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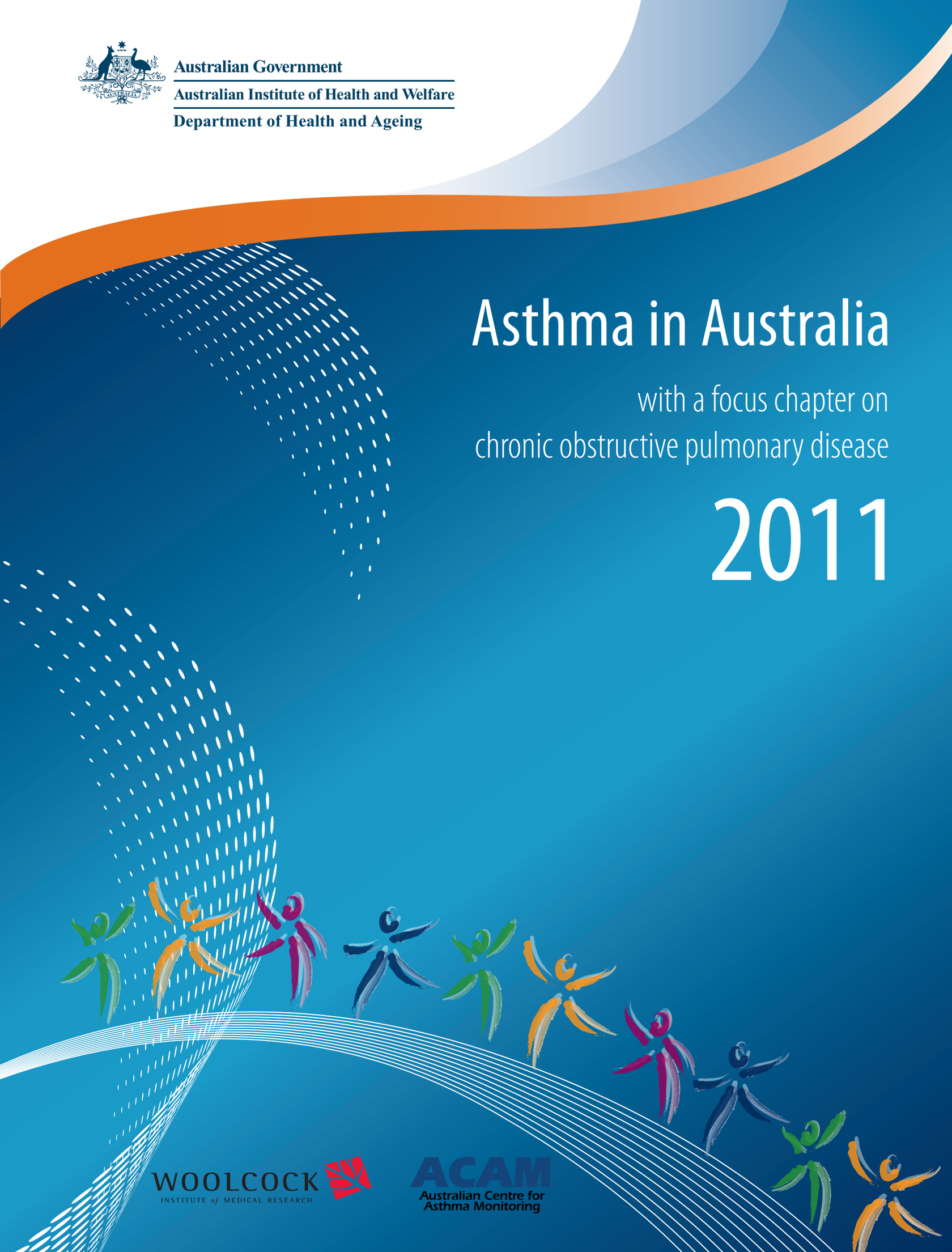
Asthma in Australia

with a focus chapter on chronic obstructive pulmonary disease

2011



WOOLCOCK INSTITUTE of MEDICAL RESEARCH
ACAM Australian Centre for Asthma Monitoring

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This publication is part of the Australian Institute of Health and Welfare's Asthma in Australia series. A complete list of the Institute's publications is available from the Institute's website <www.aihw.gov.au>.

ISSN 1448-7594

ISBN 978-1-74249-215-5

Suggested citation

Australian Centre for Asthma Monitoring 2011. Asthma in Australia 2011. AIHW Asthma Series no. 4. Cat. no. ACM 22. Canberra: AIHW.

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Published by the Australian Institute of Health and Welfare

Printed by Paragon Printers Australasia

Please note that there is the potential for minor revisions of data in this report. Please check the online version at <www.aihw.gov.au> for any amendments.

Contents

Acknowledgments

Authorship

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This report uses unit record data from the Longitudinal Study of Australian Children (LSAC) Survey. The LSAC Project was initiated and is funded by the Australian Government Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA) and is managed by the Australian Institute of Family Studies (AIFS). The findings and views presented in this report, however, are those of the author and should not be attributed to either FaHCSIA or AIFS.

Preparation of this edition of Asthma in Australia was guided by members of the National Monitoring of Asthma and Linked Chronic Respiratory Conditions Advisory Group, chaired by Carol Armour. Members of the National Monitoring of Asthma and Linked Chronic Respiratory Conditions Advisory Group are Christine Jenkins, Alan James, Anne Chang, Graeme Maguire, Sean Walsh, Michael Abramson, Amanda Barnard, Peter Gibson and Paul Magnus.

Funding

This publication was funded by the Australian Government Department of Health and Ageing through the Asthma Management Program.

Key messages

This report highlights a number of key messages in relation to asthma in Australia. It also includes a focus chapter on chronic obstructive pulmonary disease (COPD) and its relationship to asthma.

Asthma

Key messages relating to asthma:

- Asthma affects one in ten children and adults. This is equivalent to over 2 million Australians.
- Over the last decade, the prevalence of asthma has decreased among children and young adults.
- People with asthma are more likely to smoke than other people, particularly young adult females.
- 411 people died from asthma in 2009.
- People with asthma report worse health and a poorer quality of life than other people.
- People with asthma should have a written asthma action plan but most still don't.
- One in twelve children with asthma are exposed to tobacco smoke in their home.
- There was a decrease in deaths from asthma since the early 1990s. However, the Australian death rate is still high on an international scale.

Chronic obstructive pulmonary disease

Key messages relating to COPD:

- Among people aged 55 years and over:
  - deaths from COPD decreased by 65% between 1997 and 2007
  - those with COPD are twice as likely to smoke as other people
  - Indigenous Australians are more likely to be hospitalised for COPD compared with other Australians.
- There is a lack of pulmonary rehabilitation programs for people with COPD, despite evidence that these programs are effective.
- There is no national register of provision of long-term oxygen therapy.

Executive summary

This section presents selected findings from the report. Comparisons noted here are statistically significantly different, unless otherwise stated. Each chapter also begins with its own list of key points.

Introduction

- Asthma is a chronic inflammatory condition of the airways associated with episodes of wheezing, breathlessness and chest tightness.
- Asthma affects people of all ages and has a substantial impact on the community.
- There is currently no cure for asthma. However, good management can control the disease and prevent symptoms from occurring or worsening.
- Chronic obstructive pulmonary disease (COPD) is a serious long-term lung disease that mainly affects older people and is often difficult to distinguish from asthma.

Prevalence, incidence and natural history

- Asthma remains a significant health problem in Australia, with prevalence rates that are high by international comparison.
- For 2007–08, the prevalence of current asthma in Australia was estimated about one in ten (9.9%), equivalent to about 2 million people.
- Since 2001, the prevalence of current asthma has declined in children and young adults but remained stable in adults aged 35 years and over.
- Among those aged 0–14 years, current asthma is more common among males than females, but among those aged 15 years and over, the reverse is true.
- Asthma is more common among Indigenous Australians than among other Australians, particularly in adults.
- The prevalence of current asthma increases with decreasing socioeconomic status. The gap in prevalence between areas of highest and lowest socioeconomic status increased between 2004–05 and 2007–08.
- Asthma commonly coexists with other chronic conditions, such as rhinitis and sinusitis, and mental and behavioural disorders.

Asthma control and quality of life

- Poor asthma control (frequent symptoms and asthma exacerbations) is a common problem in both adults and children.
- Overall, levels of asthma symptoms and frequency of dispensing reliever medication in the Australian community are higher than is consistent with good asthma control.
- People with asthma rate their health worse than do people without the condition.
- Asthma is associated with a poorer quality of life.
- Most of the impact of asthma is on physical functioning and on the person's social and work life.
- People with current asthma are significantly more likely to take days off work, school or study than people without current asthma.
- Australians with asthma report worse psychological health than those without asthma and the difference is more pronounced in females.

Mortality

- There were 411 deaths attributed to asthma as the underlying cause in 2009. This represented 1.60 per 100,000 people and 0.29% of all deaths in that year.
- Between 1997 and 2009, the mortality rate due to asthma decreased by 45%.
- The mortality rate due to asthma in Australia remains high on an international scale.
- Deaths due to asthma occur in all age groups, although the risk of dying from asthma increases with age.
- The age distribution of asthma deaths is different to that observed for all-cause deaths. Of all asthma deaths between 2003 and 2007, 31% occurred among people aged 5–64 years. In contrast, the proportion of all-cause deaths in this age group was only 20%.
- People living in areas of lower socioeconomic status and Indigenous people have a higher risk of dying from asthma.

Use of health-care services

General practice encounters

- The rate of general practice encounters for asthma decreased among adults (by 33%) and children (by 27%) between 2000–01 and 2009–10.
- Lung function testing and provision of asthma action plans occur in less than 9% of general practice encounters for the management of asthma.
- Claims for completed Asthma Cycle of Care Practice Incentives Programs are highest for children, especially boys aged 0–4 years, girls aged 5–14 years, and for people aged 65 years and over. They tend to peak in the winter months.
- Among people with asthma, Asthma Cycle of Care programs are less likely to be completed for adults aged 15–34 years, people living in inner regional areas and people living in areas of a relatively lower socioeconomic status.

Hospitalisations and emergency department visits

- The hospital separation rate for asthma among adults and children remained stable between 2004–05 and 2008–09. Between 1993–94 and 2002–03, the rate declined by 32% for adults and 47% for children.
- Hospital separations for asthma are higher in:
  - boys compared with girls
  - adult women compared with adult men
  - adults living in remote areas compared with adults residing in major cities
  - Indigenous people aged 5 years and over compared with other Australians of the same age
  - people from an English-speaking background compared with those from a non-English-speaking background
  - people living in areas of lower socioeconomic status compared with those living in areas of higher socioeconomic status.
- Peaks in emergency department and hospital admissions for asthma vary by age, with higher rates in late summer and autumn among children and in winter among adults.
- Respiratory infections are commonly listed as an associated diagnosis among people of all ages admitted to hospital for asthma.

Invasive mechanical ventilation

- In 2008–09, 1.6% of hospitalisations for asthma included a period of invasive mechanical ventilation (supported breathing using a 'life-support machine').
- People who receive invasive mechanical ventilation during their hospital stay for asthma have a longer length of stay and a higher rate of in-hospital mortality than those who do not receive the procedure.
- The highest proportion of hospitalisations for asthma that included a period of invasive mechanical ventilation was among adults aged 35–64 years. In this age group, people from non-English-speaking backgrounds were more likely to receive invasive mechanical ventilation during hospitalisation than people from English speaking backgrounds.

Management

Asthma action plans

- The majority of people with asthma do not have a written asthma action plan, despite national guidelines over the last 20 years recommending their use for people with asthma.
- Adults, particularly young adult males, are less likely to possess a written asthma action plan than children.

Medication use

- Drug therapy is the mainstay of asthma management.
- The supply of medications used to treat asthma and other respiratory disorders remained stable between 2005 and 2009.
- The dispensing of medications for asthma (inhaled and oral corticosteroids, long-acting beta-agonists and short-acting beta-agonists) increases with age.
- Most adults and children with asthma are dispensed inhaled corticosteroids intermittently, despite treatment guidelines recommending regular use in people with persistent asthma.
- Among adults who received any inhaled corticosteroid medications, 30% were dispensed these medications only once in 2009.
- Over 80% of inhaled corticosteroids are supplied in combination with long-acting beta-agonists, despite guidelines recommending that in asthma, these medications should only be used in patients whose asthma is not well-controlled with inhaled corticosteroids alone.
- Prescriptions for combination formulations containing inhaled corticosteroids and long-acting beta-agonists are relatively common among children, despite treatment guidelines recommending against their use in most children.
- Among adults, the majority of inhaled corticosteroids are prescribed in combination with long-acting beta-agonists.
- In data sources available, there is no way of distinguishing medications dispensed for asthma from those for other obstructive lung diseases, such as COPD.

Smoking and occupational exposures

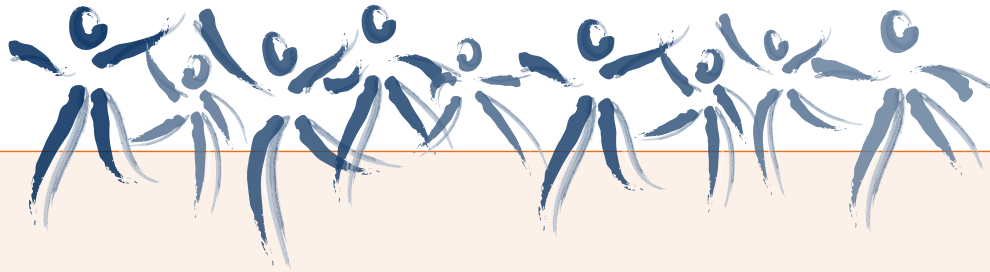
- People with asthma smoke at least as much as people without asthma, despite the known adverse effects.
- In 2007–08 the prevalence of smoking was higher in females with asthma than in those without asthma, particularly females aged 18–34 years. This trend was not observed in males.

- Socioeconomic status is a strong determinant of the risk of smoking among people with asthma, with smoking rates higher in areas of lower socioeconomic status.
- An estimated 7.8% of children with asthma reside where smoking occurs inside the home.
- Nearly 10% of adult-onset asthma is caused by occupational exposures and, hence, could be avoided if exposure to triggering agents in the workplace were removed.
- Occupational asthma is the one truly preventable form of the disease.

Focus chapter: chronic obstructive pulmonary disease among people aged 55 years and over

- The prevalence of self-reported COPD among people aged 55 years and over in Australia was estimated at 5.3% in the 2007–08 National Health Survey. This is likely to underestimate the true prevalence when using objective measures.
- The prevalence of self-reported COPD increases progressively with age, from 4.0% among people aged 55–69 years to 9.1% among those aged 85 years and over.
- In 2007, there were 5,051 deaths attributed to COPD among people aged 55 years and over. This represented 100 per 100,000 population aged 55 years and over and 4% of all deaths in this age group.
- Many more deaths were attributed to COPD than to asthma (100 compared with 6 per 100,000 population).
- Between 1997 and 2007, the mortality rate attributed to COPD decreased by 65%.
- The rate of general practice encounters for COPD decreased between 2000–01 and 2009–10, although the rate has remained relatively stable in recent years.
- Between 1998–99 and 2008–09, the hospital separation rate for COPD remained relatively stable but substantially higher than the rate for asthma.
- Among people aged 55 years and over, hospital separation rates for COPD are higher in:
  - males compared with females
  - people living in remote areas compared with those living in major cities
  - Indigenous people compared with other Australians
  - people from an English-speaking background compared with those from a non-English-speaking background
  - people living in areas of lower socioeconomic status compared with those living in areas of higher socioeconomic status.
- People with COPD admitted to hospital have higher rates of assisted ventilation (non-invasive and invasive mechanical ventilation) compared to those with asthma.
- Cancer was commonly listed as an associated diagnosis among people aged 55 years and over admitted to hospital for COPD.
- Access to pulmonary rehabilitation programs is very limited, despite evidence that these programs are effective.
- Long-term home oxygen therapy is recommended for patients with COPD and low levels of oxygen in the blood. There is no national database or register of use of oxygen therapy to help assess the use of this intervention.
- The prevalence of current smoking is twice as high among people aged 55 years and over with COPD (20%) compared to those without the disease (11%).

1. Introduction



Key points

- Asthma is a chronic inflammatory condition of the airways associated with episodes of wheezing, breathlessness and chest tightness.
- Asthma affects people of all ages and has a substantial impact on the community.
- There is currently no cure for asthma. However, good management can control the disease and prevent symptoms from occurring or worsening.
- Chronic obstructive pulmonary disease (COPD) is a serious long-term lung disease that mainly affects older people and is often difficult to distinguish from asthma.

What is asthma?

Asthma is a common chronic inflammatory condition of the airways. People with asthma experience episodes of wheezing, breathlessness and chest tightness due to widespread narrowing of the airways. The symptoms of asthma are usually reversible, either spontaneously or with treatment (GINA 2009a).

The impact of asthma ranges from mild, intermittent symptoms causing few problems for the individual, to severe and persistent wheezing and shortness of breath. In a few people with asthma the disease has a severe adverse impact on quality of life and may be life-threatening.

The underlying causes of asthma are still not well understood, although there is evidence that environmental and lifestyle factors, as well as genetic factors such as an allergic tendency, increase the risk of developing asthma. Among those with the condition, airway narrowing and symptoms can be triggered by:

- viral infections
- exposure to specific allergens such as house dust mites, pollens, mould spores, animal dander and occupational allergens
- irritants such as tobacco smoke and other air pollutants
- exercise
- some food chemicals or additives.

Asthma is one of several chronic conditions that are prevalent in Australia but, unlike most other chronic conditions, such as arthritis, cardiovascular disease or COPD, it is not progressive—that is, it does not typically worsen with increasing age.

Diagnosis of asthma

Asthma is characterised by four domains: symptoms, variable airway obstruction, airway inflammation and airway hyperresponsiveness. Airway inflammation and airway hyperresponsiveness are rarely assessed in primary care.

Spirometry is a measure of lung function performed using a spirometer. It establishes the presence of airflow obstruction and its reversibility in response to a bronchodilator. However, spirometry is often not used in primary care (Barton et al. 2009; Johns et al. 2006), so the diagnosis of asthma is often made on the basis of typical symptoms without objective confirmation.

Asthma symptoms may overlap with the symptoms of several other respiratory and non-respiratory conditions. Furthermore, the symptoms experienced by patients with asthma may vary over time. Hence, the diagnosis of asthma in primary care may be difficult.

Classification of asthma

In the past, guidelines recommended that asthma should be classified according to the *severity* of the condition, based on the pattern and severity of symptoms before anti-inflammatory treatment was commenced (NAC 2006). Adults were classified as having 'intermittent', 'mild persistent', 'moderate persistent' or 'severe persistent' asthma. In childhood, where intermittent symptoms are more common than in adults, asthma was classified as either 'persistent' (mild, moderate or severe), 'frequent episodic' or 'infrequent episodic' asthma (NAC 2002).

In more recent years, the focus has moved to classifying asthma on the level of asthma control (Taylor et al. 2008), as this is the basis for the adjustment of asthma treatment. The concept of asthma control includes consideration of both the patient's current clinical status, particularly symptoms, reliever use and activity limitation, and of their longer-term risk for adverse outcomes.

There has also been increasing awareness of heterogeneity in the clinical characteristics and underlying disease features of asthma (Wenzel 2006). This is sometimes described in terms of 'phenotypic' groups, that is, groups of patients who share common clinical, pathological or physiological features. The ultimate aim of identifying such groups is to improve prevention and disease management strategies by allowing more appropriate targeting of interventions.

The impact of asthma in Australia

Asthma affects people of all ages and is associated with a substantial impact on the community. A large proportion of the burden of asthma is attributed to young people. In 2003, asthma represented the leading cause of burden of disease among children aged 0–14 years, contributing 17.4% of lost years of healthy life in that age group (ACAM 2009b).

While there is currently no cure for asthma, there are effective management strategies available to control the disease and prevent the worsening of asthma symptoms. There is evidence that the uptake of these strategies was not optimal among people who could benefit greatly, in terms of reducing the impact of asthma on both themselves and the community (Marks et al. 2007; Marks et al. 2000).

It is important to continue monitoring the prevalence of asthma, its distribution within the community, the incidence and severity of exacerbations of asthma, and the uptake of effective clinical management practices. This will provide an evidence base for further development of strategies and policies to reduce the burden of asthma in Australia.

Overview of this report

This report, the fourth in the *Asthma in Australia* series, describes the status of asthma in Australia in the years leading up to 2011 using a range of data sources. It aims to provide a wide audience, including health professionals, policy makers, health planners, academics, consumers and interested readers, with a comprehensive record of up-to-date data and trends for asthma in Australia. The report also highlights relevant national and international research for comparison. The structure of this report and its content were guided by feedback obtained from a stakeholder survey that the Australian Centre for Asthma Monitoring (ACAM) conducted based on the 2008 edition of *Asthma in Australia*.

As with the previous editions of *Asthma in Australia* published in 2003, 2005 and 2008, the scope of the present report is based on the indicator framework for asthma, initially proposed in August 2000 (AIHW 2000) and then revised by ACAM (Baker et al. 2004). It also reflects the findings of a recent review of the national asthma indicators by ACAM using a Delphi survey (ACAM 2009c). The present report provides

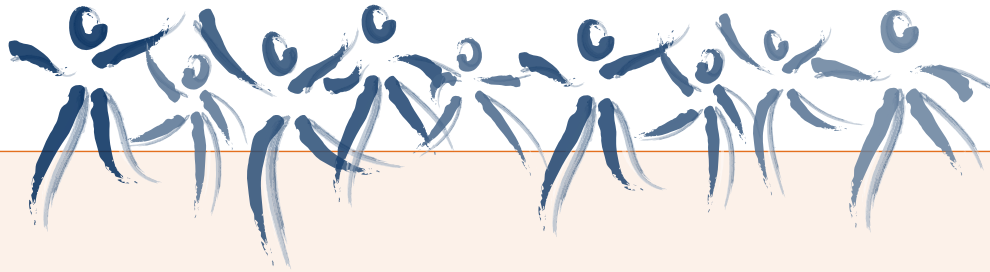
updates to data presented in previous editions of this series, and also includes new information. One important addition is the analysis of data from *Growing up in Australia: the Longitudinal Study of Australian Children* (FaHCSIA et al. 2011), which provides valuable insights on the impact of asthma among children in Australia.

This report describes the recent time trends and seasonal patterns for asthma-specific data on prevalence (Chapter 2), asthma control and quality of life (Chapter 3), mortality (Chapter 4), health-service utilisation (Chapter 5), asthma management, including the possession of asthma action plans and medications prescribed or dispensed (Chapter 6) and selected risk factors contributing to asthma, including smoking, exposure to passive smoke and occupational asthma (Chapter 7). Where data are available, this report examines differences between age groups, between males and females, between socioeconomic groups, between Indigenous and other Australians and between cities, regions and remote populations. Finally, comparisons among states and territories and with selected overseas countries are described where it is relevant.

A focus chapter is included on chronic obstructive pulmonary disease (COPD) among people aged 55 years and over (Chapter 8). COPD is a serious long-term lung disease that mainly affects older people. Most of the morbidity and mortality attributed to COPD occurs in people aged 55 years and over. In Australia, the majority of people with this condition have been long-term smokers. Among older people, COPD and asthma can be difficult to distinguish as the current definitions of asthma and COPD are not mutually exclusive and both conditions have similar manifestations.

In Australia, health policies for asthma and COPD are linked. The focus chapter draws together information from a range of sources describing the impact of COPD in Australia among people aged 55 years and over. This chapter also includes corresponding data for asthma for the same age group to facilitate comparison and contrast with COPD.

2. Prevalence, incidence and natural history



Key points

- Asthma remains a significant health problem in Australia, with prevalence rates that are high by international comparison.
- For 2007–08, the prevalence of current asthma in Australia was estimated about one in ten (9.9%), equivalent to about 2 million people.
- Since 2001, the prevalence of current asthma has declined in children and young adults but remained stable in adults aged 35 years and over.
- Among those aged 0–14 years, current asthma is more common among males than females, but among those aged 15 years and over, the reverse is true.
- Asthma is more common among Indigenous Australians than among other Australians, particularly in adults.
- The prevalence of current asthma increases with decreasing socioeconomic status. The gap in prevalence between areas of highest and lowest socioeconomic status increased between 2004–05 and 2007–08.
- Asthma commonly coexists with other chronic conditions, such as rhinitis and sinusitis, and mental and behavioural disorders.

Introduction

This chapter presents data on the prevalence, incidence and natural history of asthma in Australia. These data are gathered from a wide range of sources. Data on time trends, differences among population groups, and international comparisons are reported.

Estimating the number of people in the community who have asthma is fundamentally important in assessing the impact of asthma at a population level. Examining levels and trends in the prevalence of asthma allows planners to estimate resource needs and priorities both now and in the future. Differences among population subgroups in the prevalence of asthma provide insights into possible causative factors and also assist in targeting resources to areas of need. Finally, examination of changes over time in the number of people who have asthma contributes to the evaluation of population-based efforts to prevent the disease and, if a trend is observed, may stimulate the search for an environmental or lifestyle-related cause for that change.

There is no universally accepted definition of asthma. In epidemiological studies, sixty different definitions of asthma in children have been reported (van Wonderen et al. 2010). Also, it is important to note that the extent to which reported wheeze among children represents undiagnosed asthma, as opposed to non-asthma, viral-associated wheeze, cannot be ascertained from the available data. Children with wheezing may be labelled with the diagnosis of 'asthma', 'wheezing illness' or a range of entities such as viral bronchiolitis, bronchitis, or upper respiratory tract infections. Hence, the prevalence of asthma is difficult to estimate in children, particularly young children.

