a reference category, which is given a value of 1. In this case, odds ratios greater than 1 indicate higher odds of diagnosed asthma, and odds ratios less than 1 indicate lower odds. 95% confidence intervals (CI) are shown; there is a statistically significant difference in the odds if the limits of the confidence interval do not include 1. For more information about logistic regression see the Glossary in the HSE 2018 Methods report.

The odds of diagnosed asthma were more than seven times higher in boys aged 10 to 12 as in those aged 0 to 3. Similarly, the odds of diagnosed asthma were more than four times higher in girls aged 10 to 12 as in those aged 0 to 3.

Area deprivation was associated with diagnosed asthma in boys (odds being 1.9 and 2.1 times higher for those in the second and third least deprived areas respectively compared with those in the least deprived areas). Area deprivation was not associated with diagnosed asthma in girls.

The current cigarette smoking status of their mother was associated with diagnosed asthma in girls but not in boys. Compared with girls whose mother had never regularly smoked, the odds of diagnosed asthma were 2.3 times higher for those whose mother was an ex-regular smoker, and 2.5 times higher for those whose mother was a current smoker.

Table 14

[42] Area deprivation was classified using the Index of Multiple Deprivation (IMD), discussed elsewhere in this report.

[43] For the purpose of this analysis, 'mother' is defined as the child's resident female parent or guardian.

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