The definition for asthma used in international guidelines (GOLD 2009) does not represent a necessary and sufficient condition for establishing the diagnosis. Consequently, a range of operational definitions for asthma are used in epidemiological studies. Asthma symptoms may be non-specific and/or overlap with the symptoms of several other respiratory and non-respiratory conditions (Marks et al. 2009).

Measuring asthma

When interpreting the information in this chapter it is important to be aware of the difficulties in measuring asthma and reporting its prevalence and incidence. This was alluded to in the above paragraph.

This report presents findings from international studies involving Australia (Lai et al. 2009; Pearce et al. 2007; Asher et al. 2006) and studies of local populations (Tai et al. 2009; Valery et al. 2008; Phillips et al. 2007; Vuillermin et al. 2007; Wilson et al. 2006; Toelle et al. 2004). In these studies the prevalence of asthma was estimated using a wide range of self-reported and objective measures, alone or in combination, in both clinical and population-based settings.

Self-reported measures include:

- doctor diagnosis of asthma, which may be self-reported or parent-reported (James et al. 2010; Marks et al. 2007; Wilson et al. 2006; Adams et al. 2004b; Robertson et al. 1991)
- symptoms, such as:
  - wheeze (Pearce et al. 2007; Glasgow et al. 2001; ISAAC (International Study of Asthma and Allergies in Childhood) 1998; Robertson et al. 1991)
  - shortness of breath (particularly at night) (Zock et al. 2007; Woods et al. 2001; Burney et al. 1996)
  - cough at night (Grant et al. 2000)
  - wheezing with exercise (Grant et al. 2000; Ponsonby et al. 1996; Jones 1994)
- taking treatment for asthma (Zock et al. 2007; Burney et al. 1996).

Objective measures include:

- measuring the twitchiness of the airways in response to inhaled stimuli (known as 'bronchial provocation test' or 'challenge test') or measuring the extent to which airway narrowing can be reversed by inhaled medication (known as 'bronchodilator reversibility test') (Toelle et al. 2004)
- measurement of day-to-day variability in airway narrowing ('peak flow variability') (Parameswaran et al. 1999).

Over the last decade the prevalence of asthma in Australia was measured in a range of population health surveys, including the Australian Bureau of Statistics' (ABS) National Health Survey (NHS), and state and territory health surveillance programs. These are all based on self-reported measures and do not include objective measures. There are some time series data available from these survey programs. The limitation on these time series is that many surveys were conducted only once, or, where there are repeated measures, the definition used to identify people with asthma has changed, making it difficult to compare the prevalence rates over time. However, there are some time series that have used consistent measures and these are presented in this chapter.

2.1 Incidence and natural history of asthma

Data from the Longitudinal Study of Australian Children (LSAC) showed that almost 17% of infants experience asthma or wheeze within the first three years of life (ACAM 2009a). Recent analyses of LSAC data indicate that by the age of 4–5 years, nearly a quarter (24.4%) of children had reported asthma or wheeze at some stage (Table 2.1). However, not all wheeze qualifies as asthma and by age 4–5 years the incidence of wheeze, at 21.7%, was nearly double that of diagnosed asthma (11.5%). In contrast, among children aged 8–9 years, the incidence of asthma (16.3%) and wheeze (15.2%) over the past 4 years were similar. See Appendix 1, Section A1.7.1 for detailed information of LSAC.

In Canada, the 4-year cumulative incidence of doctor-diagnosed asthma among preschool-aged children (aged 2–5 years) was 13.7%. The incidence of diagnosed asthma was higher among children with a history of early childhood wheezing (25.7%) (Midodzi et al. 2010).

A British cohort study of children up to the age of 18 years reported that the peak incidence rate for doctor-diagnosed asthma occurred during the second year of life in boys (32.4 per 10,000 person-years) and the third year of life in girls (17.9 per 10,000 person-years). The annual incidence rate was higher in males than in females up to the 11th year of life and reversed to be significantly higher in girls from the 14th year onwards (Punekar & Sheikh 2009).

Table 2.1: Cumulative incidence of diagnosed asthma or illness with wheezing for the infant and kindergarten cohorts, Longitudinal Study of Australian Children, Australia, 2004–2008

Study	No. of new cases	No. in survey	Person-years	Incidence per 100 person-years
Infant cohort at age 4–5 years				
Ever asthma	885	4,386	8,175	11.5 (10.7–12.3)
Illness with wheezing	1,697	4,386	8,196	21.7 (20.8–22.6)
Ever asthma or illness with wheezing	1,906	4,386	8,183	24.4 (23.5–25.3)
Kindergarten cohort at age 8–9 years				
Ever asthma	1,283	4,331	8,073	16.3 (15.3–17.2)
Illness with wheezing	1,183	4,331	8,073	15.2 (14.4–16.1)
Ever asthma or illness with wheezing	1,723	4,331	8,062	22.0 (21.0–23.0)

Notes

1. Cumulative incidence per 100 person-years is weighted to the Australian population aged 4–5 years and 8–9 years at the end of March 2007.
2. Cumulative count of parent-reported wheezing or ever-diagnosed asthma from 2006 to 2008 for children aged 4–5 years and from 2004 to 2008 for children aged 8–9 years.
3. Numbers in parenthesis indicate 95% confidence interval.
4. See Appendix 1, Box A1.7 for definitions of asthma and illness with wheezing.

In a German birth cohort comprising 441 children, 126 (29%) children experienced wheezing by the age of 3 years. Among these children, 63% did not wheeze after the age of 3 years, 34% continued to wheeze intermittently and only 3% continued to wheeze every single year up to age 13 years (Matricardi et al. 2008).

A large Canadian study reported that nearly half of the children (48.6%) diagnosed with asthma before the age of 6 years were in remission by 12 years of age. However, 54% of children who were diagnosed with asthma in early childhood experienced a second asthma episode, resulting in a health-care encounter, within 1 year of diagnosis. Furthermore, children who were admitted to hospital with asthma during the first year post diagnosis had a 3-fold higher risk of persistent asthma by 12 years of age (To et al. 2007).

The Respiratory Health in Northern Europe (RHINE) study reported an overall remission rate of 20.2 per 1,000 person-years among adults aged 26–53 years during the period 1989 to 2001. This means that approximately 20% of people experienced a clinical remission of asthma during a 10-year period (Holm et al. 2007). Similarly, a Swedish study reported a 10-year remission rate of asthma as 14.6% among adults aged 20–69 years (Ekerljung et al. 2008).

People with troublesome asthma in adult life often had symptoms of asthma in childhood. The Tasmanian Longitudinal Health Study (TAHS), which included 8,583 subjects who were followed since 1968, found that 91% of adults classified as having persistent asthma (asthma symptoms reported during at least three follow-up visits over a 37-year period) or frequent asthma (asthma symptoms during two follow-up visits) at age 44 years had developed their asthma as young children (Dharmage et al. 2008).

A Melbourne longitudinal study of childhood asthma reported that the more severe the asthma at age 7–10 years, the more likely it was to persist into adulthood. Sixty percent of adults aged 42 years who had episodic asthma at age 7–10 years and 21% of those who had persistent or severe asthma during childhood were free of wheezing over the past 3 years (Robertson 2002).

In conclusion, childhood incident asthma may have implications for asthma in adult life but not all episodes of wheezing in childhood are asthma and not all asthma in children results in persistent asthma.

2.2 Prevalence of ever-diagnosed asthma

The 2007–08 National Health Survey (NHS) provides the most recent nationwide data for the prevalence of having ever been diagnosed with asthma. Based on data from this survey, it is estimated that 3,888,952 Australians have been diagnosed with asthma by a doctor or nurse at some time in their lives. This equates to 19.0% (CI: 18.2–19.7%) of Australians reporting ever having been diagnosed with asthma. It should be noted that data referring to the prevalence of ever being diagnosed with asthma is not the same as the prevalence of current asthma since some people who have ever been diagnosed with asthma no longer have asthma.

Adults

Among adults (aged 16 years and over) surveyed in the 2007–08 NHS, 19.2% (CI: 18.4%–20.0%) reported ever having been diagnosed with asthma. Data from recent state and territory health surveys in Australia show a range of estimates around this value for the proportion of adults who report ever having been diagnosed with asthma (15.1–24.3%) (Table 2.2).

Table 2.2: Prevalence of ever-diagnosed asthma in adults, most recent health survey results, 2004–2009

Study	Year	Age range	No. in survey	Rate (per cent)	95% CI
Ever told by a doctor or nurse they have asthma					
Australia (1)	2007–08	16 years and over*	16,429	19.2	(18.4–20.0)
Queensland (2)	2006	18 years and over	1,521	24.3	(21.8–26.9)
Ever told by a doctor or hospital they have asthma					
New South Wales (3)	2009	16 years and over	10,688	19.6	(18.5–20.7)
Ever told by a doctor they have asthma					
Victoria (4)	2008	18 years and over	34,169	21.2	(20.5–21.9)
Western Australia (5)	2009	16 years and over	7,894	15.1	(13.9–16.2)
South Australia (6)	2009	18 years and over	5,636	18.1	(17.2–19.2)
Tasmania (7)	2004–2008	41–45 years	1,741	22.8	(21.5–24.1)
Ever told by a doctor they have asthma or bronchial asthma					
Western Australia (8)	2005–2007	18–79 years	2,862	19.0	n.a.

CI = Confidence interval.
*age standardised to the 2001 Australian population
n.a. = Not available
Sources:
(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) Epidemiology Services Unit, Queensland Health.
(3) 2009 Report on Adult Health from the New South Wales Population Health Survey.
(4) Victorian Population Health Survey 2008, Health Intelligence Unit, Department of Health. Unpublished data.
(5) Western Australian Health & Wellbeing Surveillance System, Health Outcomes Assessment Unit, Epidemiology Branch, Department of Health. Unpublished data.
(6) South Australian Monitoring and Surveillance System (SAMSS), Department of Health, Government of South Australia. Unpublished data.
(7) Tasmanian Longitudinal Health Study.
(8) James et al. 2010.

Children

Among children (aged 0–15 years) surveyed in the 2007–08 NHS, 17.8% (CI: 16.2–19.4%) were estimated as ever having been diagnosed with asthma. In the nationally representative Longitudinal Study of Australian Children (LSAC), reported in 2008, the prevalence of ever having been diagnosed with asthma was 31.0% among children aged 8–9 years and 21.8% among those aged 4–5 years. Recent state health survey results indicate that the prevalence of ever being diagnosed with asthma among children ranges from 13.0% to 24.6% (Table 2.3).

Table 2.3: Prevalence of ever-diagnosed asthma in children, most recent health survey results, 2005–2009

Study	Year	Age range	No. in survey	Rate (per cent)	95% CI
Parent/guardian ever told by a doctor or nurse that their child has asthma					
Australia (1)	2007–08	0–15 years*	4,359	17.8	(16.2–19.4)
Parent ever told by doctor that their child has asthma					
Australia (2)	2008	4–5 years	4,386	21.8	(20.3–23.2)
		8–9 years	4,331	31.0	(29.3–32.7)
New South Wales (3)	2007–08	2–15 years	4,406	24.6	(23.2–26.1)
Victoria (4)	2009	1–12 years	≈5,000	17.2	(15.9–18.5)
Western Australia (5)	2009	0–15 years	2,218	13.0	(11.3–14.7)
South Australia (6)	2009	2–17 years	1,592	18.7	(16.9–20.7)
Victoria (Barwon region) (7)	2005	6–7 years	2,208	24.4	(22.8–26.0)
Ever told by a doctor they have asthma or bronchial asthma					
South Australia (8)	2006	4–5 years	1,509	19.0	(17.0–21.0)

CI = Confidence interval.
*age standardised to the 2001 Australian population
Sources:
(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) ACAM analysis of LSAC.
(3) New South Wales Population Health Survey 2007–2008.
(4) 2009 Victorian Child Health and Wellbeing Survey.
(5) Western Australian Health & Wellbeing Surveillance System, Health Outcomes Assessment Unit, Epidemiology Branch, Department of Health. Unpublished data.
(6) South Australian Monitoring and Surveillance System (SAMSS), Department of Health, Government of South Australia.
(7) Vuillermin et al. 2007.
(8) Tai et al. 2009.

2.3 Prevalence of current asthma

The 2007–08 NHS estimated that 2,049,086 Australians had current asthma, representing nearly 10% of the Australian population.

Prior to the latest survey, the 2001 and 2004–05 NHS measured current asthma as those who reported ever being diagnosed with asthma and responded 'yes' to 'Do you still get asthma?'. In the 2007–08 NHS, current asthma was defined as those who reported ever being diagnosed with asthma and who responded 'yes' to 'Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?'. This is the definition recommended by the Australian Centre for Asthma Monitoring (ACAM 2007b) for the purposes of estimating the prevalence of asthma.

The 2007–08 NHS also included the previous question ('Do you still get asthma?') which allowed comparison between the two definitions. In fact, there is very good agreement between the two definitions (kappa statistic, a chance corrected measure of agreement, was 0.87).

The prevalence of current asthma among all Australians was 9.9% using the new definition and 9.8% using the previous definition.

Adults

Among adults, the NHS 2007–08 nationwide estimate for the prevalence of current asthma was 9.8%. The prevalence of current asthma among adults in surveys conducted in Australian states and territories in recent years has ranged from 8.6% to 16.2% (Table 2.4). Different definitions to identify asthma were used in these surveys and this is likely to influence prevalence estimates.

Table 2.4: Prevalence of current asthma in adults, most recent health survey results, 2003–2009

Study	Year	Age range	No. in survey	Rate (per cent)	95% CI
Ever doctor-diagnosed asthma AND 'Yes' to 'Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?'					
Australia (1)	2007–08	16 years and over*	16,429	9.8	(9.2–10.4)
Western Australia (2)	2009	16 years and over	7,894	8.6	(7.7–9.5)
South Australia (3)	2009	18 years and over	5,636	12.4	(11.6–13.3)
Ever doctor/hospital diagnosed asthma AND had symptoms of asthma or taken treatment for asthma in the last 12 months					
New South Wales (4)	2009	16 years and over	10,688	10.5	(9.7–11.3)
Queensland (5)	2006	18 years and over	1,521	13.7	(11.9–15.9)
Ever doctor-diagnosed asthma AND asthma symptoms (wheezing, coughing, shortness of breath, chest tightness) in the last 12 months					
Victoria (6)	2008	18 years and over	34,169	10.7	(10.1–11.2)
Ever doctor-diagnosed asthma AND 'still have asthma' or 'had whistling or wheezing in the chest at any time in the past 12 months'					
Australia (7)	Dec 2003–Jan 2004	16 years and over	1,006	11.2	(9.1–13.0)
Ever doctor-diagnosed asthma OR significant bronchodilator responsiveness					
South Australia (8)	2004–2006	18 years and over	3,205	16.2	n.a.

CI = Confidence interval.
*age standardised to the 2001 Australian population
n.a. = Not available
Sources:
(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) WA Health & Wellbeing Surveillance System, Epidemiology Branch, WA Health.
(3) South Australian Monitoring and Surveillance System (SAMSS), Department of Health, Government of South Australia.
(4) 2009 Report on Adult Health from the New South Wales Population Health Survey.
(5) Queensland Omnibus Survey, Epidemiology Services Unit, Queensland Health.
(6) Victorian Population Health Survey 2008, Health Intelligence Unit, Department of Health.
(7) Marks et al. 2007.
(8) Population Research and Outcomes Studies Unit 2007.

Children

The NHS 2007–08 estimated that 10.4% of children aged 0–15 years in Australia had current asthma.

In the Longitudinal Study of Australian Children the prevalence of current asthma in 2008 was 16.8% among children aged 8–9 years and 15.4% among those aged 4–5 years.

In addition to these nationwide estimates, the prevalence of asthma among children has also been measured in a number of state, territory or local population-based surveys in Australia (Table 2.5).

The surveys have used different definitions to identify asthma and this is likely to influence the prevalence estimates. However, most state surveys defined current asthma as ever being diagnosed

with asthma, and also having symptoms of asthma and/or taking treatment for asthma in the preceding year. Using this definition, the estimated prevalence of asthma in children was:

- 13.9% (age 2–15 years) in New South Wales (2007–08)
- 8.2% (age 0–15 years) in Western Australia (2009)
- 12.5% (age 2–17 years) in South Australia (2009)(Table 2.5).

The differences in prevalence estimates are also likely to be influenced by the different age ranges of survey participants.

The prevalence of 'recent wheeze' was higher than the prevalence of current asthma in children (Table 2.5). In Victoria in 2009, it was estimated that 21.5% of children aged 1–12 years had experienced wheeze or whistling in their chest in the past 12 months, and in South Australia in 2009, 17.5% of children aged 2–17 years had experienced the same symptoms.

Table 2.5: Prevalence of current asthma in children, most recent health survey results, 2005–2009

Study	Year	Age range	No. in survey	Rate (per cent)	95% CI
Ever doctor-diagnosed asthma AND 'Yes' to 'Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?'					
Australia (1)	2007–08	0–15 years*	4,359	10.4	(9.1–11.7)
Ever told by a doctor they have asthma AND 'Yes' to 'In the last 12 months, has child had an illness with wheezing in the chest which lasted for a week or more or taken any medication for asthma?'					
Australia (2)	2008	4–5 years	4,386	15.4	(14.2–16.6)
	2008	8–9 years	4,331	16.8	(15.5–18.1)
Ever told by a doctor they have asthma AND Child had symptoms of asthma or has taken treatment for asthma in the last 12 months					
New South Wales (3)	2007–08	2–15 years	4,406	13.9	(12.7–15.1)
Western Australia (4)	2009	0–15 years	2,218	8.2	(6.7–9.7)
Australian Capital Territory (5)	2005	4–6 years	3,851	11	(10.0–12.0)
South Australia (6)	2009	2–17 years	1,592	12.5	(10.9–14.2)
Ever told by a doctor they have asthma AND symptoms of asthma					
Victoria (7)	2009	1–12 years	≈5,000	11.2	(10.2–12.3)
Experienced wheeze or whistling in the chest in past 12 months					
Victoria (7)	2009	1–12 years	≈5,000	21.5	(20.1–22.9)
South Australia (6)	2009	2–17 years	1,592	17.5	(15.7–19.4)
Victoria (Barwon region) (8)	2005	6–7 years	2,208	20.2	(18.4–22.2)
South Australia (9)	2006	4–5 years	1,509	23.7	(21.5–25.9)

CI = Confidence interval.
*age standardised to the 2001 Australian population
Sources:
(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) ACAM analysis of LSAC.
(3) NSW Population Health Survey 2007–08, Health Outcomes and Information Statistical Toolkit (HOIST).
(4) WA Health & Wellbeing Surveillance System, Epidemiology Branch, WA Health.
(5) Phillips et al. 2007.
(6) South Australian Monitoring and Surveillance System (SAMSS), Department of Health, Government of South Australia.
(7) 2009 Victorian Child Health and Wellbeing Survey.
(8) Vuillermin et al. 2007.
(9) Tai et al. 2009.

2.4 Time trends in the prevalence of asthma

Important changes in the prevalence of asthma have been noted over the past 30 years. During the 1980s and early 1990s there was a substantial worldwide increase in the prevalence of asthma. In recent years, the increasing trend in asthma symptoms appears to have plateaued in Australia (Asher et al. 2006; Eder et al. 2006), but there is no evidence of an overall decrease in the prevalence of asthma worldwide (Anandan et al. 2010).

Ever-diagnosed asthma

In Australia, comparison of results from the 2007–08 NHS with those reported in 2004–05 and 2001 shows that, overall, the prevalence of ever being diagnosed with asthma remained relatively constant (20.4% in 2001 compared with 20.3% in 2004–05 and 19.0% in 2007–08).

In New South Wales, there was a significant increase in the proportion of all adults ever being diagnosed with asthma from 16.8% in 1997 to 19.9% in 2008, with this increase being significant for both males and females (Centre for Epidemiology and Research 2009).

Between 1981 and 2005–2007, there was a significant (and substantial) increase in the prevalence of ever being diagnosed with asthma or bronchial asthma by a doctor among adults in Busselton, Western Australia (James et al. 2010), with higher rates among those aged 18–54 years than among those aged 55–79 years. Interestingly, there was no significant change in the prevalence of airway hyperresponsiveness or doctor-diagnosed bronchitis over the same time period. The authors of this study suggested that changes in diagnostic labels may have contributed to the rise in prevalence of doctor-diagnosed asthma.

Among 4–5 year old children from South Australia, it was reported that the prevalence of ever having been diagnosed with asthma declined significantly between 1993 and 2006 (Tai et al. 2009).

Between 2000 and 2005, a large British study reported a decline in lifetime prevalence rates of asthma among children aged 0–14 years, although children aged 5–14 years were reported to have the highest rates with almost one in six ever having been diagnosed with asthma at some point in their lives (Simpson & Sheikh 2010). In contrast, this same study reported an increase in ever being diagnosed with asthma among adults over the 5-year period.

Current asthma

Adults

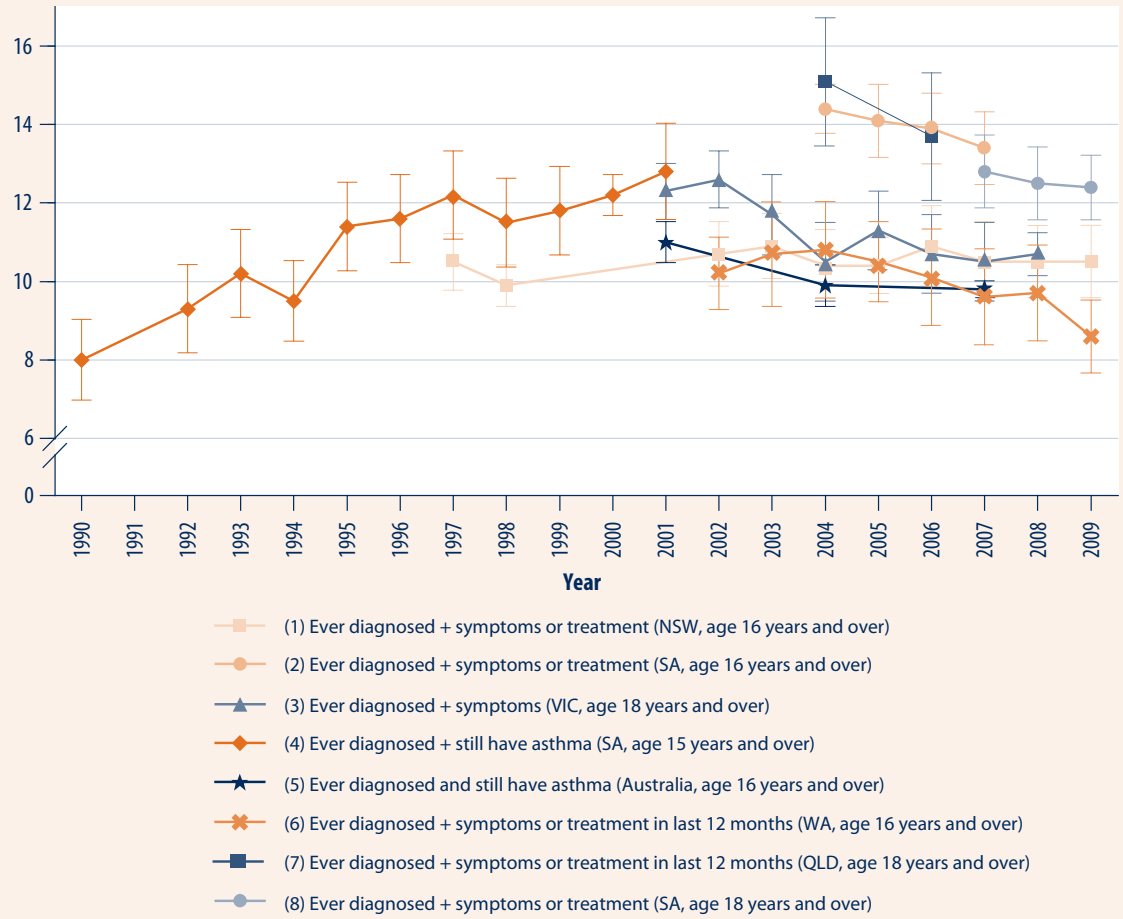
Among adults in South Australia, the prevalence of current asthma diagnosed by a doctor increased in the early 1990s, especially among females and the elderly (Wilson et al. 2006). The North West Adelaide Health Study showed an increase in the prevalence of doctor diagnosed asthma or bronchodilator responsiveness among adults aged 18 years and over from 12.5% between 2000–2003 to 16.2% between 2004–2006 (Population Research and Outcomes Studies Unit 2007).

However, the prevalence of current asthma among adults was relatively stable in a number of Australian studies (Figure 2.1).

The nationwide prevalence of current asthma among adults aged 16 years and over, using the previous definition of 'Do you still get asthma?' to allow for comparisons over time, has remained constant since a decline between 2001 and 2004–05 with 11.0% in 2001, 9.9% in 2004–05 and 9.8% in 2007–08 ($p<0.0001$, National Health Surveys).

Using the new definition of current asthma, the prevalence among adults in 2007–08 is estimated at 9.8%.

Examining all of the studies presented in Figure 2.1, between 2000 and 2009, the prevalence of asthma in adults decreased by 0.18 percentage points per year (CI: 0.12–0.23; p<0.0001) in absolute terms, as a percentage of all adults (Appendix 1, Section A1.1.2).



Note: NHS data is age-standardised to the Australian population as at June 2001.

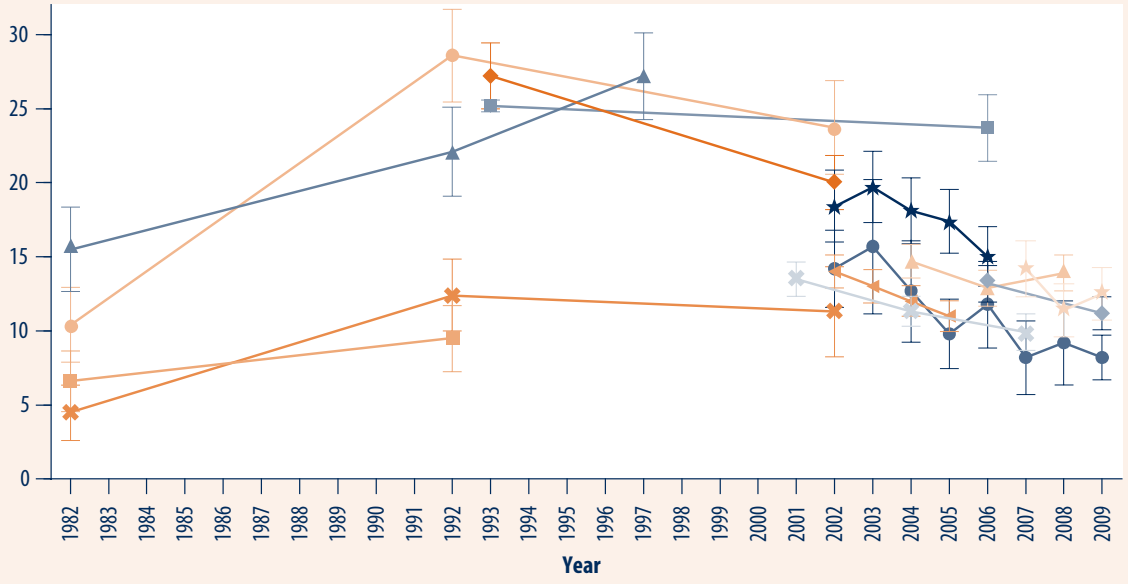
Sources:

(1) NSW Population Health Survey 2007–08, Health Outcomes and Information Statistical Toolkit (HOIST).
(2) South Australian Monitoring and Surveillance System (SAMSS), Department of Health, Government of South Australia.
(3) Victorian Child Health and Wellbeing Survey.
(4) South Australian Omnibus Survey.
(5) ABS National Health Surveys.
(6) WA Health & Wellbeing Surveillance System, Epidemiology Branch, WA Health.
(7) Queensland Omnibus Survey, Epidemiology Services Unit, Queensland Health.
(8) SAMSS, Department of Health, Government of South Australia.

Figure 2.1: Prevalence of current asthma, adults, 1990–2009

Children

In contrast, the prevalence of current asthma among children increased during the 1980s and early 1990s but since that time the trend has reversed (Figure 2.2).



(1) Recent wheeze (SA, age 4–5 years)
(2) Recent wheeze (Belmont, NSW)
(3) Recent wheeze (Wagga Wagga, NSW)
(4) Current wheeze (Melbourne, Vic)
(5) Ever diagnosed + symptoms or treatment (SA, SAMSS, age 2–15 years)
(6) Recent wheeze + AHR (Belmont, NSW)
(7) Recent wheeze + AHR (Wagga Wagga, NSW)
(8) Ever diagnosed + symptoms or treatment in the last 12 months (WA, age 0–15 years)
(9) Ever diagnosed + symptoms or treatment in last 12 months (ACT)
(10) Ever diagnosed + symptoms or treatment in last 12 months (NSW, age 2–15 years)
(11) Ever diagnosed + symptoms in last 12 months (VIC, age 1–12 years)
(12) Ever diagnosed + symptoms or treatment in last 12 months (SA, age 2–17 years)
(13) Ever diagnosed + symptoms or treatment in last 12 months (Australia, age 0–15 years)

Note: NHS data is age-standardised to the Australian population as at June 2001.
Sources:
(1) Population Research and Outcome Studies Unit, South Australian Department of Human Services.
(2)(6) Toelle et al. 2004.
(3)(7) Downs et al. 2001, Peat et al. 1994.
(4) Robertson et al. 2004.
(5) Population Research and Outcome Studies Unit, South Australian Department of Human Services, Tai et al. 2009.
(8) WA Health and Wellbeing Surveillance System, Epidemiology Branch, Department of Health, Government of Western Australia.
(9) Phillips et al. 2007.
(10) NSW Population Health Survey 2007–08, Health Outcomes and Information Statistical Toolkit (HOIST).
(11) Victorian Child Health and Wellbeing Survey.
(12) South Australian Monitoring and Surveillance System (SAMSS), Department of Health, Government of South Australia.
(13) ACAM analysis of ABS National Health Survey 2001, 2004–05 and 2007–08.

Figure 2.2: Prevalence of current asthma, children aged 17 years and under, 1982–2009

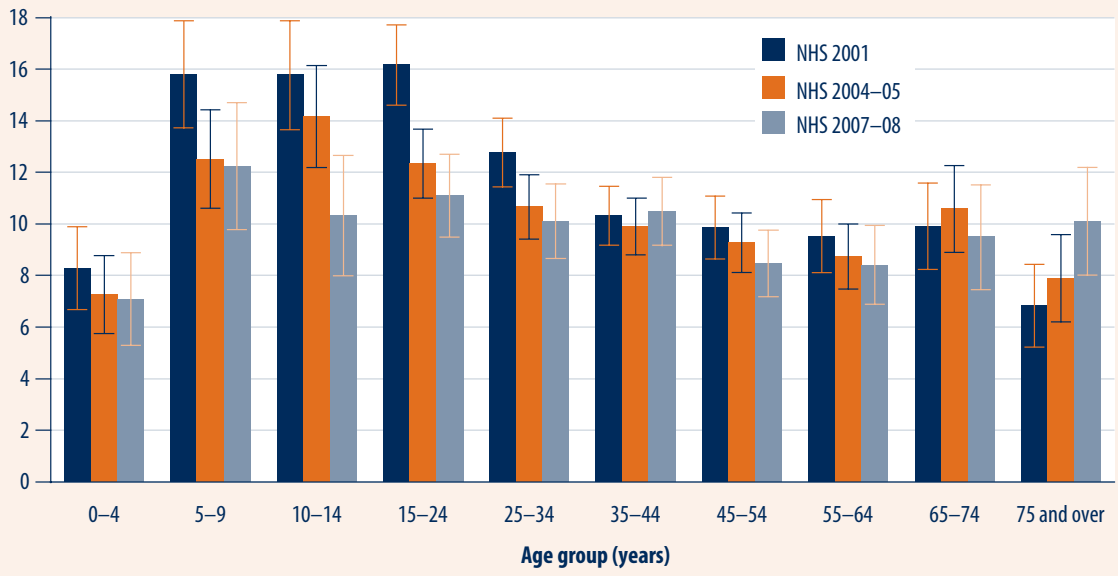
The nationwide prevalence of current asthma among children aged 0–14 years, using the previous definition of 'Do you still get asthma?' to allow for comparisons over time, declined from 13.5% in 2001 to 11.3% in 2004–05 and to 9.9% in 2007–08 ($p<0.0001$, National Health Surveys).

Using the new definition of current asthma, the prevalence among children in 2007–08 is estimated at 10.4%. This downward trend is confirmed in several series of surveys conducted on children since the mid-1990s. Overall, between 2000 and 2009, the prevalence of asthma in children decreased by 0.63 percentage points per year (CI: 0.45–0.81; $p<0.0001$) in absolute terms (that is, as a percentage of all children) (Figure 2.2).

Comparison of data from the National Health Surveys in 2001, 2004–05 and 2007–08 show that the prevalence of current asthma has declined among children ($p<0.0001$) and young adults aged 15–34 years ($p<0.0001$), but has remained relatively stable among people aged 35 years and over (Figure 2.3).

Between 2000 and 2005, there was a decrease in the prevalence of current asthma for children aged 4–6 years in the Australian Capital Territory. This was accompanied by a reduction in night cough and shortness of breath but not recent wheeze (Ponsonby et al. 2008).

International studies have also observed a decrease in the prevalence of asthma symptoms among children in countries with a history of high prevalence rates (Asher et al. 2006).



Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey (NHS) 2001, 2004–05 and 2007–08.

Figure 2.3: Prevalence of current asthma, by age and National Health Survey year

2.5 International comparisons

The prevalence of ever having had asthma and current symptoms of asthma is relatively high in Australia by international standards. Generally, international data have used the criteria of 'ever having had asthma' and 'current wheezing' for comparisons of asthma worldwide.

In 2002, the International Study of Asthma and Allergies in Childhood (ISAAC) showed that the prevalence of wheeze in the last 12 months among those aged 6–7 years ranged from 2.4–37.6%, and was highest in New Zealand, the United Kingdom, Australia, and Latin America (Lai et al. 2009; Pearce et al. 2007–supplementary web-tables).

In Australia, the ISAAC study found that the prevalence of current wheeze had decreased by 0.8% per year between 1993 and 2002. Singapore (0.80% per year) and South Korea (1.71% per year in Seoul) also reported decreases in the prevalence of current wheeze between 1993 and 2002, but increases were observed in the Eastern Mediterranean region (0.79% per year), Spain, the United Kingdom (0.50% per year) and Canada (0.47% per year) (Pearce et al. 2007–supplementary web-tables).

A recent systematic review that examined ISAAC and non-ISAAC studies reported that overall, Australia had a higher prevalence of current wheeze compared with the United Kingdom, but the rate of increase in Australia was significantly lower than the United Kingdom (Patel et al. 2008).

The ISAAC studies have shown high prevalence of current wheeze and ever having had asthma in the Oceania region, North America and among English-speaking countries. Most countries that reported a low prevalence of ever having had asthma reported a higher prevalence of current wheeze, suggesting that these countries may experience an increase in asthma diagnoses in the future. Furthermore, the prevalence of severe episodes of wheezing was reported to be higher in English-speaking countries and Latin America than in Africa, the Indian subcontinent and the Eastern Mediterranean (Lai et al. 2009).

Generally speaking, the ISAAC studies have demonstrated a trend towards a decline in the prevalence of current wheezing in English-speaking countries. However, overall the prevalence of ever having had asthma and current wheezing remains higher in English-speaking countries compared with non-English-speaking countries.

2.6 Population subgroups

2.6.1 Age and sex

Prevalence of ever-diagnosed asthma

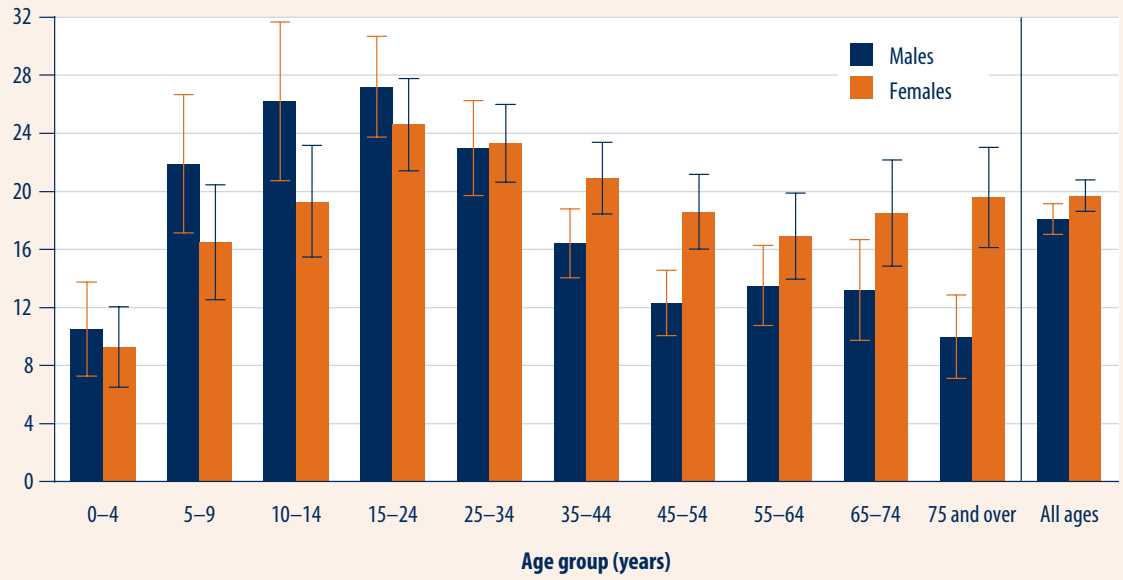
In the 2007–08 NHS, the overall estimated prevalence of ever having been diagnosed with asthma was similar in females (19.7%, CI: 18.7–20.6%) and males (18.1%, CI: 17.1–19.1%). However, among children (aged 5–14 years) the prevalence was higher in males ($p=0.0001$) and among adults the prevalence was higher in females, particularly among adults aged 75 years and over ($p<0.0001$) (Figure 2.4).

Prevalence of current asthma

In 2007–08, the median age of people with current asthma, defined as those who reported ever being diagnosed with asthma and responding 'yes' to 'have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?', was 37 years (excluding those aged less than 5 years).

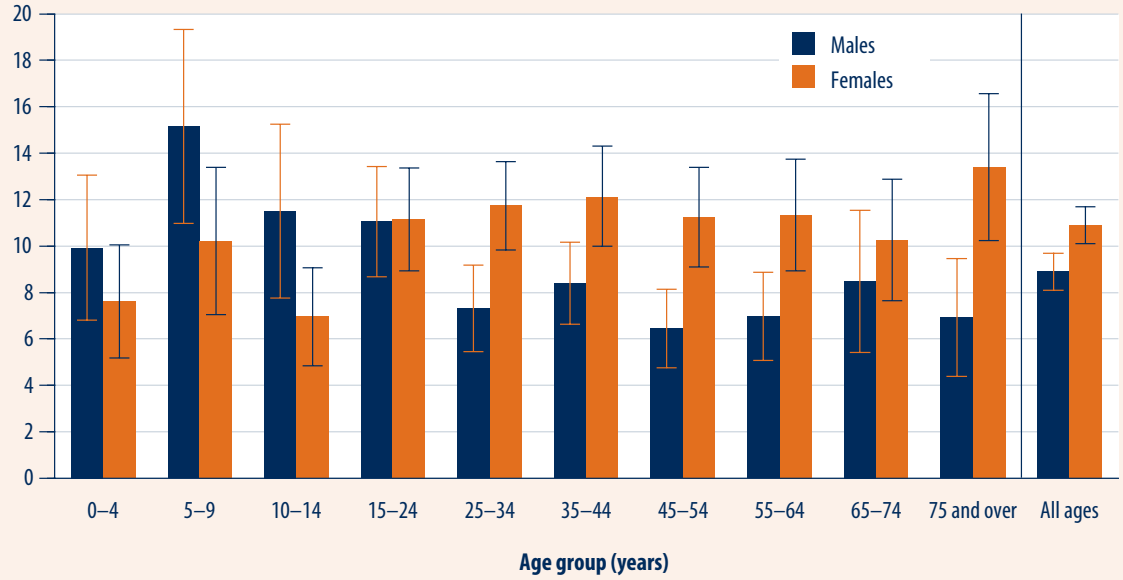
Overall, females had a significantly higher prevalence of current asthma than males (10.9% compared with 8.9%, $p<0.0001$) in 2007–08.

Among children (aged 0–14 years), the prevalence was higher for males than females, but among adults (aged 15 years and over), current asthma was more prevalent in females than males. Among males, the highest prevalence was in those aged 5–9 years (15.1%, CI: 11.0–19.3%), while among females it was highest in those aged 75 years and over (13.4%, CI: 10.3–16.5%) (Figure 2.5).



Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 2.4: Prevalence of ever-diagnosed asthma, by age and sex, 2007–08



Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 2.5: Prevalence of current asthma, by age and sex, 2007–08

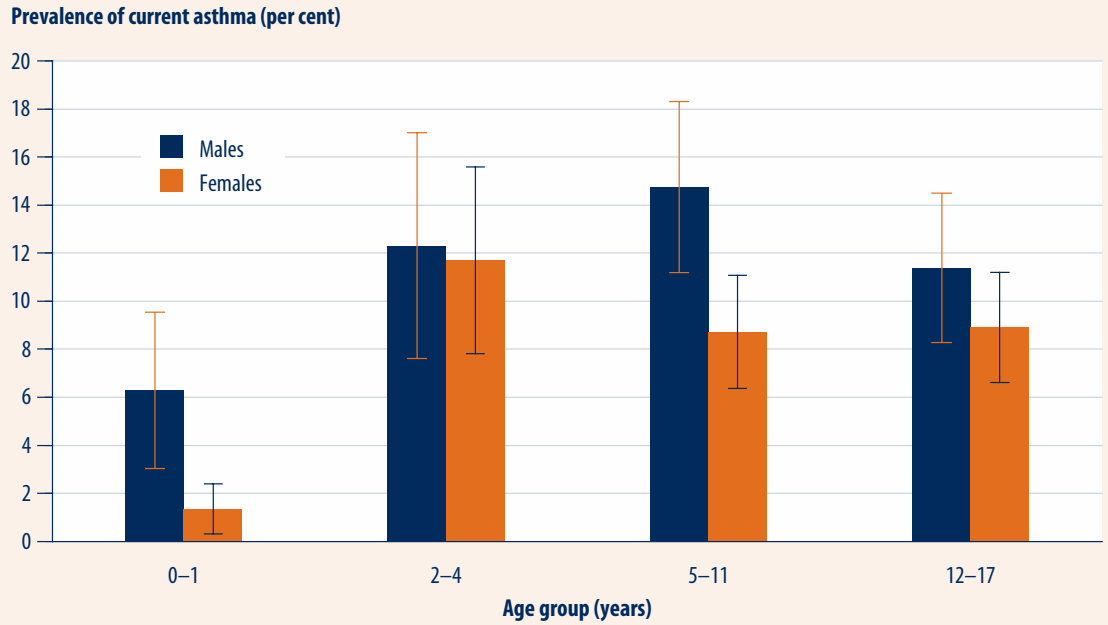
Prevalence of current asthma in children

The prevalence of current asthma was higher among boys than girls aged 0–17 years, with the highest being among boys of primary school age (5–11 years) (Figure 2.6). In this age group, the prevalence of current asthma was 14.8% (CI: 11.2–18.3%) in boys compared with 8.7% (CI: 6.4–11.1%) in girls.

The prevalence of current asthma, using the previous definition of current asthma as those who reported ever being diagnosed with asthma and responded 'yes' to 'Do you still get asthma?' to allow for trend comparisons, among children aged 0–17 years declined significantly from 14.0% in 2001 to 11.3% in 2004–05 and to 10.0% in 2007–08 ($p<0.0001$).

The Longitudinal Study of Australian Children confirmed that boys aged 8–9 years had a significantly higher prevalence of current asthma (20.3%, CI: 18.3–22.3%) compared with girls of the same age (13.3%, CI: 11.6–15.0%). Similarly, boys aged 4–5 years had a slightly higher prevalence of current asthma (16.9%, CI: 15.2–18.7%) than girls of this age (13.8%, CI: 12.1–15.5%), although this was not statistically significant ($p=0.06$).

Between July 2002 and July 2007, the prevalence of asthma among children in South Australia was reported to be significantly higher among males aged 2–15 years, compared with females (Population Research and Outcomes Studies Unit 2008). A similar pattern was reported among South Australian males aged 5–15 years compared with females (Collins et al. 2008).

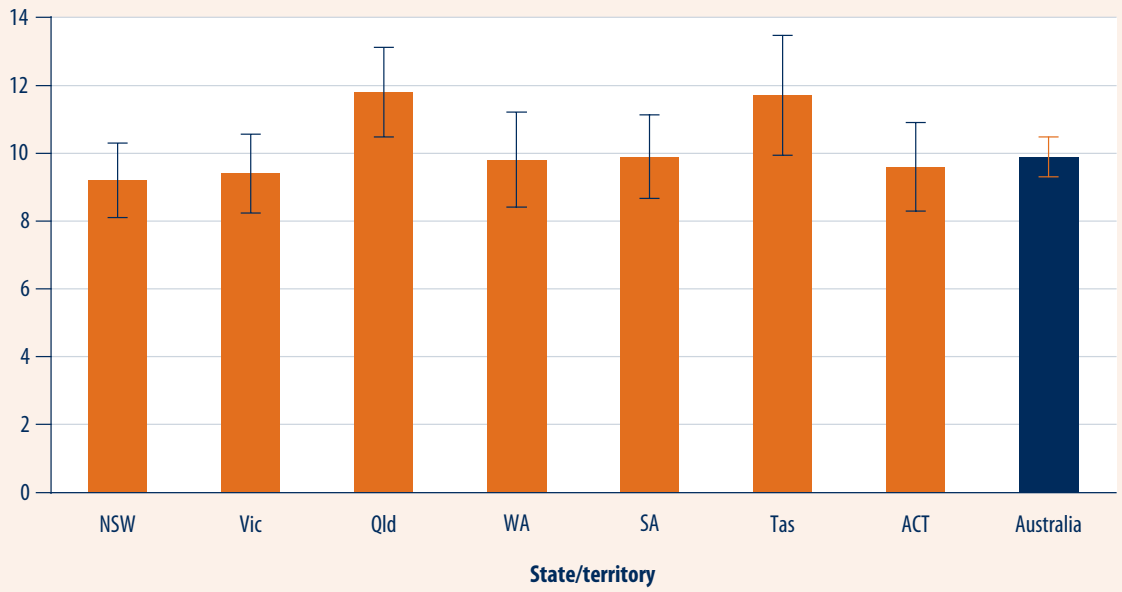


Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 2.6: Prevalence of current asthma in children, by age and sex, 2007–08

2.6.2 States and territories

Estimates of the prevalence of current asthma in 2007–08 varied between 9.2% (CI: 8.1–10.2%) in New South Wales and 11.8% (CI: 10.5–13.1%) in Queensland (Figure 2.7). The prevalence of current asthma did not differ significantly from the national average (9.9%, CI: 9.4–10.5%) in any of the states or the Australian Capital Territory.



Notes

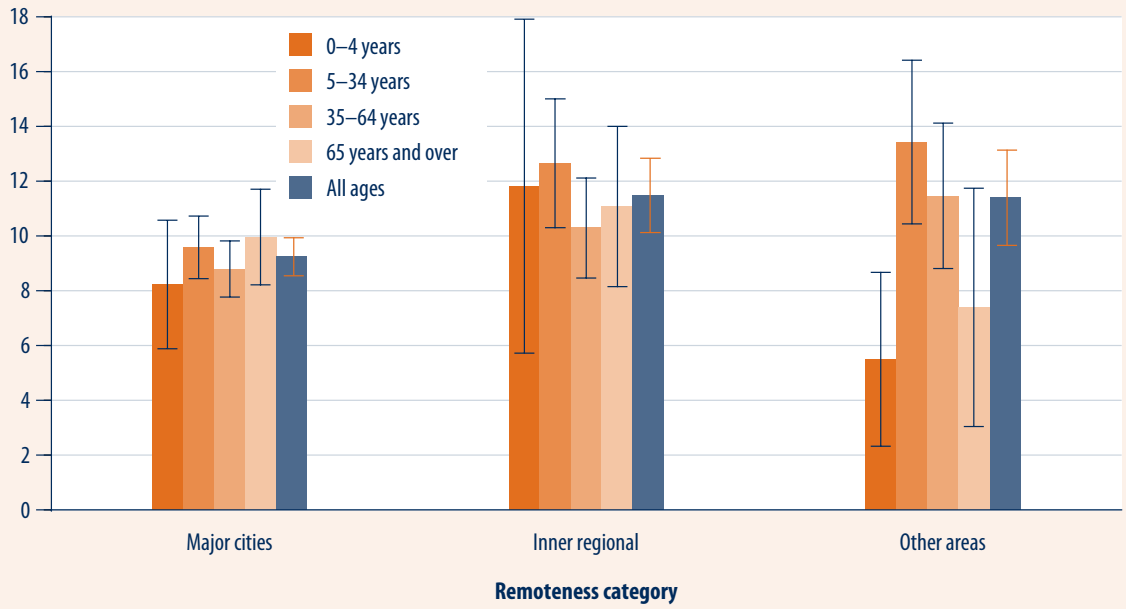
1. Age-standardised to the Australian population as at June 2001.
2. The Northern Territory is excluded as the numbers are too small to produce reliable estimates, but it does contribute to the national estimate.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 2.7: Prevalence of current asthma, by state and territory, all ages, 2007–08

2.6.3 Cities, regions and remote areas

In 2007–08, there were approximately 13.6 million people living in *Major cities* of Australia, about 4.6 million people living in *Inner regional* Australia and the remaining 2.4 million people were residing in *Other* areas of Australia. The prevalence of current asthma among all ages was significantly higher in people living in *Inner regional* areas (11.5%, CI: 10.2–12.8%) compared with those living in *Major cities* (9.2%, CI: 8.6–9.9%) (Figure 2.8).



Notes
1. Age-standardised to the Australian population as at June 2001.
2. Other areas includes Outer regional and Remote categories of remoteness. No data available for Very remote areas.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 2.8: Prevalence of current asthma, by age and geographic remoteness, 2007–08

A recent adult population health survey in New South Wales reported variations in the prevalence of current asthma among different areas of the state. In 2009, the highest rate of current asthma was seen in the Greater Western area (16.5%, CI: 13.6–19.3%), while northern Sydney and the Central Coast had the lowest rate (9.3%, CI: 7.4–11.2%). Adult females living in rural health areas of New South Wales had a higher prevalence of current asthma (15.2%, CI: 13.5–16.9%) compared with adult females living in urban health areas (11.3%, CI: 10.0–12.6). This difference was not seen among adult males (Centre for Epidemiology and Research 2010b).

2.6.4 Aboriginal and Torres Strait Islander Australians

In 2004–05, the National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) estimated that the overall prevalence of current asthma was higher among Indigenous Australians (16.5%, CI: 14.9–18.1%) than non-Indigenous Australians (10.2%, CI: 9.7–10.7%) (ACAM 2008a). The difference in prevalence of current asthma was greatest among Indigenous adults aged 18 years and over (17.5%, CI: 15.4–19.5%) compared with non-Indigenous adults (9.8%, CI: 9.3–10.4%). On the other hand, among children the prevalence rates were similar in Indigenous children (13.5%, CI: 11.9–15.1%) and non-Indigenous children (11.2%, CI: 10.1–12.3%) (Table 2.6) (ACAM 2008a).

Several other surveys have measured the prevalence of asthma in Indigenous children (Table 2.6). These surveys used various definitions and age groups and were conducted in a variety of settings, which makes it difficult to draw confident conclusions about the prevalence of asthma in Indigenous children. However, most estimates are at least as high if not higher (ABS 2006; Zubrick et al. 2004) than those observed in non-Indigenous children. The Longitudinal Study of Indigenous Children (LSIC) provides the most recent estimate of parent-reported or carer-reported ever having asthma among Indigenous children aged 6 months to 4 years at 12.6% (CI: 12.6–12.7%). It should be noted that asthma among very young children can be difficult to diagnose. See Appendix 1, Section A1.7.2 for detailed information about LSIC.

Table 2.6: Prevalence of current or ever asthma among Aboriginal and Torres Strait Islander children and adults, Australia, 1998–2009

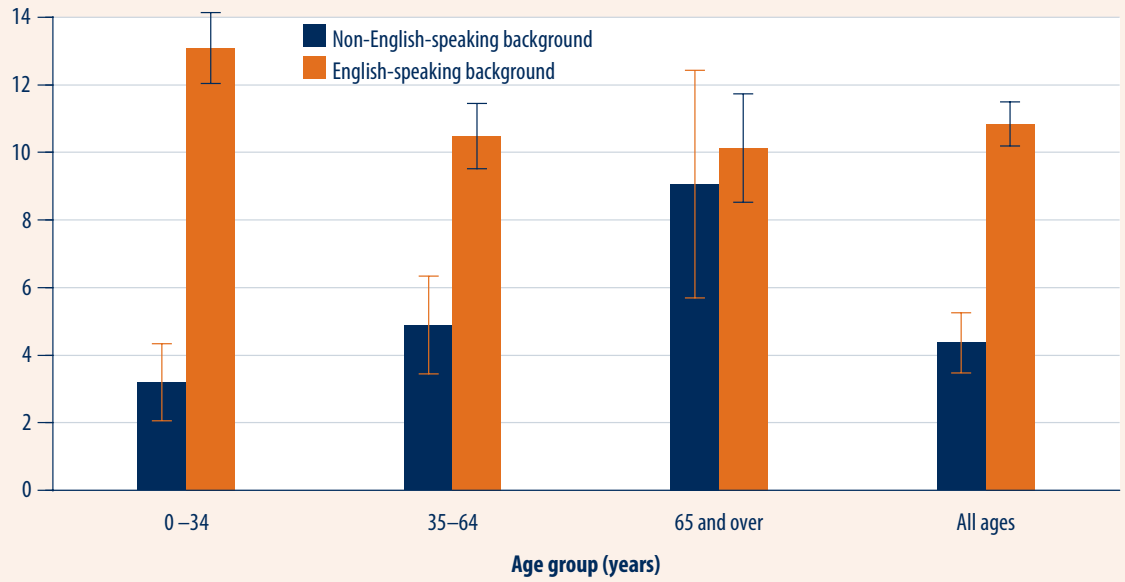
			Indigenous		Non-Indigenous	
Population/study	Year	Age range	No. in survey	Rate (95% CI)	No. in survey	Rate (95% CI)
ALL AGES						
Ever diagnosed by doctor or nurse and still have asthma?						
Australia (1)	2004–05	All ages	10,439	16.5% (14.9–18.1)	25,511	10.2% (9.7–10.7)
CHILDREN						
Ever diagnosed by doctor or nurse and still have asthma?						
Australia (1)	2004–05	0–17 years	4,682	13.5% (11.9–15.1)	6,241	11.2% (10.1–12.3)
Has (child) ever had asthma?						
Australia (2)	2008–09	6mths–4 years	1,679	12.6% (11.1–14.3)	n.a.	n.a.
Does your child have asthma?						
Victoria, School Entrant Health Questionnaire (3)	1998–2004	4–6 years	6,657	26.5% (25.4–27.6)	363,207	20.0% (19.9–20.1)
ADULTS						
Ever diagnosed by doctor or nurse and still have asthma?						
Australia (1)	2004–05	18 years and over	5,757	17.5% (15.4–19.5)	19,270	9.8% (9.3–10.4)

n.a. = Not available.
CI = Confidence interval.
Sources:
(1) ACAM analysis of ABS National Aboriginal and Torres Strait Islander Health Survey 2004–05.
(2) Longitudinal Study of Indigenous Children (LSIC) 2009.
(3) Griffin et al. 2006.

2.6.5 Country of birth

In 2007–08, people from non-English-speaking backgrounds had a significantly lower prevalence of current asthma than other Australians, especially among those aged 0–34 years and 35–64 years (Figure 2.9). Compared with people from non-English-speaking backgrounds, the prevalence of current asthma among people from English-speaking backgrounds was 4 times higher in those aged less than 35 years ($p<0.0001$), and 2 times higher in those aged 35–64 years ($p<0.0001$). There was no difference in the prevalence of asthma by English-speaking background for people aged 65 years and over ($p=0.5$).

Data reported from South Australia between July 2002 and July 2007 show that the prevalence of current asthma in children aged 2–15 years was significantly higher among children born in Australia compared with those born elsewhere (Population Research and Outcomes Studies Unit 2008). The same pattern was observed when considering languages other than English spoken at home, which may also reflect country of birth. Among children who only spoke English at home, the prevalence of current asthma was higher (17.4%) than among children who spoke a language other than English (11.9%) (Population Research and Outcomes Studies Unit 2008).



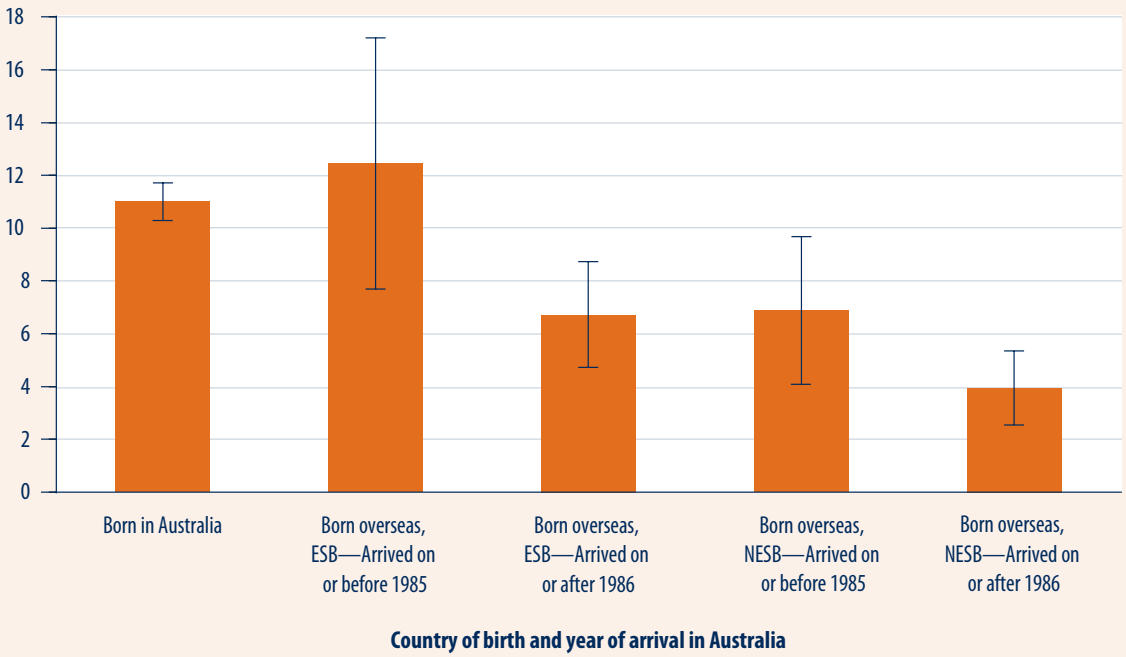
Notes

1. Age-standardised to the Australian population as at June 2001.
2. See Glossary for definition of English-speaking and non-English-speaking backgrounds.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 2.9: Prevalence of current asthma, by age group and country of birth, 2007–08

There was no difference in the prevalence of asthma between those born in Australia and those born in other English-speaking countries who migrated to Australia in or before 1985 (2007–08 National Health Survey) (Figure 2.10). On the other hand, people who were born in Australia had a significantly higher prevalence of asthma than English-speaking migrants who arrived in Australia after 1985 ($p<0.001$). Among people born overseas, the prevalence of asthma was significantly higher among those who had migrated to Australia in or before 1985 compared with those who arrived in 1986 or later, regardless of whether they were born in an English-speaking or non-English-speaking country ($p<0.0001$).



Notes

1. ESB – English-speaking background, NESB – Non-English-speaking background
2. See Glossary for definition of English-speaking and non-English-speaking backgrounds.

Source: ACAM analysis of ABS National Health Survey 2007–08.

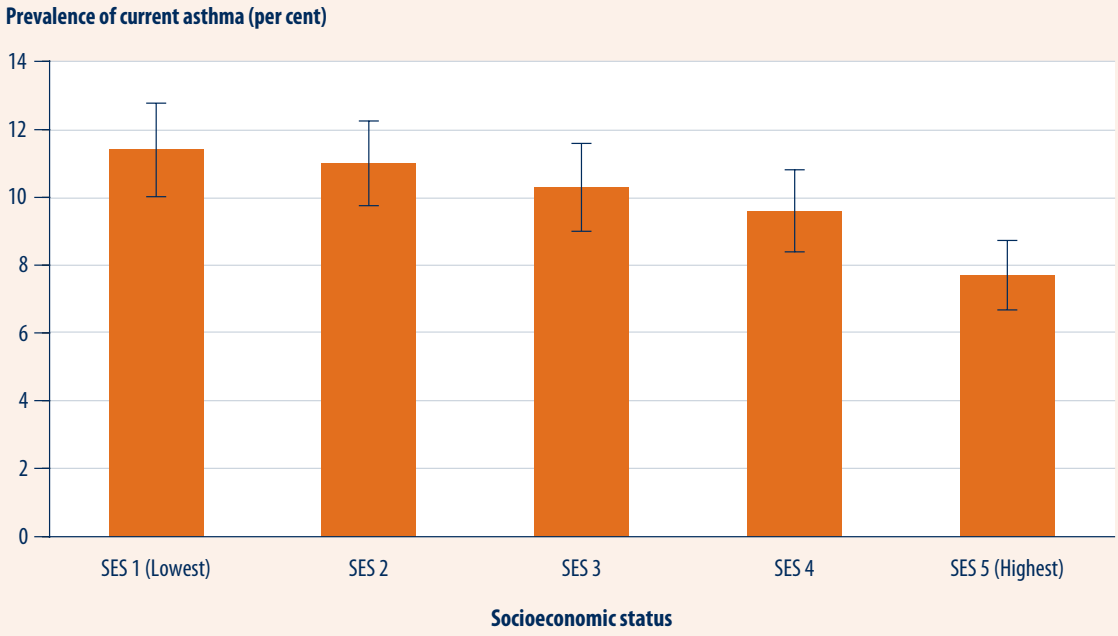
Figure 2.10: Prevalence of current asthma by country of birth and year of arrival in Australia, 2007–08

2.6.6 Socioeconomic status

In 2007–08, the prevalence of current asthma was significantly higher among people living in areas of lower socioeconomic status compared with those in areas of higher socioeconomic status ($p<0.0001$, Figure 2.11). The trend did not differ between males and females ($p=1.0$).

A South Australian study found that asthma was associated with lower socioeconomic status among adults aged 18–64 years. The authors of the study reported that females with low income had a higher prevalence of current asthma than those with higher income, while low education and not being in the paid labour force was associated with a higher prevalence of current asthma among men (Chittleborough et al. 2010).

A Western Australian study reported that children who had lived in a chronic low-income household since birth had a 2-fold increased risk of having asthma at age 14 years (Kozyrskyj et al. 2010).



SES = Socioeconomic status (see Appendix 1.13.3).
Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 2.11: Prevalence of current asthma by socioeconomic status, 2007–08

Analyses comparing the 2004–05 and 2007–08 National Health Surveys show an increase in the disparity and a significant difference in asthma prevalence between those living in areas of lowest socioeconomic status and those living in areas of highest socioeconomic status. The difference in the prevalence of asthma between the lowest and highest socioeconomic quintile (socioeconomic status 1 and 5) was 3.7 percentage points in 2007–08. This gap had widened since the 2004–05 survey, when the difference in prevalence between the lowest and the highest socioeconomic quintile of the population was 2.2 percentage points. These results support theories that asthma is shifting from a condition more prevalent among the rich to one more strongly associated with poverty.

2.7 Comorbid conditions among people with asthma

Asthma commonly coexists with other chronic conditions. The presence of one or more comorbid conditions in people with current asthma is likely to compromise their quality of life. Furthermore, the presence of comorbid conditions may complicate the management of asthma. This section examines the prevalence of comorbid long-term conditions among people with and without asthma using data from the 2007–08 National Health Survey (NHS).

It was suggested that people with asthma are more likely to report diabetes, arthritis, heart disease, stroke, cancer and osteoporosis (Adams et al. 2006). Having both asthma and another chronic condition has also been associated with greater health-care use (Gershon et al. 2010) and worse quality of life, especially among those aged 35 years and over (Adams et al. 2006). A higher prevalence of mental illness has also been reported among people with asthma compared to those without asthma, particularly among those aged 18–34 years (Zhang et al. 2009).

From the 2007–08 NHS, the most common respiratory comorbid condition among people with asthma was sinusitis or rhinitis (40.5%). The prevalence of sinusitis or rhinitis among people without asthma was less than half of this (17.7%) (Table 2.7). The association with asthma was strongest in those aged 0–34 years, among whom people with asthma were 2.6 times (CI: 2.2–3.1%) more likely to have sinusitis or rhinitis than people without asthma.

People with asthma were 5.6 times (CI: 3.9–8.1%) more likely to also report emphysema or chronic bronchitis (prevalence 9.1%) than people without asthma (prevalence 1.6%). Among those aged 35–64 years, the difference was even greater. In this age group, people with asthma were 6.6 times (CI: 3.8–11.4%) more likely to report emphysema or chronic bronchitis than those without asthma. However, there is considerable overlap in primary care in the assignment of these diagnostic labels (Gibson et al. 2010; Price et al. 2010).

In terms of non-respiratory comorbidities, overall, people with asthma were 2.0 times (CI: 1.7–2.3%) more likely to also report mental and behavioural disorders than people without asthma. The association was strongest in those aged 35–64 years, among whom people with current asthma were 2.2 times more likely to report mental and behavioural disorders than people without current asthma.

There was no difference in the prevalence of diabetes mellitus among people with and without asthma in 2007–08.

Among those aged 0–34 years, people with current asthma were 2.2 times as likely to report arthritis or osteoporosis as those without asthma. The strength of this association decreased with increasing age. This relationship was observed in previous studies. It was shown that people who are hospitalised with asthma or die from asthma are more likely to have also had musculoskeletal problems reported (ACAM 2006). It was hypothesised that this may be related to steroid-induced osteoporosis associated with the use of systemic corticosteroids to manage the asthma (Walsh et al. 2002).

Table 2.7: The prevalence and rate ratios associated with selected long-term comorbidities among people with and without asthma by age group, 2007–08

Age group	Comorbidity	Current asthma Per cent (95% CI)	No asthma Per cent (95% CI)	Rate ratio (95%CI)
0–34 years	Rhinitis and sinusitis	37.0 (33.0–41.0)	14.3 (13.3–15.4)	2.6 (2.2–3.1)
	COPD	4.9 (3.2–6.6)	0.9 (0.6–1.1)	5.8 (2.8–12.0)
	Diabetes mellitus	0.3 (0.2–0.4)	0.3 (0.2–0.5)	1.0 (0.5–1.8)
	Heart, stroke or vascular disease	*0.5 (0.0–1.0)	*0.5 (0.2–0.7)	1.0 (0.3–3.3)
	Arthritis and osteoporosis	4.2 (2.7–5.7)	1.9 (1.4–2.3)	2.2 (1.3–3.9)
	Mental and behavioural disorders	13.6 (10.8–16.3)	7.6 (6.8–8.3)	1.8 (1.4–2.4)
35–64 years	Rhinitis and sinusitis	47.7 (43.1–52.3)	22.1 (20.7–23.5)	2.2 (1.9–2.5)
	COPD	10.0 (7.5–12.4)	1.5 (1.2–1.8)	6.6 (3.8–11.4)
	Diabetes mellitus	4.9 (4.3–5.5)	4.6 (4.0–5.2)	1.1 (0.9–1.3)
	Heart, stroke or vascular disease	8.6 (5.9–11.3)	4.4 (3.8–5.0)	2.0 (1.3–3.0)
	Arthritis and osteoporosis	31.8 (28.3–35.4)	19.8 (18.6–20.9)	1.6 (1.4–1.9)
	Mental and behavioural disorders	23.6 (19.6–27.5)	10.8 (9.9–11.7)	2.2 (1.7–2.8)
65 years and over	Rhinitis and sinusitis	32.1 (25.7–38.6)	17.3 (15.4–19.1)	1.9 (1.4–2.5)
	COPD	22.5 (15.2–29.7)	4.9 (3.7–6.1)	4.6 (2.4–8.7)
	Diabetes mellitus	13.8 (12.0–15.5)	13.9 (12.0–15.8)	1.0 (0.8–1.2)
	Heart, stroke or vascular disease	34.9 (27.6–42.2)	22.9 (20.9–24.9)	1.5 (1.2–2.0)
	Arthritis and osteoporosis	72.3 (64.7–79.9)	52.3 (49.9–54.8)	1.4 (1.2–1.6)
	Mental and behavioural disorders	13.5 (8.7–18.3)	7.7 (6.4–9.1)	1.7 (1.1–2.8)
All ages	Rhinitis and sinusitis	40.5 (37.7–43.3)	17.7 (16.9–18.4)	2.3 (2.1–2.5)
	COPD	9.1 (7.5–10.6)	1.6 (1.4–1.8)	5.6 (3.9–8.1)
	Diabetes mellitus	3.8 (3.4–4.1)	3.7 (3.3–4.0)	1.0 (0.9–1.2)
	Heart, stroke or vascular disease	7.9 (6.5–9.3)	4.8 (4.4–5.1)	1.7 (1.3–2.1)
	Arthritis and osteoporosis	23.3 (21.5–25.2)	15.1 (14.5–15.7)	1.5 (1.4–1.7)
	Mental and behavioural disorders	17.4 (15.3–19.5)	8.8 (8.3–9.4)	2.0 (1.7–2.3)

* Estimate has a relative standard error greater than 25% and should be interpreted with caution.

Notes

1. Age-standardised to the 2001 Australian Population. Age-standardised rates shown except for Diabetes mellitus in 0–34 year olds where crude rates are shown.
2. Rhinitis includes infectious and allergic, sinusitis includes acute and chronic.
3. Chronic obstructive pulmonary disease (COPD) includes emphysema and bronchitis.
4. Diabetes mellitus includes Type I, Type II and Type unknown.
5. Heart, stroke and vascular diseases include ischaemic heart diseases, cerebrovascular diseases, oedema and heart failure, and diseases of the arteries, arterioles and capillaries
6. Arthritis and osteoporosis includes all types
7. Mental and behavioural disorders includes mood (affective) problems, anxiety-related problems, and behavioural and emotional problems with usual onset in childhood/adolescence.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Summary

Among children aged 0–14 years, asthma was more common in boys than girls, but among people aged 15 years and over, asthma was more common among females than males. The highest reported prevalence in children was among boys aged 5–11 years and in adults was among females aged 75 years and over.

Since 2001, the prevalence of asthma in Australia has decreased in people aged less than 35 years but has remained unchanged among people aged 35 years and over.

There is also evidence of an increase in socioeconomic disparity in the prevalence of asthma.

People from English-speaking backgrounds had a higher prevalence of asthma than those from a non-English-speaking background, particularly among those aged less than 65 years.

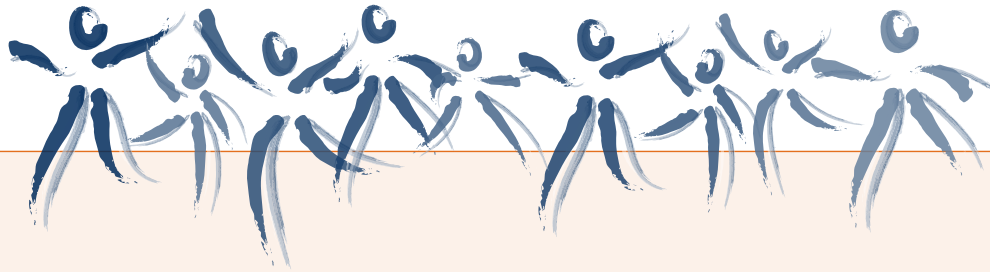
None of the states or territories had prevalence rates for asthma that differed from the national average.

The proportion of people reporting diagnoses of emphysema or chronic bronchitis was 5.8 times higher and the proportion of people with sinusitis or rhinitis was 2.3 times higher among people with asthma compared with people without asthma.

There was also a higher prevalence of arthritis or osteoporosis and of mental and behavioural disorders among people with current asthma compared with people without asthma.

The presence of one or more comorbid conditions in people with current asthma is likely to compromise their quality of life and may complicate the management of the disease.

3. Asthma control and quality of life



Key points

- Poor asthma control (frequent symptoms and asthma exacerbations) is a common problem in both adults and children.
- Overall, levels of asthma symptoms and frequency of dispensing reliever medication in the Australian community are higher than is consistent with good asthma control.
- People with asthma rate their health worse than do people without the condition.
- Asthma is associated with poorer quality of life.
- Most of the impact of asthma is on physical functioning and on the person's social and work life.
- People with current asthma are significantly more likely to take days off work, school or study than people without current asthma.
- Australians with asthma report worse psychological health than those without asthma and the difference is more pronounced in females.

Introduction

This chapter presents information on asthma control in the Australian population, specifically the frequency and severity of asthma symptoms, sleep disturbance attributed to asthma, the use of short-acting beta-agonist medication and health-related quality of life (HRQoL). Data are presented from the Australian Bureau of Statistics (ABS) National Health Survey, state health surveys, other population studies conducted throughout Australia and the Pharmaceutical Benefits Scheme (PBS). Comparisons are made (where available and applicable) among people with and without asthma, and the impact of asthma on overall social, emotional and physical wellbeing is described.

Clinicians monitor markers of asthma control to guide management and changes in medication. The term 'well-controlled asthma' is used when symptoms are infrequent, lung function is normal or close to normal, asthma does not interfere with the patient's usual activities and there are few, if any, exacerbations. Well-controlled asthma indicates that a patient's disease is mild (able to be well-controlled with minimal or no maintenance therapy) or is well managed, whereas poor asthma control may indicate severe disease or poor management.

Knowledge of the overall level of asthma control in the population provides some information on the effectiveness of the management of asthma in the community and the need for further efforts in improving asthma management.

Traditional measures of disease impact, such as prevalence and mortality rates, are important but are of limited use in understanding the extent of the impact of disease. 'Health-related quality of life', or HRQoL, is a term often used to describe an individual's perception of how a disease or condition affects their physical, psychological (emotional) and social wellbeing. This can be used to measure the impact of asthma on a person's health and everyday functioning. Generic measures of quality of life are frequently used in health surveys to evaluate the overall impact of a person's health status on their health and everyday functioning.

Among people with asthma, disease severity, the level of asthma control and the impact of the disease on HRQoL are interrelated. People with severe asthma can be expected, on average, to have worse outcomes and, hence, worse HRQoL than people with less severe disease. During periods of poor asthma control, people with asthma report poorer HRQoL (Vollmer et al. 1999).

A number of aspects of the physical impact of disease and its effect on social functioning or role performance can also be considered as markers of asthma control. These include sleep disturbance, reduced activity days, restricted physical activity, reduced functioning ability and days lost from work or school. The frequency with which short-acting bronchodilator ('reliever') medication is required is an indicator of the level of asthma control.

Asthma control has a direct impact on measures of asthma-specific HRQoL, and identifying the aspects of asthma control that explain variations in these measures may assist in targeting interventions to improve HRQoL (King et al. 2009).

Objective measures of asthma control include lung function and airway inflammation testing. However, these measures are not the focus of this chapter.

The frequency of exacerbations and short-term episodes of loss of control are also key components of the measurement of asthma control and have an important impact on HRQoL. Data on exacerbations are dealt with in the chapter on use of health-care services (see Chapter 5).

A comprehensive overview of the evaluation of asthma control and related endpoints in individuals and in clinical trials was recently published (Reddel et al. 2009). Although, the use of the terms 'control' and 'severity' is not consistent in all publications in this field, the present publication conforms to the nomenclature outlined in Reddel et al. 2009.

3.1 Asthma control

This section presents data on indicators of asthma control including the frequency and severity of day-time and night-time symptoms and the frequency of use of bronchodilator medications.

3.1.1 Symptom frequency and severity

The International Study of Asthma and Allergies in Childhood (ISAAC) reported that 4.9% of children worldwide had severe asthma, with estimates ranging from 3.2% in Asia-Pacific and Northern and Eastern Europe to 9.5% in Oceania (Lai et al. 2009). In this study, patients with severe asthma were defined as those with current wheeze who had ≥4 attacks of wheeze, or ≥1 night per week sleep disturbance from wheeze, or wheeze affecting speech, in the last 12 months.

The Australian centre in the ISAAC study reported a slight reduction in the prevalence of symptoms of severe asthma among 6–7 year old children between 1993 and 2002. Decreases in night cough (0.43% per year) and also a reduction in the proportion of children who reported more than 4 attacks of wheezing in the previous 12 months (0.32%) was observed (Pearce et al. 2007–supplementary web-tables).

It cannot be determined whether this apparent reduction in symptoms of severe asthma between 1993 and 2002 can be attributed to better management of the condition (both at home and in the primary care setting) or a decrease in the prevalence of severe asthma during this time.

The Tasmanian Longitudinal Health Study (TAHS) found that, in a general population sample of 1,741 adults, 4.3% had symptoms of asthma in the past 12 months but not in the last month, 4.2% had symptoms in the last month (less than once a week), 2.4% had symptoms once a week while 1.2% had symptoms of asthma daily (Matheson et al. 2010).

Among a representative sample of children (*n*=461) attending general practitioners (GPs) for the management of asthma in 2008, 72.7% had 'infrequent' asthma (exacerbations 6–8 weeks or more apart) and 2.6% had 'persistent' asthma (symptoms of asthma most days). Among adults (*n*=371) with asthma attending a GP, more than one-third (39.9%) had 'very mild' (intermittent) asthma and less than one-third (32.1%) were described as having 'mild' asthma, while 22.9% had 'moderate' asthma and only 5.1% had 'severe' asthma (AIHW: Britt et al. 2009).

The frequency of asthma symptoms was measured in a number of national, state and local population-based surveys (Table 3.1 and 3.2). In the nationally representative Longitudinal Study of Australian Children (LSAC), more than half (52%) the children aged 8–9 years with current asthma had experienced one or more episodes of wheezing that lasted for more than a week in the last 12 months. Similarly, 66% of children aged 4–5 years with current asthma had experienced the same frequency of wheezing in the last 12 months. Approximately, 17% of all children with current asthma aged 4–5 years experienced four or more episodes of wheezing that lasted for a week or more in the last 12 months (Table 3.1).

Table 3.1: Symptom frequency among people with current asthma, 2008–2009

Population/study	Age range	Response	Rates	(95% CI)
ADULTS				
During the past 12 months, did you have any symptoms of asthma?				
South Australia, 2009 (1)	18 years and over	No	11.8%	(9.7–14.4)
		Yes	88.1%	(85.5–90.3)
			(*n*=700)	
CHILDREN				
In the last 12 months, how many times has your child had wheezing that lasted for a week or more?				
Australia, 2008 (2)	4–5 years	None	34.1	(30.0–38.2)
		Once	20.3	(16.7–24.0)
		Twice	17.7	(14.4–21.1)
		3 times	10.4	(7.7–13.1)
		4 times or more	17.4	(14.2–20.7)
			(*n*=630)	
Australia, 2008 (2)	8–9 years	None	47.7	(43.6–51.8)
		Once	20.8	(17.5–24.2)
		Twice	15.0	(11.8–18.3)
		3 times	7.0	(4.9–9.0)
		4 times or more	9.5	(6.9–12.1)
			(*n*=697)	
During the past 12 months, did your child have any symptoms of asthma?				
Victoria, 2009 (3)	1–12 years	No	37.9%	(33.9–41.9)
		Yes	62.1%	(58.1–66.1)
			(*n*≈5,000)	
South Australia, 2009 (1)	2–17 years	No	8.6%	(5.5–13.4)
		Yes	91.4%	(86.6–94.5)
			(*n*=198)	

CI = Confidence interval.
n = Number.
Note: The definition for current asthma was: doctor diagnosis of asthma plus symptoms of asthma in the last 12 months for the South Australian Survey, Longitudinal Study of Australian Children, Victorian Child Health and Wellbeing Survey.
Sources:
(1) South Australian Monitoring and Surveillance System (SAMSS), Department of Health, Government of South Australia 2009.
(2) ACAM analysis of LSAC, Wave 3, 2008.
(3) Victorian Child Health and Wellbeing Survey 2009. Unpublished data.

Among children from South Australia aged 4–5 years who reported ever having wheeze in their life, nearly half (46.8%) the children reported having 1–3 wheezing episodes in the previous 12 months, while 6.1% reported more than 12 wheezing episodes in the past year (Table 3.2).

Table 3.2: Symptom frequency among children who have ever had wheeze, 2006

Study	Age range	Response	Rates	(95% CI)
How many attacks of wheezing has your child had in the last 12 months?				
South Australia, 2006	4–5 years	0	32.4%	(28.4–36.4)
		1–3	46.8%	(42.5–51.1)
		4–12	14.6%	(11.6–17.6)
		>12	6.1%	(4.0–8.2)
			(*n*=521)	
In the last 12 months, has wheezing ever been severe enough to limit your child's speech to only one or two words a time between breaths?				
South Australia, 2006	4–5 years	Yes	14.3%	(11.4–17.2)
			(*n*=521)	

CI = Confidence interval.
n = Number.
Source: Tai et al. 2009.

Short-acting beta-agonist use and asthma control

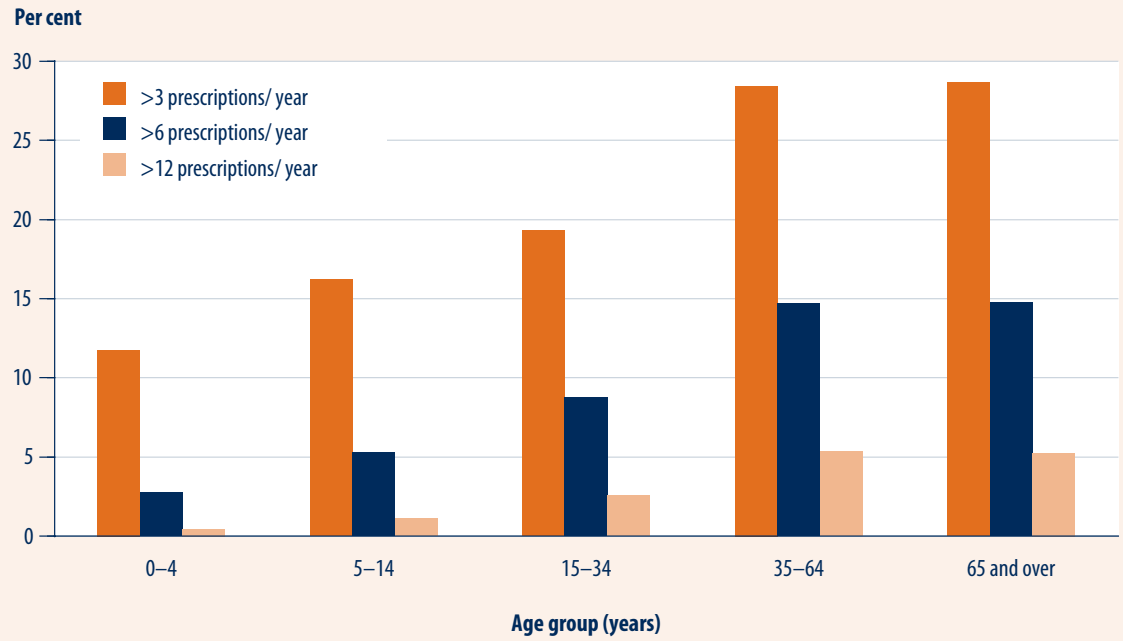
Short-acting beta-agonists (SABA) are commonly used by patients with asthma or COPD for relief of symptoms. More information on medications for asthma and COPD is found in chapters 6 and 8, respectively.

In people with asthma, frequent use of SABA is considered an indicator of poor asthma control and a prompt to review maintenance treatment. In the analysis presented here three thresholds were used as indicators of poor, very poor and extremely poor asthma control: dispensing of 3 or more, 6 or more and 12 or more SABA prescriptions per year respectively.

This analysis was performed using data from the Pharmaceutical Benefits Scheme (PBS) (see Appendix 1, A1.9.2). In this dataset, it is not possible to distinguish the dispensing of SABA for asthma from that for COPD.

Short-acting beta-agonists cost less than the PBS copayment amount and are only subsidised by the PBS when the patient is a concession cardholder. For this reason, the **data were limited to concession cardholders and those who were dispensed any inhaled or oral medication for asthma or COPD**. The proportion of concession cardholders among people dispensed any respiratory medication within the PBS is approximately 65%. The majority of SABA prescriptions are delivered by a metered dose inhaler rather than a nebuliser solution (see Figure 6.13).

Dispensing of SABA prescriptions during 2009 were examined in a cohort of subjects who held concession cards and had been dispensed any inhaled or oral medications for asthma or COPD (see list Appendix 1, A1.11). This cohort was deemed to represent those individuals with asthma or COPD who would be likely to purchase SABA medications through the PBS. In this cohort, dispensing of 3 or more, 6 or more and 12 or more SABA prescriptions per year increased with age in younger age groups, but rates were similar in the age ranges 35–64 years and 65 years and over (Figure 3.1). It cannot be determined how many were taking these medications for COPD as opposed to asthma but can assume that many of those in the older age group did have COPD (see Chapter 8).



Notes

1. The number of short-acting beta-agonist prescriptions per year (≥3, ≥6, and ≥12) are arbitrary numbers that are used to represent cut-off points for identifying poor asthma control among people who have been dispensed any inhaled or oral medications for asthma or COPD within the same year.
2. 12 prescriptions = 2 nebuliser doses or 3.4 MDI doses (3 puffs) per day, 6 prescriptions = 1 nebuliser dose or 1.7 MDI doses (2 puffs) per day, 3 prescriptions = ½ nebuliser dose or 0.8 MDI doses (1 puff) per day. These doses reflect the maximum coverage use that people could be taking.

Source: Pharmaceutical Benefits Scheme (PBS).

Figure 3.1: Proportion of concession cardholders taking any inhaled or oral medications for asthma or COPD who were dispensed 3, 6 and 12 or more short-acting beta-agonist prescriptions, by age group, 2009

3.1.2 Sleep disturbance attributed to asthma

People with severe or poorly controlled asthma may be woken from sleep with asthma symptoms. Sleep disturbance due to asthma is an important adverse outcome of the illness and is regarded as a marker of poor asthma control. Population surveys confirm that this is a common problem in both adults and children with asthma (Table 3.3). In Victoria in 2009, 20.9% of children with current asthma aged 1–12 years had been woken by wheezing or other symptoms of asthma in the last 4 weeks (Victorian Child Health and Wellbeing Survey 2009, unpublished data).

In Australia in the summer of 2003–04, an estimated 22.5% of adults and 20.4% of children with current asthma were woken due to asthma during the previous 4 weeks (Marks et al. 2007) (Table 3.3). International studies have demonstrated higher rates of sleep disturbance, varying from 36–59% in North America, Europe and Asia (Rabe et al. 2004).

Table 3.3: Proportion of people with current asthma whose sleep was disturbed by asthma, 2003–2009

Population/study	Age range	Response	Rates	(95% CI)
ADULTS				
Times woken up because of asthma in the past 4 weeks				
Australian Asthma Survey, December 2003 to January 2004 (1)	16 years and over	Not at all	77.5%	(75.4–80.6)
		Less than once per week	10.5%	(8.2–11.9)
		More than once per week	8.8%	(7.1–10.6)
		Every night	3.2%	(2.1–4.3)
			(*n*=1,006)	
Woken at night due to asthma				
SA Omnibus, 2003 (2)	15 years and over	Weekly or more often	16.2%	n.a.
CHILDREN				
Been woken by asthma or wheezing in last 4 weeks				
Victorian Child Health and Wellbeing Survey, 2009 (3)	1–12 years	No	79.1%	(74.9–83.2)
		Yes	20.9%	(16.8–25.1)
			(*n*=5,000)	
Times woken up because of asthma in the past 4 weeks				
Australian Asthma Survey, December 2003 to January 2004 (1)	0–15 years	Not at all	79.6%	(74.4–85.6)
		Less than once per week	11.9%	(7.5–16.5)
		More than once per week	7.6%	(3.9–11.3)
		Every night	0.9%	(0.0–2.2)
			(*n*=199)	

CI = Confidence interval.
n.a = Not available.
n = Number.
Sources:
(1) Marks et al. 2007.
(2) Wilson et al. 2006.
(3) 2009 Victorian Child Health and Wellbeing Survey. Unpublished data.

3.2 Asthma-related quality of life

3.2.1 Impact of asthma on self-assessed health status

The presence of asthma is associated with worse self-assessed health status (Table 3.4). In the 2007–08 National Health Survey among adults aged 15 years and over, 39% of those with current asthma rated their health as 'excellent' or 'very good', compared with 58% of those without asthma. At the other end of the scale, 25% of people with current asthma rated their health as 'fair' or 'poor' compared with only 14% of people without the condition.

Although the definitions of asthma varied, in all surveys listed in Table 3.4, the distribution of responses on self-assessed health status was shifted towards a more adverse health status among people with asthma.

Table 3.4: Self-assessed health in adults with and without current asthma, 2006–2009

Study	Age range	Response	Rate (per cent)			
			With asthma	95% CI	Without asthma	95% CI
In general, would you say your health is: excellent, very good, good, fair or poor?						
Australia, 2007–08 (1)	15 years and over	Excellent	11.7	9.7–13.8	21.4	20.6–22.3
		Very good	27.7	25.1–30.4	36.5	35.5–37.5
		Good	35.6	32.4–38.8	28.2	27.3–29.2
		Fair	16.3	14.1–18.5	10.3	9.6–11.0
		Poor	8.7	6.9–10.4	3.5	3.2–3.9
			(*n*=1,766)		(*n*=14,976)	
New South Wales, 2009 (2)	16 years and over	Excellent	13.2	10.3–16.1	20.3	19.1–21.5
		Very good	26.8	23.2–30.4	30.9	29.5–32.2
		Good	31.7	28.1–35.4	29.7	28.4–31.1
		Fair	18.4	15.6–21.3	14.1	13.1–15.1
		Poor	7.7	5.7–9.6	4.4	3.9–5.0
		Very poor	2.2	1.1–3.2	0.6	0.4–0.7
			(*n*=1,252)		(*n*=9,386)	
Western Australia, 2009 (3)	16 years and over	Excellent	13.7	9.9–17.3	20.2	18.9–21.5
		Very good	38.0	32.7–43.2	39.2	37.6–40.7
		Good	27.7	23.1–32.3	29.9	28.5–31.3
		Fair	13.3	10.2–16.5	8.0	7.2–8.8
		Poor	7.3	4.6–10.1	2.7	2.2–3.2
			(*n*=678)		(*n*=5,313)	
South Australia, 2009 (4)	16 years and over	Excellent	9.4	7.5–11.7	19.7	18.6–20.8
		Very good	29.3	26.1–32.7	38.4	37.1–39.7
		Good	31.3	28.0–34.7	28.1	26.9–29.4
		Fair	23.3	20.4–26.4	10.8	10.0–11.7
		Poor	6.7	5.2–8.8	3.0	2.6–3.5
			(*n*=741)		(*n*=5,137)	
Victoria, 2008 (5)	18 years and over	Excellent	6.4	5.2–7.8	12.2	11.7–12.8
		Very good	25.3	23.1–27.6	32.8	32.0–33.7
		Good	38.9	36.4–41.4	37.6	36.7–38.5
		Fair	20.5	18.7–22.5	14.2	13.5–14.8
		Poor	8.6	7.3–10.0	2.9	2.7–3.2
			(*n*=3,824)		(*n*=30,345)	

CI = Confidence interval.
n = Number.
Sources:
Asthma was defined as doctor diagnosis of asthma plus treatment or symptoms of asthma in the last 12 months:
(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) New South Wales Population Health Survey, (Centre for Epidemiology and Research 2006; Centre for Epidemiology and Research (NSW Department of Health) 2004, 2003).
(3) Western Australia Health and Wellbeing Surveillance System unpublished data, 2009, Health Information Centre, Department of Health, Government of Western Australia.
(4) South Australian Department of Health, South Australian Monitoring and Surveillance System (SAMSS), 2009 (unpublished data).
Asthma was defined as doctor diagnosis of asthma plus symptoms of asthma in the last 12 months:
(5) Department of Human Services, Victorian Population Health Survey 2008 (unpublished data).

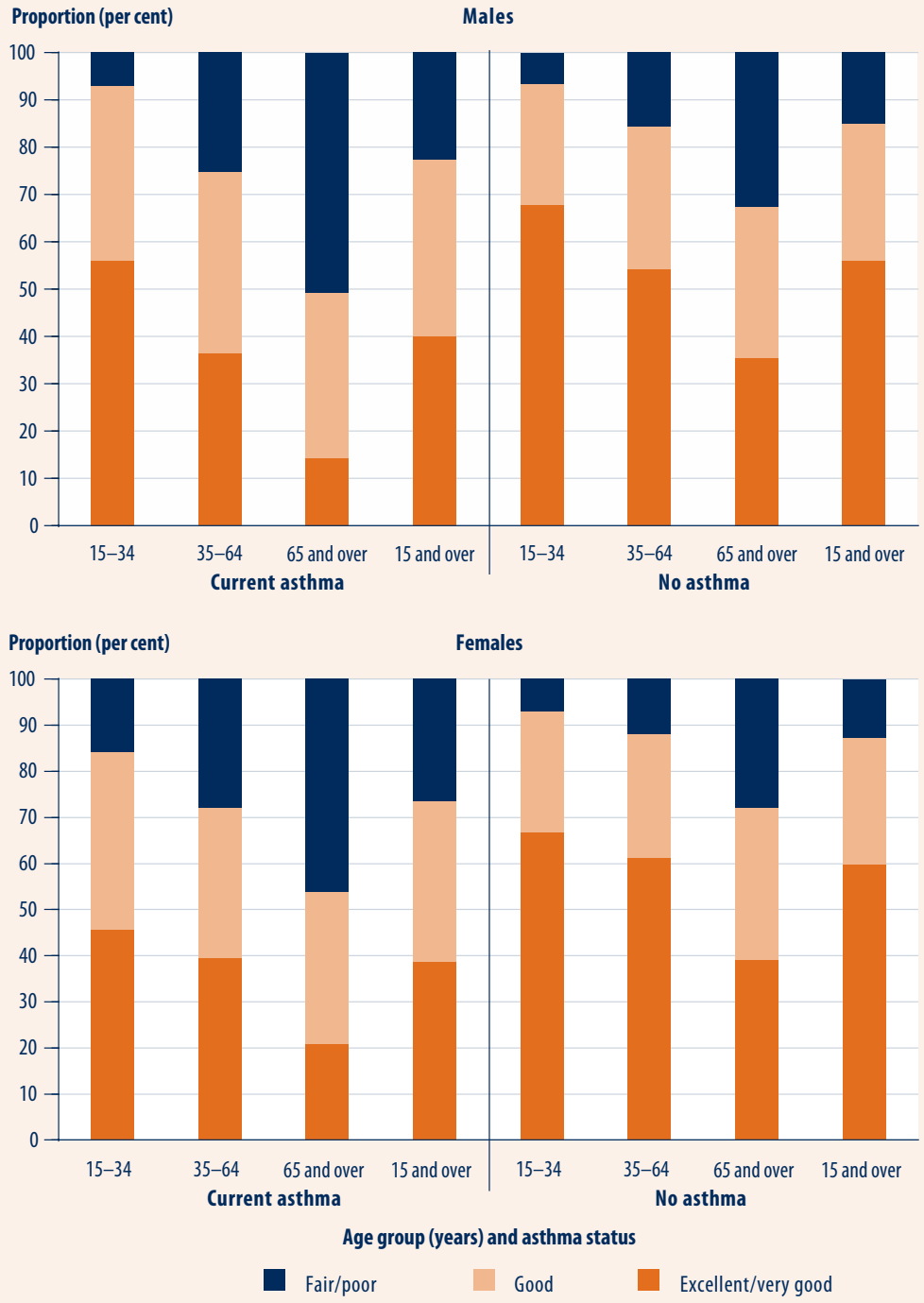
This relationship also exists among children (Table 3.5). In the Longitudinal Study of Australian Children (LSAC) in 2008, parents of 76.6% of children aged 4–5 years with asthma compared with 90.6% of children without asthma reported that their child's general health was 'excellent' or 'very good'. Furthermore, parents of 75.8% of children aged 8–9 years with asthma compared with 88.5% of children without asthma reported that their child's general health was 'excellent' or 'very good'. Similar results were found in the Victorian Child Health and Wellbeing Survey in 2009 (Table 3.5).

Table 3.5: Parent-reported health status in children with and without current asthma, 2008–2009

			Rate (per cent)			
Study	Age range	Response	With asthma	95% CI	Without asthma	95% CI
In general, would you say your child's current health is: excellent, very good, good, fair or poor?						
Australia, 2008 (1)	4–5 years	Excellent/Very good	76.6	72.7–80.6	90.6	86.9–94.4
		Good	17.4	13.8–20.9	7.8	4.2–11.4
		Fair/Poor	6.0	3.9–8.1	1.5	0.16–2.9.
			(*n*=645)		(*n*=260)	
Australia, 2008 (1)	8–9 years	Excellent/Very good	75.8	72.4–79.3	88.5	85.7–91.2
		Good	19.7	16.5–23.0	9.7	7.1–12.2
		Fair/Poor	4.4	2.7–6.1	1.9	0.7–3.1
			(*n*=716)		(*n*=606)	
Overall, how would you rate your child's health during the past 4 weeks? Excellent, very good, good, fair, poor or very poor?						
Victoria, 2009 (2)	1 to under 13 years	Excellent/ Very good	75.5	71.1–79.8	92.1	91.1–93.1
		Good	18.6	14.8–22.5	6.9	5.9–7.8
		Fair/Poor	5.9	3.3–8.5	1.0	0.7–1.4
			(*n*=552)		(*n*=4,058)	

CI = Confidence interval.
n = Number.
Sources:
Asthma was defined as doctor diagnosis of asthma plus treatment for asthma in the last 12 months:
(1) Growing Up in Australia: Longitudinal Study of Australian Children (LSAC) Wave 3, 2008.
Asthma was defined as doctor diagnosis of asthma plus symptoms of asthma in the last 12 months:
(2) Department of Human Services, 2009 Victorian Child Health and Wellbeing Survey (unpublished data).

In the 2007–08 NHS, the disparity in self-rated health status between people with and without asthma increased with increasing age among both males and females (Figure 3.2). Males with current asthma rated their health marginally better than females with current asthma, particularly among those aged 15–34 years.



Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 3.2: Self-assessed health status in people aged 15 years and over, by sex, current asthma status and age group, 2007–08

3.2.2 Impact of asthma on the domains of health-related quality of life

Health-related quality of life (HRQoL) measures are commonly described in terms of physical, psychological and social domains. Available evidence suggests that in all these domains the HRQoL of people with asthma is worse than that observed in people without the disease. The impact of asthma on the psychological and social domains of HRQoL is reviewed below.

Psychological domain

The psychological component of quality of life encompasses thoughts, emotions and behaviours. Asthma, like other chronic conditions, has an impact on this domain of quality of life.

In a South Australian study, males aged 18 years and over with asthma had a higher prevalence of depression than males without asthma. Adult females with asthma also had a significantly higher prevalence of depression compared to those without asthma (Wilson et al. 2010).

General measures of the psychological component of quality of life (such as the mental component summary of the SF-12 Health Survey—12-item short form) are able to detect small differences in the psychological health of people with and without asthma. Specific measures of anxiety and depression, such as the Kessler Psychological Distress Scale, have been used in surveys of people with and without asthma. In this section, Australian data from both generic and specific measures of the psychological component of HRQoL is presented and compared among people with and without asthma.

Two Australian surveys have found higher levels of psychological distress in people with current asthma compared with people without asthma (Table 3.6).

Table 3.6: Psychological distress, adults, 2004–2009

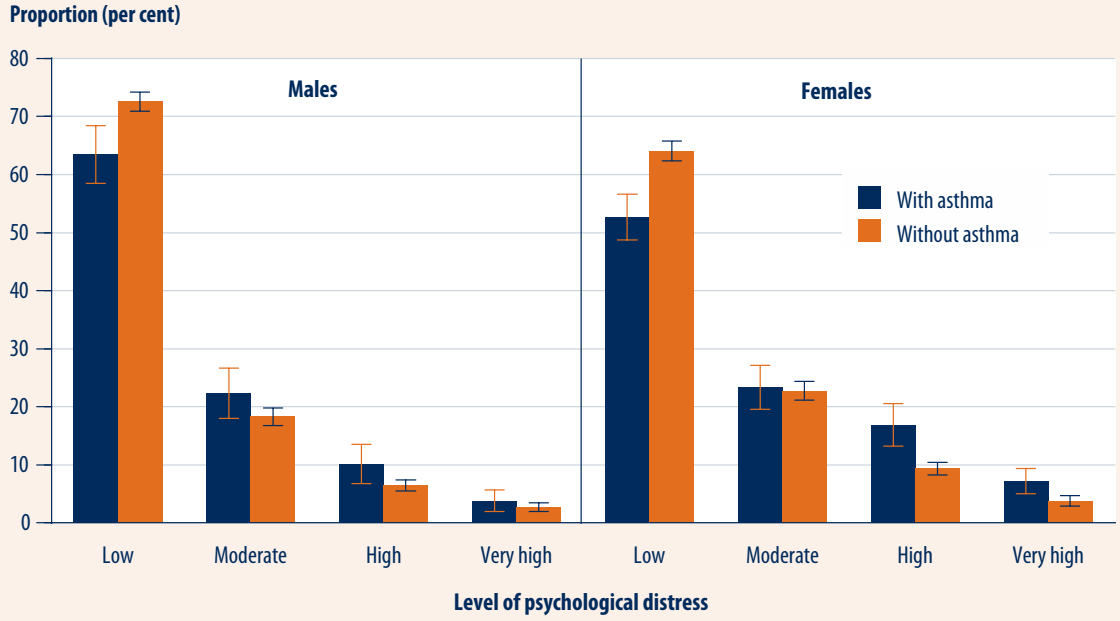
Study	Age range	Response	Rate (per cent)			
			With asthma	95% CI	Without asthma	95% CI
Kessler-10 Psychological Distress Scale						
Australia, 2007–08 (1)	18 years and over	Low (<16)	56.9	54.1–59.6	68.3	67.3–69.4
		Moderate (16–21)	23.0	20.5–25.6	20.5	19.5–21.5
		High (22–29)	14.1	11.7–16.5	7.9	7.3–8.5
		Very high (≥30)	5.9	4.5–7.3	3.2	2.8–3.6
			(*n*=1,658)		(*n*=14,121)	
South Australia, 2009 (2)	16 years and over	Low (<16)	61.2	57.7–64.7	74.8	73.6–76.0
		Moderate (16–21)	22.6	19.7–25.8	17.7	16.7–18.8
		High (22–29)	9.0	7.1–11.2	5.7	5.1–6.3
		Very high (≥30)	7.2	5.5–9.3	1.8	1.5–2.2
			(*n*=738)		(*n*=5,125)	

CI = Confidence interval.
n = Number.
Sources:
Asthma was defined as doctor diagnosis of asthma plus treatment for asthma in the last 12 months:
(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) South Australian Department of Health, South Australian Monitoring and Surveillance System 2009 (SAMSS, unpublished data).

In the general population surveyed in the 2007–08 National Health Survey, females were more likely than males to have high or very high psychological distress (Odds Ratio (OR) 1.6, CI: 1.4–1.7). Among people with current asthma, the disparity in psychological distress between the sexes was even more pronounced. Females with current asthma were 2.0 times (CI: 1.5–2.6) more likely to have high or very high psychological distress than males with current asthma (Figure 3.3). Females and males with current asthma were 2.1 times (CI: 1.8–2.5) and 1.6 times (CI: 1.2–2.0) more likely to have high or very high psychological distress than females and males without asthma, respectively.

A Canadian study showed that, compared to the general population, the prevalence of both depressive disorders and anxiety disorders among adults with asthma was at least double the prevalence observed in the general population (Lavoie et al. 2006).

A large population-based health survey in the United States reported that the prevalence of serious psychological distress was 2.5 times higher among adults with asthma (7.5%) compared to those without asthma (2.6%), and those with asthma were more likely to report fair/poor health and functional limitations compared with adults without asthma (Orka et al. 2010).



Notes

1. Age-standardised to the Australian population as at June 2001.
2. The Kessler-10 scores corresponding to the levels of psychological distress are: low = 10–15; moderate = 16–21; high = 22–29; very high = 30–50.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 3.3: Prevalence of low to very high psychological distress, by asthma status and sex, people aged 18 years and over, 2007–08

The World Mental Health Survey was conducted across 17 countries covering the Americas, Europe, the Middle East, Africa, Asia and New Zealand (Scott et al. 2007). Those who had ever received a doctor-diagnosis of asthma were 1.7 times (CI: 1.4–2.1) more likely to have generalised anxiety than those without 'ever asthma', 1.7 times (CI: 1.4–2.0) more likely to have agoraphobia (fear of open/public spaces) or panic disorder and 1.8 times (CI: 1.4–2.3) more likely to have post-traumatic stress disorder.

Anxiety was also reported among children with asthma. A study from the Barwon region in Victoria reported that children with doctor-diagnosed asthma aged 5–13 years were substantially more likely to suffer anxiety than children without asthma. Specifically, children with asthma reported higher levels of panic/agoraphobia, separation anxiety, generalised anxiety and obsessions/compulsions (Vuillermin et al. 2010).

A study of 765 high school aged adolescents with current asthma reported a higher level of social anxiety compared to those adolescents without current asthma (Bruzzese et al. 2009). The authors suggested that higher levels of social anxiety among adolescents with asthma were due to experiencing asthma symptoms and taking asthma medication in front of peers.

Social domain

The social domain of HRQoL refers to the ability to perform roles and activities. Activity limitation is a good measure for monitoring the impact of asthma at a population level (King et al. 2009). This has most commonly been measured as time away from work or other usual activities. Asthma accounts for a large proportion of days lost from work, school or study (Table 3.7).

In the 2007–08 National Health Survey, the proportion of people with current asthma who had taken time off work, school or study in the previous 12 months because of any long-term condition (24.2%) was higher than the proportion of people without asthma who had taken time off for any long-term illness (8.8%, $p < 0.0001$, Table 3.7). These proportions did not differ between males and females. The proportion of people with asthma who actually attributed their days off work, school or study to asthma was 15.6% (Table 3.7). Of these people, 46% of 5–14 year olds and 10% of those aged 15 years and over had at least one day away due to their asthma in the last 12 months.

A South Australian study reported that children aged 5–15 years with asthma were 1.25 times more likely than children without asthma to have had at least one day away from school in the last month (Collins et al. 2008).

Table 3.7: Social component of quality of life in adults and children, Australia, 2006–2009

Population/study	Age range	Response	Rate (per cent)			
			With asthma	95% CI	Without asthma	95% CI
ALL AGES						
Days away from work, school or usual activities						
Australia, 2007–08 (1)	5 years and over	Any days away from work/school/study in last 12 months (due to any long term condition)	24.2 (*n*=2,067)	22.2–26.2	8.8 (*n*=17,218)	8.2–9.4
		Any days away from work/school **due to asthma** in last 12 months	15.6 (*n*=2,067)	13.5–17.8	..	..
ADULTS						
Totally unable to work or carry out normal duties because of health in the last 4 weeks						
South Australia, 2009 (2)	16 years and over	None	73.2	69.9–76.2	84.2	83.2–85.2
		At least one day	26.8	23.8–30.1	15.8	14.8–16.8
			(*n*=741)		(*n*=5,134)	
Able to work and carry out your activities, but had to cut down what you did, or did not get as much done as usual because of your health in the last 4 weeks						
South Australia, 2009 (2)	16 years and over	None	72.9	69.6–76.0	81.5	80.4–82.5
		At least one day	27.1	24.0–30.4	18.5	17.5–19.6
			(*n*=740)		(*n*=5,129)	
CHILDREN						
During the last 4 weeks, did your asthma interfere with your ability to manage your day-to-day activities?						
New South Wales, 2007–08 (3)	2–15 years	None	78.4	72.8–84.1	..	..
		A little bit	9.0	4.9–13.0	..	..
		Moderately	7.4	4.0–10.9	..	..
		Quite a lot/ Extremely	5.2	2.3–8.1	..	..
			(*n*=265)			
How many days (other than holidays) child has been away from school for any reason in the previous month						
South Australia, 2009 (2)	5–15 years	None	48.9	40.4–57.4	52.4	49.2–55.5
		1 day	17.3	11.7–24.8	16.7	14.5–19.2
		2 days	12.3	7.7–19.1	13.3	11.3–15.7
		3 or more	19.9	13.9–27.6	15.1	13.0–17.5
			(*n*=129)		(*n*=947)	

CI = Confidence interval.
.. = Not applicable.
n = Number.
Note: Any long-term condition includes: cardiovascular disease, cancer, arthritis, osteoporosis, diabetes, sight/hearing conditions, mental problems and any other long-term condition.
Sources:
Asthma was defined as doctor diagnosis of asthma plus symptoms or treatment for asthma in the last 12 months:
(1) ACAM analysis of ABS National Health Survey 2007–08 (data requested from ABS).
(2) Department of Health, Government of South Australia, South Australian Monitoring and Surveillance System (SAMSS), unpublished data 2009;
(3) New South Wales Population Health Survey, New South Wales Department of Health, Centre for Epidemiology and Research.

It was demonstrated that people with severe asthma tend to have greater absenteeism from work on account of their disease in comparison to those with mild-to-moderate asthma (ENFUMOSA 2003).

A study in the United States reported that lack of asthma control is correlated to increased work impairment. The overall work productivity loss among patients with controlled asthma was 11% lower than that experienced by people with uncontrolled asthma (Williams et al. 2009).

Hence, there is evidence from a range of sources that asthma has a negative impact on the ability to perform social roles and activities.

Summary

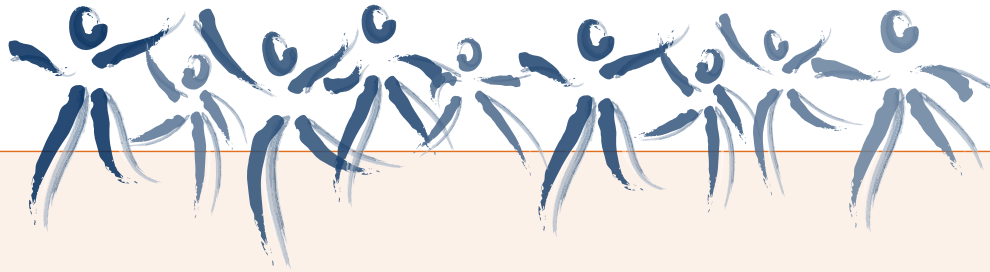
The level of asthma control and the impact of asthma on overall health status are interrelated. Poor asthma control is a common problem in both adults and children. People with asthma experience asthma symptoms frequently and are dispensed reliever medication frequently.

Asthma has a measurable impact on how people assess their overall health status. Asthma is associated with poorer self-assessed health, and people with current asthma are significantly more likely to take days off work, school or study than people without current asthma.

Most of the impact of asthma is on physical functioning and on the ability to perform social roles. The effects of asthma can include reduced participation in the workforce and sporting and other leisure activities.

There is also an important association between depression/anxiety and asthma. Australians with asthma report higher levels of psychological distress than those without asthma and the difference is more pronounced in females.

4. Mortality



Key points

- There were 411 deaths attributed to asthma as the underlying cause in 2009. This represented 1.60 per 100,000 people and 0.29% of all deaths in that year.
- Between 1997 and 2009, the mortality rate due to asthma decreased by 45%.
- The rate of mortality due to asthma in Australia still remains high on an international scale.
- Deaths due to asthma occur in all age groups, although the risk of dying from asthma increases with age.
- The age distribution of asthma deaths is different to that observed for all-cause deaths. Of all asthma deaths between 2003 and 2007, 31% occurred among people aged 5–64 years. In contrast, the proportion of all-cause deaths in this age group was only 20%.
- People living in areas of lower socioeconomic status and Indigenous people have a higher risk of dying from asthma.

Introduction

Death attributable to asthma is the most serious consequence of the disease. Effective management of asthma, particularly the regular use of inhaled corticosteroids, reduces the risk of death due to this disease (Suissa et al. 2000).

This chapter presents data from the AIHW National Mortality Database investigating time trends in asthma deaths, seasonality of deaths due to asthma as well as differences in age-standardised asthma mortality rates according to age, sex, remoteness of residence, Indigenous status, socioeconomic status and country of birth. International comparisons in asthma mortality rates are also investigated.

This chapter focuses on deaths where asthma was listed as the underlying cause of death, that is, the condition which is 'deemed to have started the train of events that led to death' (ABS 2003). Asthma was certified as the underlying cause of 411 deaths in 2009. This corresponds to an asthma mortality rate of 1.60 per 100,000 population, representing 0.29% of all deaths in that year.

4.1 Time trends in asthma deaths

Deaths before 1997 were classified using earlier versions of the International Classification of Diseases (see Appendix 1, Section A1.11.2) and, therefore, these data are not directly comparable with more recent data. For this reason age-specific comparability factors were applied to data on deaths due to asthma which occurred before 1997 for the analysis of long-term trends (see Appendix 1, Section A1.11.3).

Deaths among people of all ages

In 1908, the overall rate of mortality attributed to asthma was 11.0 per 100,000 population and ranged between 9.9 and 6.1 per 100,000 until 1924. Between that year and 1938 the rate declined by 77% to 2.3 per 100,000 and remained stable until around 1950. The rate increased after 1950, peaking at 5.9 and 5.6 per 100,000 in 1957 and 1965, respectively. By 1978 the rate had declined to 2.2 per 100,000 but it steadily increased to 5.0 per 100,000 towards the late 1980s (Figure 4.1). After that peak, the rate declined by almost 70% to 1.5 in 2003 and has remained stable, below 2.0 per 100,000 population, since then. Overall, between 1997 and 2009, the mortality rate due to asthma decreased by 45% (Figure 4.2).

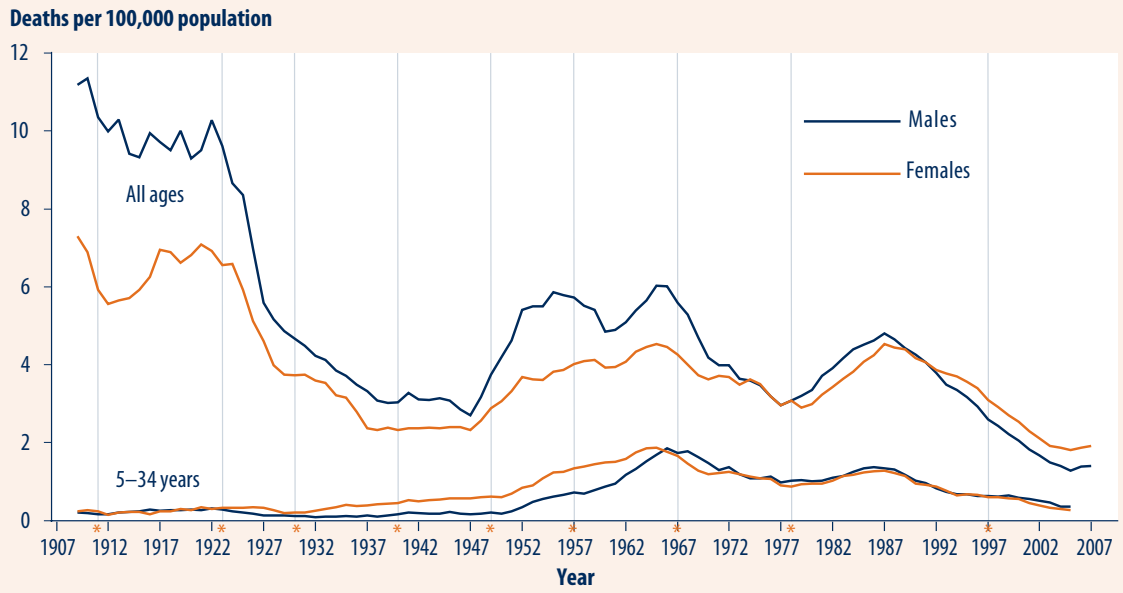
From the early 1900s to the late 1980s, the asthma mortality rate was higher in males than females, except for a period during the 1970s when the death rates for males and females were equal (Figure 4.1). Since the

late 1980s, the mortality rate has declined more among men than women (see Table A2.3) and from 1993, the mortality rate has remained higher in females than males. In 2009, the asthma mortality rate was 1.6 times higher in females (1.9 per 100,000 population) than males (1.2 per 100,000 population). This gender difference occurs mostly among those aged 35 years and over (Figure 4.2).

Deaths among people aged 5–34 years

Attribution of death to asthma is more certain among those aged 5–34 years (Malmstrom et al. 2007; Campbell et al. 1992), thus this age group is commonly used for examining time trends and for making international comparisons. In older people, other causes of death, in particular chronic obstructive pulmonary disease, commonly cause difficulties in the attribution of causes of death (Jones et al. 1999a; Smyth et al. 1996; Sears et al. 1986). This is due to the complexity of diagnosis of respiratory problems in the elderly. In fact, there is also considerable overlap between self-reported diagnoses of asthma, chronic bronchitis and emphysema (Marks et al. 2009; Abramson 2005).

From the AIHW National Mortality Database, the rate of death attributed to asthma in those aged 5–34 years during the first half of the 20th century remained low and relatively stable at around 0.3 per 100,000 (Figure 4.1). From the 1950s the rate of deaths attributed to asthma in this age group increased, reaching a peak of 2.2 per 100,000 in 1966. After that peak, the rate declined steadily and remained stable around 0.9 per 100,000 during the late 1970s. A small increase occurred between 1985 and 1991 followed by a steady decline until around 2002. There was little change over the last 5 to 6 years. In 2007, the asthma mortality rate was 0.3 per 100,000 population aged 5–34 years (Figure 4.1; see also Table A2.4).



* indicates change to the International Classification of Diseases (ICD): ICD-2 was introduced in 1911, ICD-3 in 1923, ICD-4 in 1930, ICD-5 in 1940, ICD-6 in 1949, ICD-7 in 1957, ICD-8 in 1967, ICD-9 in 1978, and ICD-10 in 1997.

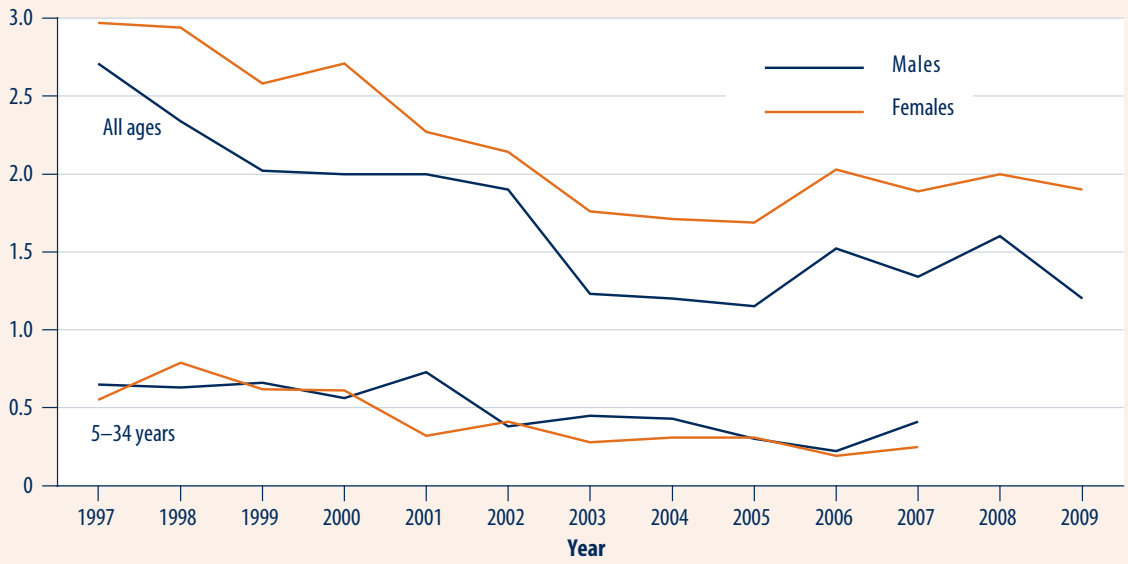
Notes

1. Age-standardised to the Australian population as at 30 June 2001.
2. Asthma classified according to International Classification of Diseases, 5th Revision (ICD-5), 6th Revision (ICD-6), 7th Revision (ICD-7), 8th Revision (ICD-8), 9th Revision (ICD-9) code 493 and 10th Revision (ICD-10) codes J45 and J46. Deaths coded to ICD-5 (1940-1949), ICD-6 (1950-1957), ICD-7 (1958-1967), ICD-8 (1968-1978) and ICD-9 (1979–1996) were converted to ICD-10 (1997 onwards) using conversion factors (see Section A1.11.3 for details).

Source: AIHW National Mortality Database.

Figure 4.1: Long-term trends in deaths due to asthma per 100,000 population, 5-year moving average, by sex, all ages and people aged 5–34 years, 1907–2009

Among people aged 5–34 years, the asthma mortality rate was higher among females than males between the 1930s and late-1960s. However, in contrast to the trend observed in the population as a whole as discussed above, there was little difference between the sexes in the mortality rate due to asthma in this age range since then (Figure 4.2).



Notes

1. Age-standardised to the Australian population as at 30 June 2001.
2. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.

Source: AIHW National Mortality Database.

Figure 4.2: Recent trends in deaths due to asthma per 100,000, by sex, all ages and people aged 5–34 years, 1997–2009

Interpretation

Little is known about the reasons for major fluctuations in asthma mortality rates in the first half of the 20th century. Some of the variation may be attributable to changes in the International Classification of Diseases (despite the use of comparability factors to attempt adjustment for this, see Section A1.11.3) or to other changes in diagnostic or labelling practices. Examination of the trends in relation to the timing of the introduction of new versions of the International Classification of Diseases (see Section A1.11.2) shows that the increase in the mortality rate in the 1950s coincides with the introduction of International Classification of Diseases version 6 (ICD-6) and the subsequent decline in 1968 coincides with the introduction of ICD-8 (Dobbin et al. 2004). The issue is canvassed in some detail in a report concerning similar data in England and Wales (Marks & Burney 1997).

The epidemic of asthma mortality in the 1960s was probably attributable to the introduction and over-reliance on a high-dose formulation of a non-selective beta-agonist aerosol (isoprenaline). A similar, though less marked, increase in deaths in the 1980s may have been related to another potent beta-agonist, fenoterol (Pearce & Hensley 1998; Beasley et al. 1991; Pearce et al. 1990) although other possible explanations have also been proposed (Taylor et al. 1997).

The reason for the more recent reduction in the rate of asthma mortality is also uncertain. There was no corresponding decline in the prevalence of asthma among adults. Hence, the reduction in deaths due to asthma must be largely attributable to a reduction in the risk of dying among people who have asthma.

The introduction of asthma management guidelines in 1989, together with changes in the availability and use of inhaled corticosteroid treatment for asthma since then, may have contributed to this favourable outcome. Furthermore, policy initiatives at state and national levels, including targeted funding and increased awareness amongst health professionals and patients with asthma, also occurred over this period. Among older adults, better diagnosis of asthma and chronic obstructive pulmonary disease followed by more accurate cause-of-death certification may partially explain the decrease in asthma-related mortality. Finally, environmental changes, which affect the severity of asthma and the severity of exacerbations of the condition, may have also played a part in reducing the rate of asthma mortality. However, no single change or initiative can be clearly linked to the decline in asthma mortality at this time.

4.2 International comparisons

Mortality rates due to asthma in Australia are relatively high in comparison with many other countries. Although similar rates are reported for New Zealand, the United States and the United Kingdom (Figure 4.3), Japan, Germany, France, Canada and Italy have lower rates of asthma mortality.

A study involving 20 developed countries reported an overall trend of higher asthma mortality rates in the late 1960s and mid 1980s among those aged 5–34 years (Wijesinghe et al. 2009). New Zealand, Scotland, England and Wales reported higher peaks than Australia in the late 1960s with New Zealand reaching 2.99 per 100,000 in 1968. Similarly, in 1986, New Zealand had asthma mortality rates nearly twofold higher than Australia (2.87 compared with 1.50 per 100,000). Since the late 1980s, there was a widespread reduction in asthma mortality rates and, in 2005, the rates of asthma mortality were similar in Australia, the United States, and England and Wales. Lower rates were reported in Germany, Netherlands and Spain.

It is important to note that there are insufficient data to determine the likely causes of the variations in asthma mortality between countries. The global mortality rates due to asthma do not appear to correlate with the prevalence of the condition (GOLD 2010).

Notes

1. Data are for countries reporting to the World Health Organization Statistical Information System (WHOSIS) Mortality Database in International Classification of Diseases, 10th Revision (ICD-10) format (J45 and J46). Analysis of these data was undertaken by the Australian Centre for Asthma Monitoring (ACAM) and all interpretations and conclusions published here are those of ACAM and not the WHO, which is responsible only for the provision of the original data.
2. Data for Australia were sourced separately (see below).
3. For each country, data are the average over one or more years during the period 2003–2007 (years of coverage for each country are shown in brackets).
4. Rates are age-standardised to the WHO World Standard Population (Ahmad et al. 2001). Only those countries for which the relative standard error for the average asthma mortality rate was less than 25% are included.

Sources:

(1) Data were obtained from the WHO Mortality Database for all countries, except Australia.
(2) Data for Australia for 2003–2007 were obtained from the AIHW National Mortality Database.

Figure 4.3: World ranking of asthma mortality per 100,000 population, people aged 5–34 years, 2003–2007

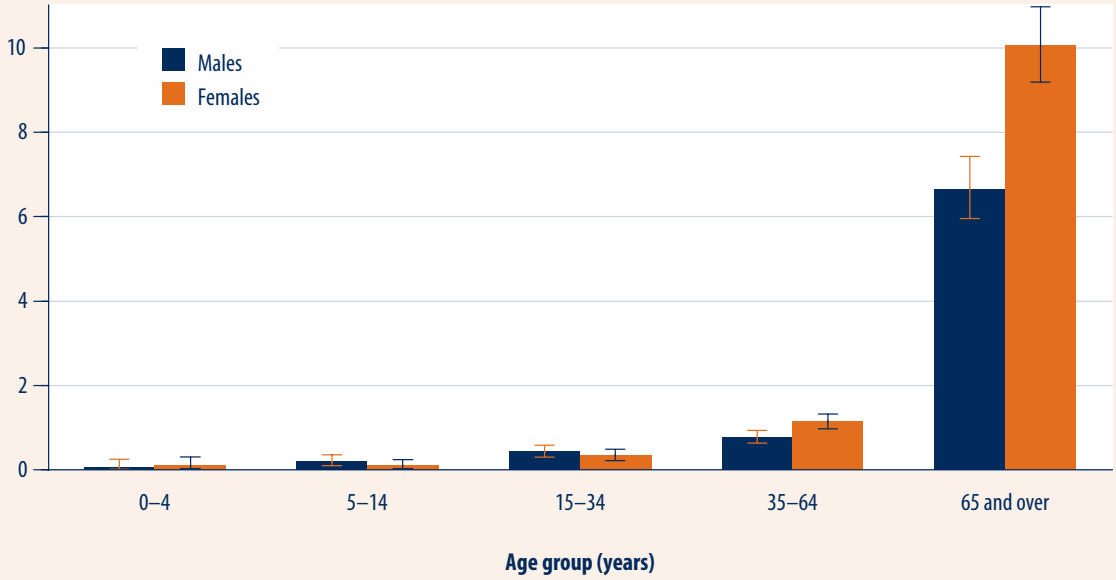
4.3 Population subgroups

4.3.1 Age and sex

While deaths due to asthma occur in all age groups, the risk of dying from asthma increases with age in both males and females ($p<0.0001$) (Figure 4.4). Most deaths attributed to asthma occur in people aged 65 years and over. This is also the age group in which chronic obstructive pulmonary disease (COPD) is common (see Chapter 8). There is substantial overlap in the clinical features of asthma and COPD. As a result, the attribution of death to one or the other of these diseases is not reliable in clinical practice or in mortality statistics.

The death rates among children aged 0–4 years and 5–14 years were less than 0.2 per 100,000 population during the period 2003–2007, while those aged 15–34 years and 35–64 years had mortality rates of 0.4 and 1.0 per 100,000 population, respectively.

There is no difference in the rate of mortality between males and females under the age of 35 years. However, among people aged 35–64 years and 65 years and over the rate of death attributed to asthma is higher in females than males (Figure 4.4). The relative importance of sex differences in the risk of asthma and gender differences in the labelling of airway disease in this age group is uncertain (see Chapter 8).



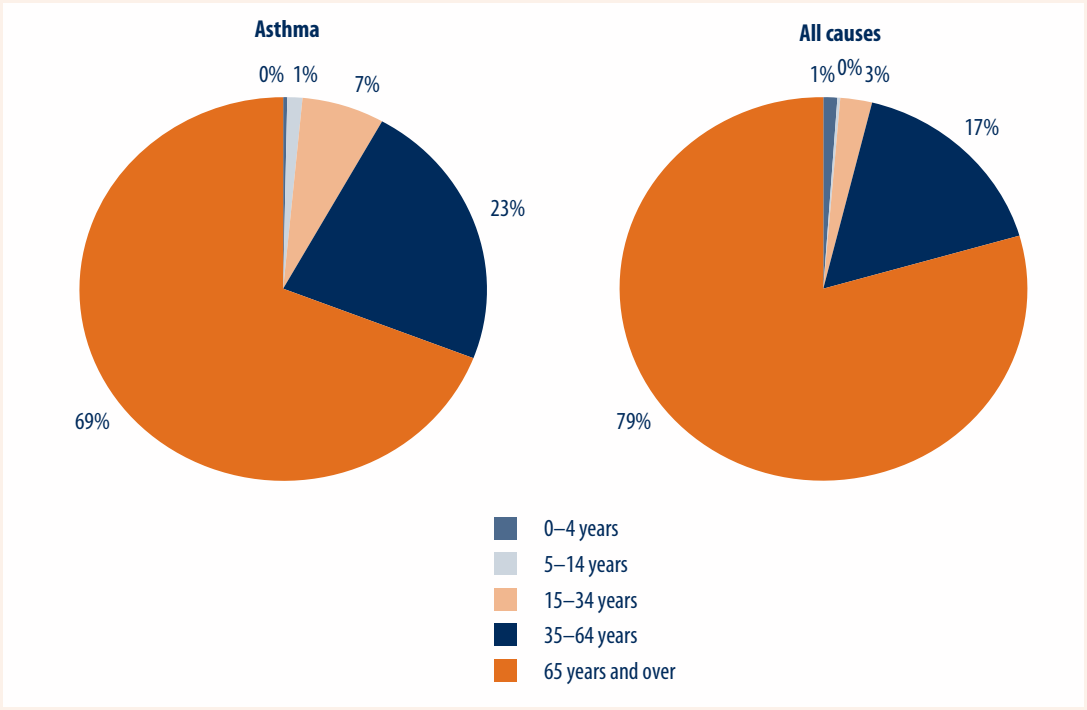
Notes

1. Age-specific mortality rates calculated for aggregated data from 2003–2007.
2. Age-standardised to the Australian population as at June 2001.
3. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.

Source: AIHW National Mortality Database.

Figure 4.4: Deaths attributed to asthma per 100,000 population, by age and sex, 2003–2007

During 2003–2007, most deaths due to asthma occurred in people aged 65 years and over (Figures 4.4 and 4.5). The proportion of asthma-related deaths that occurred in this age group (69%) was smaller than the proportion of deaths due to all causes in this age group (79%; Figure 4.5). In contrast, deaths among people aged 5–64 years represented a larger proportion of asthma deaths than of all-cause deaths (31% and 20%, respectively).



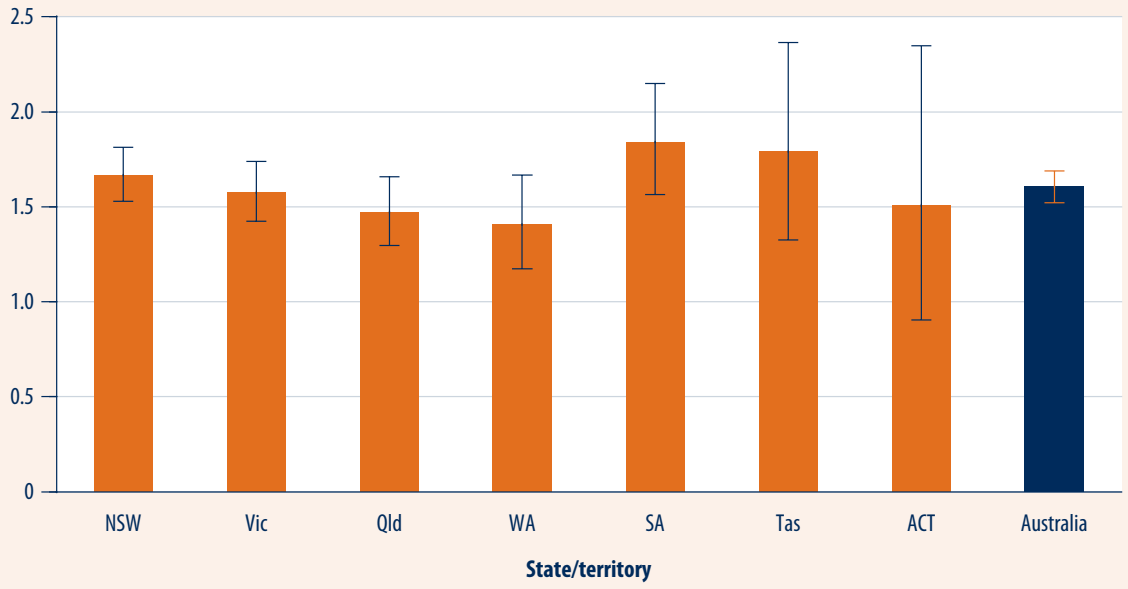
Notes
1. Age-specific mortality rates calculated for aggregated data from 2003–2007.
2. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.

Source: AIHW General Record of Incidence of Mortality (GRIM) books.

Figure 4.5: Age distribution for asthma and all-causes mortality, 2003–2007

4.3.2 States and territories

During 2003–2007, mortality rates due to asthma ranged from 1.41 per 100,000 population in Western Australia to 1.84 per 100,000 population in South Australia (Figure 4.6). The death rate due to asthma in South Australia was significantly higher than that in Western Australia (p=0.02) but no differences in the asthma death rate were observed between other jurisdictions. However, the small number of deaths in the states and territories with smaller populations means that the differences need to be interpreted with caution.



Notes

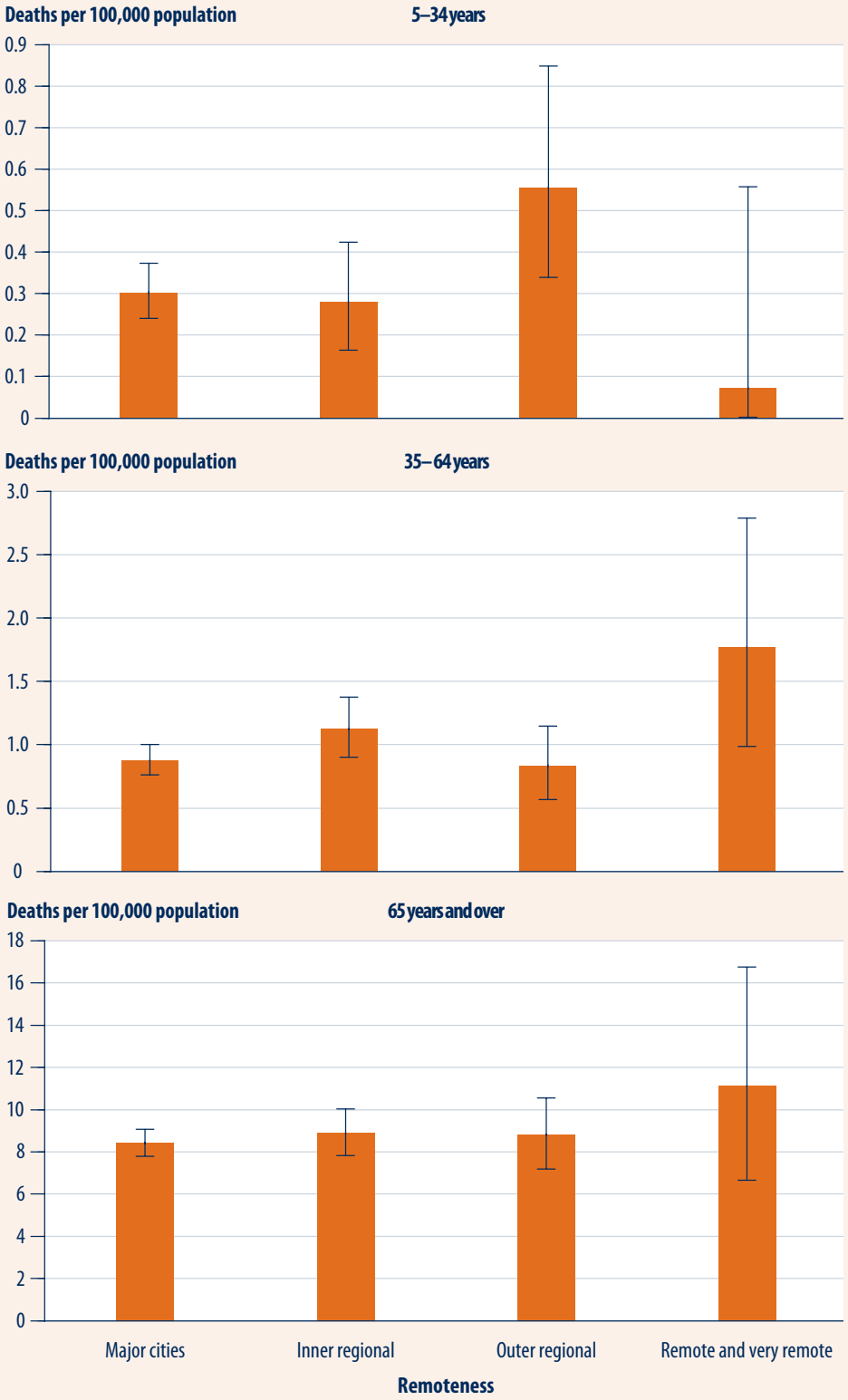
1. Age-standardised to the Australian population as at June 2001.
2. Mortality rates for aggregated data from 2003–2007. NT excluded because the numbers were too small to produce a reliable estimate.
3. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.

Source: AIHW National Mortality Database.

Figure 4.6: Deaths due to asthma per 100,000 population, by state and territory of usual residence, 2003–2007

4.3.3 Cities, regions and remote areas

The relation between mortality rates and remoteness of residence differed between age groups (p=0.01, Figure 4.7). Among those aged 5–34 years the highest death rate occurred in the *Outer regional* areas whereas for those aged 35–64 years and 65 years and over the highest asthma mortality rate occurred in *Remote/Very remote* areas (Figure 4.7).



Notes

1. Age-standardised to the Australian population as at June 2001. Mortality rates for aggregated data from 2003–2007.
2. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.
3. Remoteness classified according to the Australian Standard Geographical Classification (ASGC) categories of remoteness.
4. Vertical axis scale varies for each graph.

Source: AIHW National Mortality Database.

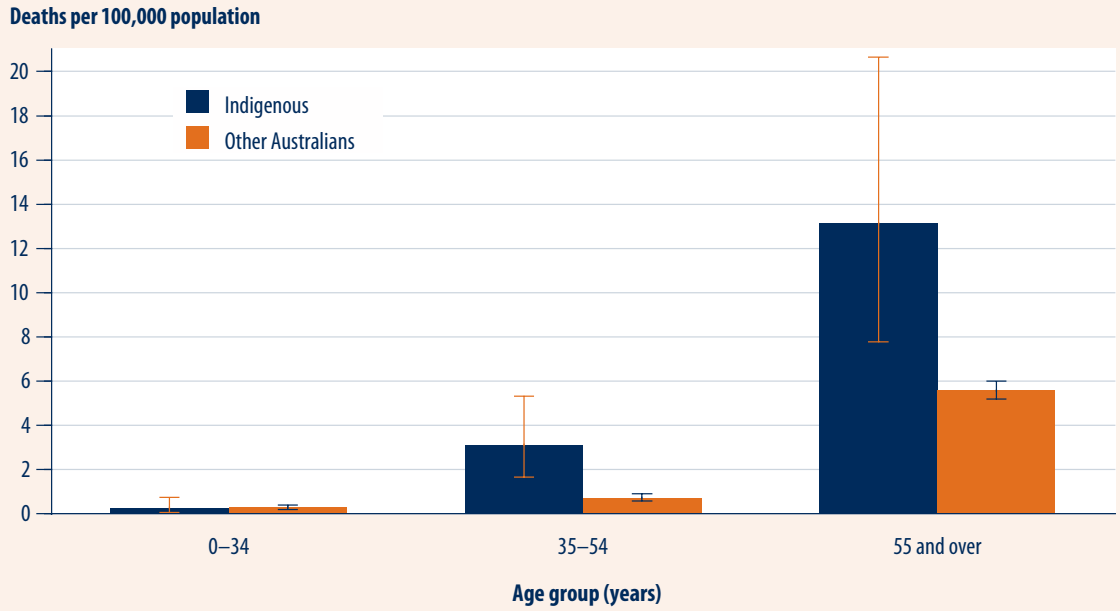
Figure 4.7: Deaths due to asthma per 100,000 population, by remoteness, people aged 5 years and over, 2003–2007

4.3.4 Aboriginal and Torres Strait Islander Australians

There is a disparity in overall mortality rates between Indigenous Australians and other Australians (ABS 2005).

Mortality rates due to asthma were compared between Indigenous Australians and other Australians using data from the AIHW National Mortality Database. The analysis was limited to data from New South Wales, Queensland, Northern Territory, Western Australia and South Australia because these are the only jurisdictions where the recording of Indigenous status on death certificates is considered adequate for reporting statistics on Indigenous mortality (ACAM 2009b).

During the period from 2003 to 2007, the age-standardised mortality rate among Indigenous Australians was 3.9 per 100,000 population (Figure 4.8). This was 2.5 (CI: 1.8–3.5) times higher than the rate among other Australians (1.6 per 100,000 population).



Notes

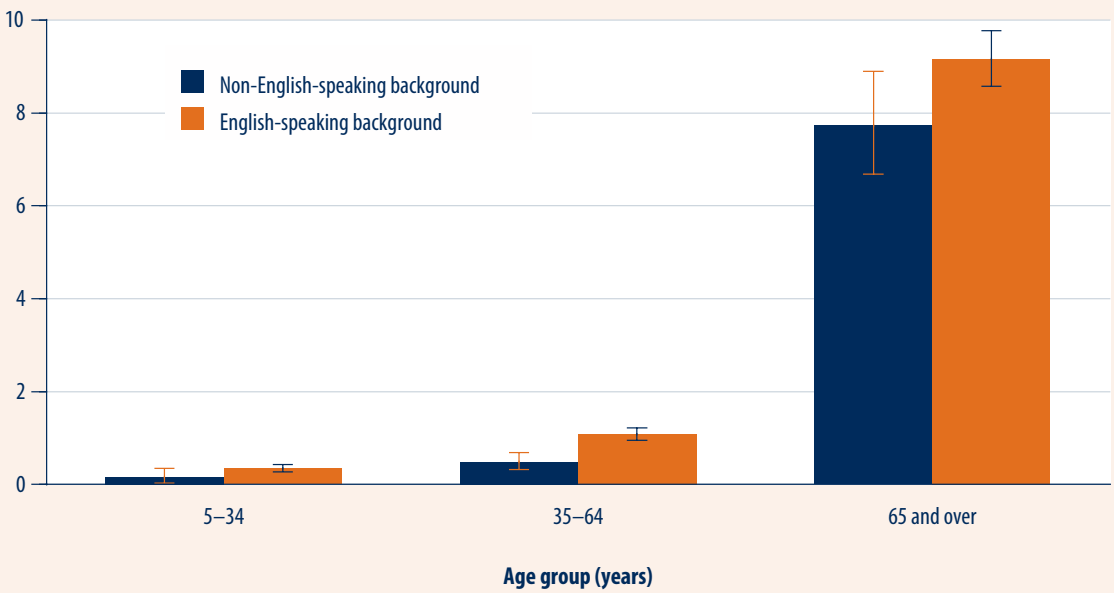
1. Age-standardised to the Australian population as at June 2001.
2. Due to the small number of asthma deaths in Indigenous Australians, confidence intervals (CIs) have been calculated based on a Poisson approximation to the gamma distribution and therefore are asymmetrical (see Appendix 1, Section A1.1).
3. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.

Source: AIHW National Mortality Database.

Figure 4.8: Deaths due to asthma per 100,000 population, by broad age group and Indigenous status, 2003–2007

4.3.5 Country of birth

Among people aged 5 years and over, the mortality rate due to asthma was higher among people from an English-speaking background (1.83 per 100,000 population) compared with those from a non-English-speaking background (1.31 per 100,000 population) ($p<0.0001$). The disparity was largest among those aged 35–64 years (Figure 4.9).



Notes

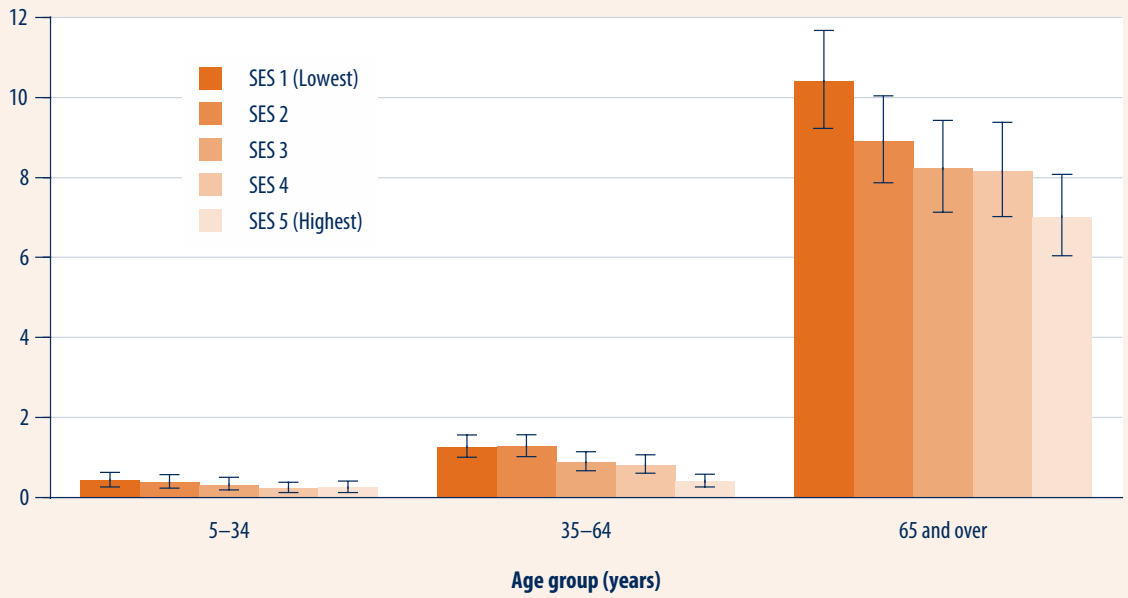
1. Age-standardised to the Australian population as at June 2001.
2. Mortality data aggregated from 2003–2007.
3. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.
4. English-speaking background includes anyone born in Australia, New Zealand, Canada, United Kingdom, Ireland, United States of America, South Africa or Zimbabwe. Non-English-speaking background includes all those born in other countries. See Appendix 1, Section A1.13.2 for further information on country-of-birth classifications.
5. Results for significance testing for differences between non-English-speaking versus English-speaking background within each age group were as follows: 5–34 years, $p=0.0333$; 35–64 years, $p<0.0001$; 65 years and over, $p=0.0238$.

Source: AIHW National Mortality Database.

Figure 4.9: Deaths due to asthma per 100,000 population, by country of birth, people aged 5 years and over, 2003–2007

4.3.6 Socioeconomic status

Socioeconomic factors may influence asthma control and health-seeking behaviours. In children, it was shown that severe asthma is associated with lower socioeconomic status and poverty (Babin et al. 2007; Mielck et al. 1996). Studies from the United States of America also show a higher risk of asthma mortality related to lower socioeconomic status (Castro et al. 2001; Grant et al. 2000). This is reflected in Australian mortality data, which show a significant relationship between decreasing levels of socioeconomic status and higher risk of death from asthma, particularly among those aged 35–64 years and 65 years and over (Figure 4.10).



SES = Socioeconomic status (see Appendix1, A1.13.3)

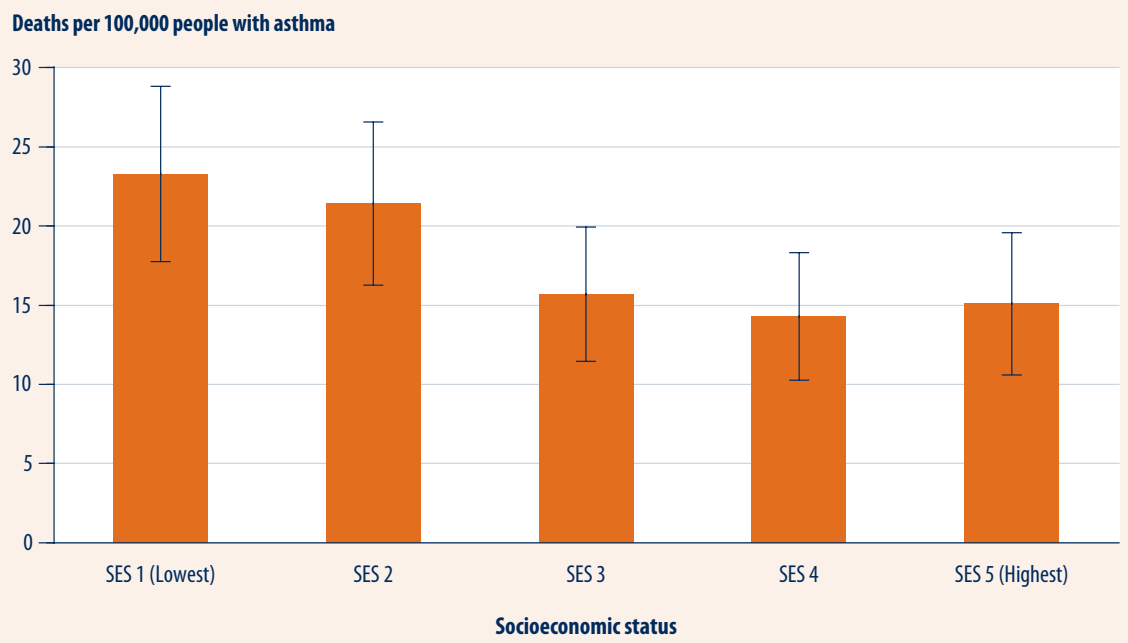
Notes

1. Age-standardised to the Australian population as at June 2001.
2. Mortality data aggregated from 2003–2007.
3. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.
4. Results for testing for linear trends in mortality according to socioeconomic status were as follows: 5–34 years, p=0.0095; 35–64 years, p<0.0001; 65 years and over, p<0.0001.

Source: AIHW National Mortality Database.

Figure 4.10: Deaths due to asthma per 100,000 population, by age and socioeconomic status, people aged 5 years and over, 2003–2007

We also describe the rate of deaths attributed to asthma among people who have the condition (case-fatality rate) in relation to socioeconomic status. There was an increasing trend in the case-fatality rate due to asthma with decreasing socioeconomic status ($p<0.0001$) (Figure 4.11).



SES = Socioeconomic status (see Appendix 1, A1.13.3)

Notes

1. Age-standardised to the Australian population as at June 2001.
2. Mortality data aggregated from 2003–2007.

Source: AIHW National Mortality Database.

Figure 4.11: Deaths due to asthma per 100,000 people with asthma (case-fatality rate due to asthma), by socioeconomic status, people aged 5 years and over, 2003–2007

4.4 Seasonal variation in mortality risk

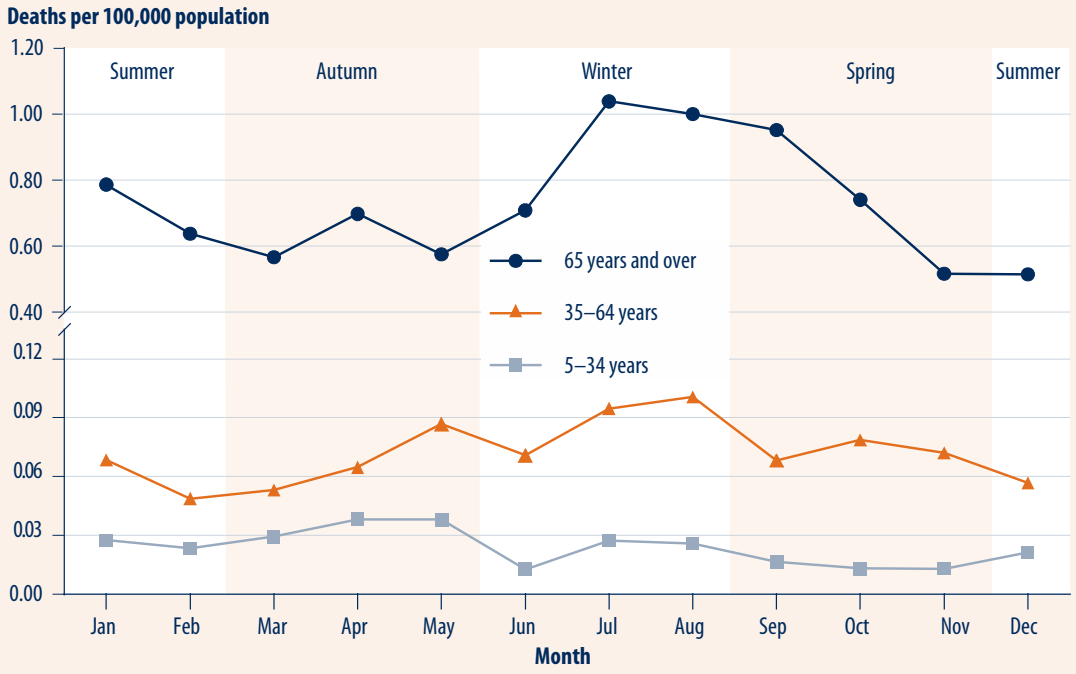
The risk of death due to asthma varies with the time of year and is different between age groups.

Studies from the United States (Weiss 1990) and the United Kingdom (Marks & Burney 1997) have demonstrated higher rates of asthma deaths during winter months among older people. Higher death rates in winter months are also reported among asthma patients who are admitted to Australian hospitals (Watson et al. 2007).

Data for Australia (Figure 4.12) reflect a similar pattern in people aged 65 years and over, while for those aged 35–64 years, the risk of death due to asthma is higher in late winter and May. This pattern could reflect the impact of the winter rise in influenza and pneumonia.

Among those aged 5–34 years, the highest death rates tend to occur in April and May, coinciding with mid–late autumn.

Northern Hemisphere studies report that deaths among children and young adults attributed to asthma are more common in the summer months. The reasons for these seasonal differences in children and young adults are unclear, but have been hypothesised to be related to a high prevalence of the common cold (due to respiratory viral infections) and aeroallergen exposure (Johnston & Sears 2006), together with reduced adherence with medications during the summer holidays (Spahn et al. 2009).



Notes

1. Asthma classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46.
2. Mortality data aggregated from 2003–2007. For each month, the average age-standardised rate over the 5-year period was calculated for the relevant age group.
3. Results for significance testing of an equal proportion of deaths in each month were as follows: 5–34 years, p=0.0863; 35–64 years, p=0.0948; 65 years and over, p<0.0001.

Source: AIHW National Mortality Database.

Figure 4.12: Seasonal variation in the rate of deaths due to asthma, by broad age group, 2003–2007

4.5 Comorbidities in people who died from asthma

This section describes the prevalence of selected comorbid conditions listed on the death certificate as associated causes of death among people whose underlying cause of death was asthma.

Among people whose deaths were attributed to asthma, the most common comorbidity group was heart, stroke and vascular disease, which was listed on 32.4% of all death certificates (Table 4.1), including 14.4% among those who died aged 35–64 years and 41.6% among those who died aged 65 years and over.

Of all deaths due to asthma between 2003 and 2007, 29.7% had an acute respiratory infection (ICD-10 codes J0–J22) listed as an associated cause of death. It is well established in children (Johnston et al. 1996; Johnston et al. 1995) and adults (Green et al. 2002) that viral infections, including rhinovirus, are an important trigger for exacerbations of asthma. The relatively low prevalence of acute respiratory infections recorded in association with deaths attributed to asthma may indicate that other factors are more important in precipitating fatal attacks. However, it is also possible that preceding viral infections did occur but that the attending medical practitioner who certified the patient's death was not aware of the antecedent events or chose not to report them on the death certificate.

The proportion of people who died due to asthma and who had comorbid conditions listed on the death certificate increased with age. Among those aged 65 years and over, 21.9% had COPD or bronchiectasis listed as a comorbid condition. In contrast, only 6.5% of non-asthma deaths among people aged 65 years and over had COPD or bronchiectasis listed as a comorbid condition. Furthermore, 7% of non-respiratory deaths among people aged 65 years and over had COPD or bronchiectasis listed as a comorbid condition.

Table 4.1: Comorbidities in people who died from asthma, by broad age group, 2003–2007

	Proportion of asthma deaths (per cent)		
Comorbidity	35–64 years	65 years and over	All ages
Influenza, pneumonia and other acute lower respiratory infections	9.1	39.3	29.7
Chronic obstructive pulmonary disease (COPD) and bronchiectasis	11.4	21.9	17.8
Diabetes mellitus	6.6	10.8	8.9
Heart, stroke and vascular disease	14.4	41.6	32.4
Arthritis and osteoporosis	1.5	7.8	5.7
Mental and behavioural problems	2.8	2.1	2.1
Cancer	1.3	5.7	4.3

Notes

1. Results for people aged less than 35 years are not presented because the number of deaths due to asthma with a comorbid condition listed was too small to produce a reliable estimate.
2. Associated causes of death are not mutually exclusive. Therefore, the columns for each age group can add up to more than 100%.
3. Asthma was classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46. Comorbidities were classified as follows: Influenza, pneumonia and other acute lower respiratory infections (J0–J22); COPD and bronchiectasis (J40–J44, J47); diabetes mellitus (includes Type I, Type II) (E10–E14); heart, stroke and vascular disease (I20–I25, I60–I69, I50, I70–I79); arthritis and osteoporosis (M00–M25, M80–M82); mental and behavioural disorders (F30–F39, F40–F48, F90–F98); and malignant neoplasms (i.e. cancer) (C00–C97).

Source: AIHW National Mortality Database.

Similar comorbidities have been reported elsewhere. In France, where asthma was the underlying cause of death, cardiovascular disease was the most common comorbidity among all ages (44.6%) and COPD was an associated cause in 10.5% of asthma deaths among those aged 65 years and over (Fuhrman et al. 2009).

4.6 Asthma as an associated cause of death in deaths attributed to other underlying causes

Asthma is relatively uncommonly listed as an associated cause of death in people dying of other causes. Between 2003 and 2007, there were 667,107 deaths in Australia. Asthma was listed as an *associated* cause of death on 4,510 death certificates (0.68%) during this time (Table 4.2).

The underlying causes of death for which asthma was most likely to be an associated cause of death were arthritis and osteoporosis (1.38%) and diabetes (1.16%%) (Table 4.2).

Table 4.2: Proportion of deaths due to other causes where asthma was listed as an associated cause, 2003–2007 (per cent)

	Age group (years)			
Condition	**5–34**	**35–64**	**65 and over**	**All ages**
Malignant neoplasms (cancer)	0.32	0.45	0.58	0.55
Endocrine, nutritional and metabolic diseases	0.82	1.72	1.19	1.25
Diabetes mellitus	0.93	1.37	1.13	1.16
Mental and behavioural disorders	1.46	0.95	0.39	0.44
Diseases of the circulatory system	0.74	0.90	0.88	0.88
Heart, stroke and vascular disease	0.93	0.82	0.86	0.86
Diseases of the respiratory system	0.55	0.96	0.38	0.42
Influenza, pneumonia and other acute lower respiratory infections	0.00	0.78	0.24	0.27
Chronic obstructive pulmonary disease (COPD) and bronchiectasis	0.00	0.98	0.44	0.49
Other upper respiratory tract diseases	0.00	3.13	0.00	0.68
Diseases of the musculoskeletal system and connective tissue	1.45	1.57	1.05	1.11
Arthritis and osteoporosis	0.00	1.56	1.37	1.38
Total deaths	**0.37**	**0.63**	**0.70**	**0.68**

Note: Asthma was classified according to International Classification of Diseases, 10th Revision (ICD-10) codes J45 and J46. Comorbidities were classified as follows: malignant neoplasms (i.e. cancer) (C00–C97); diabetes mellitus (includes Type I and Type II) (E10–E14); mental and behavioural disorders (F30–F39, F40–F48, F90–F98); heart, stroke and vascular disease (I20–I25, I60–I69, I50, I70–I79); influenza, pneumonia and other acute lower respiratory infections (J0–J22); COPD and bronchiectasis (J40–J44, J47); and arthritis and osteoporosis (M00–M25, M80–M82).

Source: AIHW General Record of Incidence of Mortality (GRIM) books.

Summary

Death due to asthma is uncommon. The decline in mortality rates due to asthma, which commenced in the late 1980s, has stabilised over the last 4 to 5 years. In 2009, the mortality rate due to asthma was 1.60 per 100,000 population.

The rate in Australia remains high by international standards.

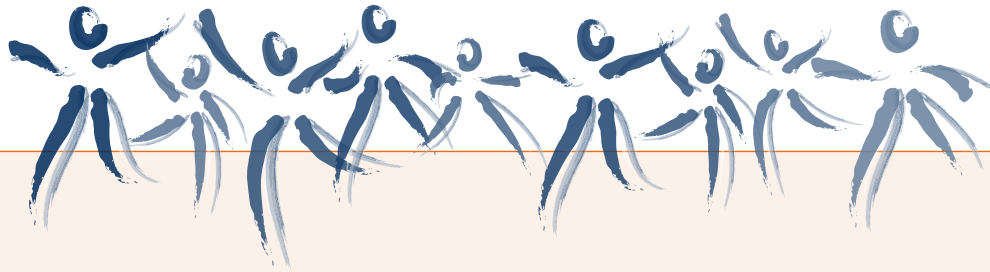
The risk of death due to asthma increases with age. However, compared to deaths from all causes, a higher proportion of deaths due to asthma occur in younger age groups.

Indigenous Australians have a higher mortality rate due to asthma than other Australians.

People aged 35 years and over living in areas of lower socioeconomic status have higher mortality rates due to asthma than those living in areas of higher socioeconomic status.

Over one-quarter of all deaths due to asthma are reported to be associated with respiratory infections, but it is likely that the reporting of viral exacerbations on death certificates is understated.

5. Use of health services



Key points

General practice encounters for asthma

- The rate of general practice encounters for asthma decreased among adults (by 33%) and children (by 27%) between 2000–01 and 2009–10.
- Lung function testing and provision of asthma action plans occur in less than 9% of general practice encounters for the management of asthma.
- Claims for completed Asthma Cycle of Care Practice Incentives Programs are highest for children, especially boys aged 0–4 years, girls aged 5–14 years, and for people aged 65 years and over. They tend to peak in the winter months.
- Among people with asthma, Asthma Cycle of Care programs are less likely to be completed for adults aged 15–34 years, people living in inner regional areas and people living in areas of a relatively lower socioeconomic status.

Hospitalisations and emergency department visits for asthma

- The hospital separation rate for asthma among adults and children remained stable between 2004–05 and 2008–09. Between 1993–94 and 2002–03, the rate declined by 32% for adults and 47% for children.
- Hospital separations for asthma are higher in:
  - boys compared with girls
  - adult women compared with adult men
  - adults living in remote areas compared with adults residing in major cities
  - Indigenous people aged 5 years and over compared with other Australians of the same age
  - people from an English-speaking background compared with those from a non-English-speaking background and
  - people living in areas of lower socioeconomic status compared with those living in areas of higher socioeconomic status.
- Peaks in emergency department and hospital admissions for asthma vary by age, with higher rates in late summer and autumn among children and highest in the winter months among adults.
- Respiratory infections are commonly listed as an associated diagnosis among people of all ages admitted to hospital for asthma.

Invasive mechanical ventilation

- In 2008–09, 1.6% of hospitalisations for asthma included a period of invasive mechanical ventilation.
- People who receive invasive mechanical ventilation during their hospital stay for asthma have a longer average length of stay and a higher rate of in-hospital mortality than those who do not receive the procedure.
- The highest proportion of hospitalisations for asthma that included a period of invasive mechanical ventilation was among adults aged 35–64 years. In this age group, people from non-English-speaking backgrounds were more likely to receive invasive mechanical ventilation during hospitalisation than people from English-speaking backgrounds.

Introduction

In this chapter, we investigate general practice encounters, hospitalisations and emergency department (ED) visits for asthma, as well as hospital admissions that received invasive mechanical ventilation.

Health-care use attributable to exacerbations of asthma is an indicator, albeit imperfect, of the level of control of asthma in the community. The nature and intensity of health service use gives a further indication of disease control by reflecting the severity of the exacerbations of asthma.

People with asthma seek health care for non-urgent reasons, such as routine review and prescription of usual asthma therapy, or for urgent management of disease exacerbations or 'attacks'. This chapter presents analyses of data on the use of health-care services by people with asthma. In particular, there is a focus on the application of these data to investigate the nature of exacerbations of asthma at a population level.

Most markers of disease control require clinical measures that are not readily available at a population level. However, exacerbations are one marker of poor asthma control that can be measured using urgent health-care utilisation data as a proxy for the occurrence of exacerbations. Therefore, these data can be used to monitor levels of asthma control in the population. For more information on asthma control see Chapter 3.

There is empirical support for the interpretation of health-care utilisation as a population-based indicator of the level of control of asthma (de Marco et al. 2003; Herjavecz et al. 2003; Vollmer et al. 2002; Cowie et al. 2001). Factors predisposing to poorly controlled asthma that are associated with greater health-care utilisation include:

- poor knowledge about asthma (Backer et al. 2007; Goeman et al. 2004; Radeos et al. 2001)
- factors contributing to inadequate response to worsening asthma, such as:
  - absence of an asthma action plan (Camargo et al. 2008; Fernandes et al. 2003; Radeos et al. 2001; Adams et al. 2000)
  - poor self-management skills (Laforest et al. 2007; Kennedy et al. 2003; Soriano et al. 2003)
  - limited access to primary care (Christakis et al. 2001).

Interventions that are aimed at improving asthma control through self-management plans and education have reduced urgent health-care utilisation (Boyd et al. 2009; Castro et al. 2003; Cote et al. 2001).

The occurrence of exacerbations does not always indicate the presence of severe or poorly controlled asthma. Viral respiratory tract infections can cause disease exacerbations, even in people with otherwise well-controlled asthma (Reddel et al. 1999). Hence, the incidence of exacerbations of asthma is an imperfect marker of the potential for improved control of asthma at a population level.

There is a broad relationship between severity of the exacerbation and type of health care used (Figure 5.1). General practitioners provide the largest volume of care, including maintenance and review care for asthma, which is part of good asthma management, as well as management of asthma exacerbations (represented by the wide area at the top of Figure 5.1). Hospitals are generally only used for the management of exacerbations of asthma, although some people do attend emergency departments for care that could best be described as 'maintenance'.

Generally, people with more severe exacerbations require admission to hospital for a period of one or more days. At the most severe end of the spectrum of exacerbations are those associated with acute ventilatory failure, for which mechanical ventilation is required (represented by the small area at the bottom of Figure 5.1). Hence, there is a spectrum of intensity of health-care interventions, which approximately corresponds to the severity of the exacerbation.

The categories presented in Figure 5.1 are not mutually exclusive. A proportion of those cases managed by general practitioners subsequently visit an ED, which, for some patients results in admission to hospital.

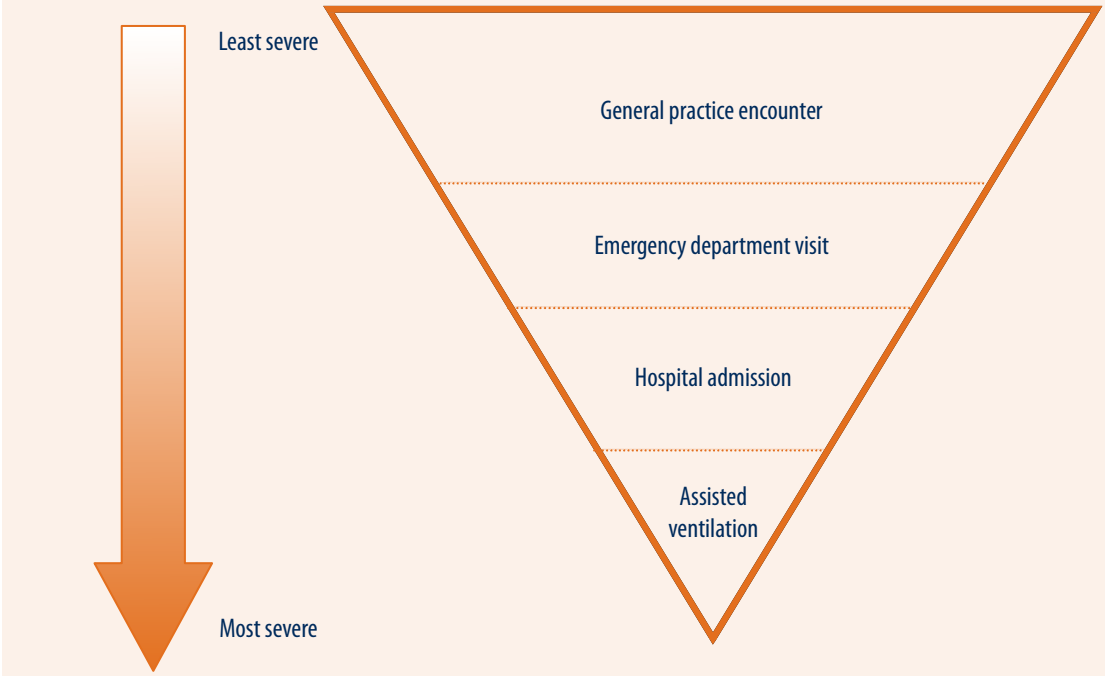


Figure 5.1: Types of health service use for exacerbations of asthma

5.1 General practice encounters for asthma

General practitioners (GPs) play a central role in the management of asthma in the community. This role includes assessment, prescription of regular medications, education and review as well as managing acute exacerbations.

Asthma-related visits to GPs may occur for a variety of reasons, including:

- acute or reactive management of asthma symptoms
- review during or following an acute episode
- maintenance activities, such as monitoring and prescription of regular medications.

The GP may initiate an opportunistic review when a patient visits for another condition or the patient or GP may schedule a structured asthma review visit.

This section presents information on all asthma-related problems managed during general practice encounters. These estimates are based on data from the Bettering the Evaluation and Care of Health (BEACH) survey (AIHW: Britt et al. 2009), which are derived from a set of encounters reported by a rolling random sample of GPs in Australia. Rates are expressed as population-based rates and as proportions of all general practice encounters.

This section also includes data on how asthma is managed in general practice, also obtained from the BEACH survey. Information on referrals, performance of spirometry and other lung function tests and the provision of action plans for the management of asthma are provided. For more details about BEACH data and methods, see Appendix 1, Section A1.3.

This section also reports data on Practice Incentives Program (PIP) claims for reimbursement for structured general practice review visits for asthma (the Asthma Cycle of Care).

5.1.1 International comparisons

In Australia, many patients with asthma are not under regular care by a general practitioner. An analysis of Australian GP consultations found that 54% of 396 patients with asthma who had visited the GP in the past 12 months had asthma managed during at least one of those visits. Of those who had not had their asthma managed by a GP in the last 12 months (*n*=171), 70.2% stated it had been more than 2 years since such management was provided by their GP (AIHW: Britt et al. 2008).

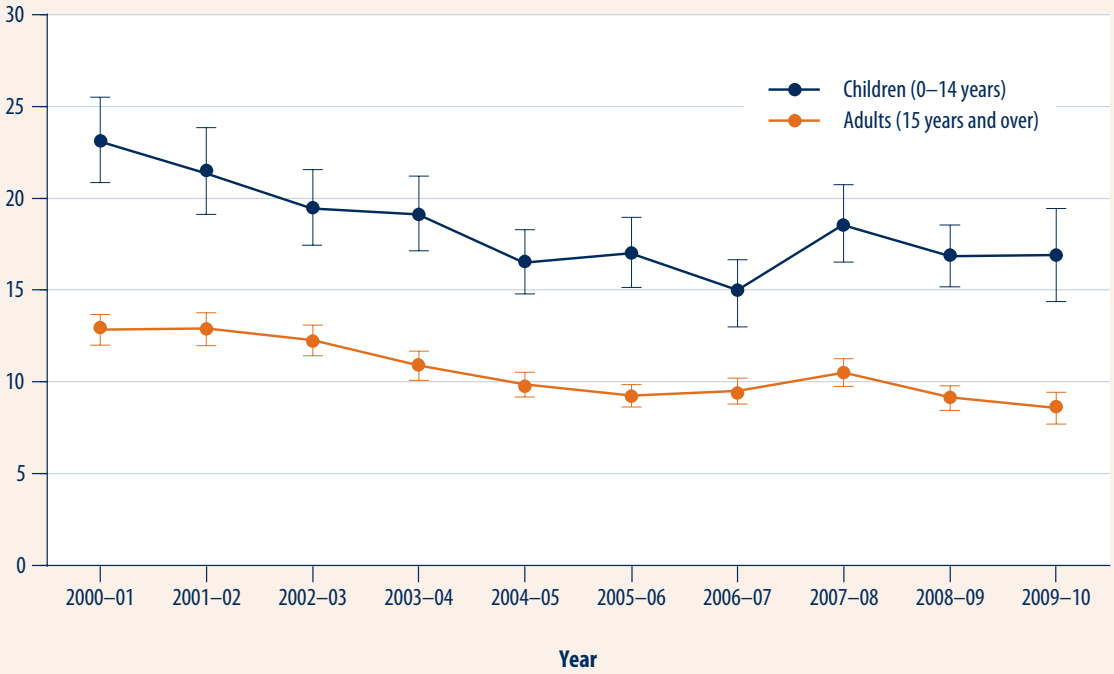
The proportion of adults with asthma under the care of a GP varies greatly within Europe: from 96% in Denmark and 80% in the United Kingdom to 20% in Georgia and 10% in Greece. Among children with asthma, the proportion under care of a GP was higher in the United Kingdom (80%) but lower in most other countries in Europe (0–50%) (Roberts et al. 2009).

Unscheduled medical visits for asthma, which are most likely to represent visits for acute or reactive management of asthma symptoms, occur less commonly among Australians with asthma than people with asthma in other countries. Among people with current asthma during 2003 and 2004, 14.3% of 1,006 adults with asthma and 21.4% of 199 children with asthma had an emergency visit to a GP for asthma in the 12 months before being surveyed (Marks et al. 2007).

In similar surveys conducted in North America, Europe and Asia, the rate of unscheduled emergency asthma visits to a health facility other than a hospital ED (for example, visits to a GP) among people with asthma ranged from 25% in western Europe to 47% in Japan (Rabe et al. 2004). However, the choice of health-care facility for urgent visits (GP or ED) may vary with the health-care system, as may the definition of an urgent visit.

5.1.2 Time trends

Between 2000–01 and 2009–10, the rate of GP encounters where asthma was managed among adults fell from 12.8 to 8.6 per 100 population (Figure 5.2). While the rate among children also decreased steadily between 2000–01 and 2006–07 (from 23.2 to 14.8 per 100 population), it has risen slightly since then to 16.9 per 100 in 2009–10 (Figure 5.2; see also Table A2.5).



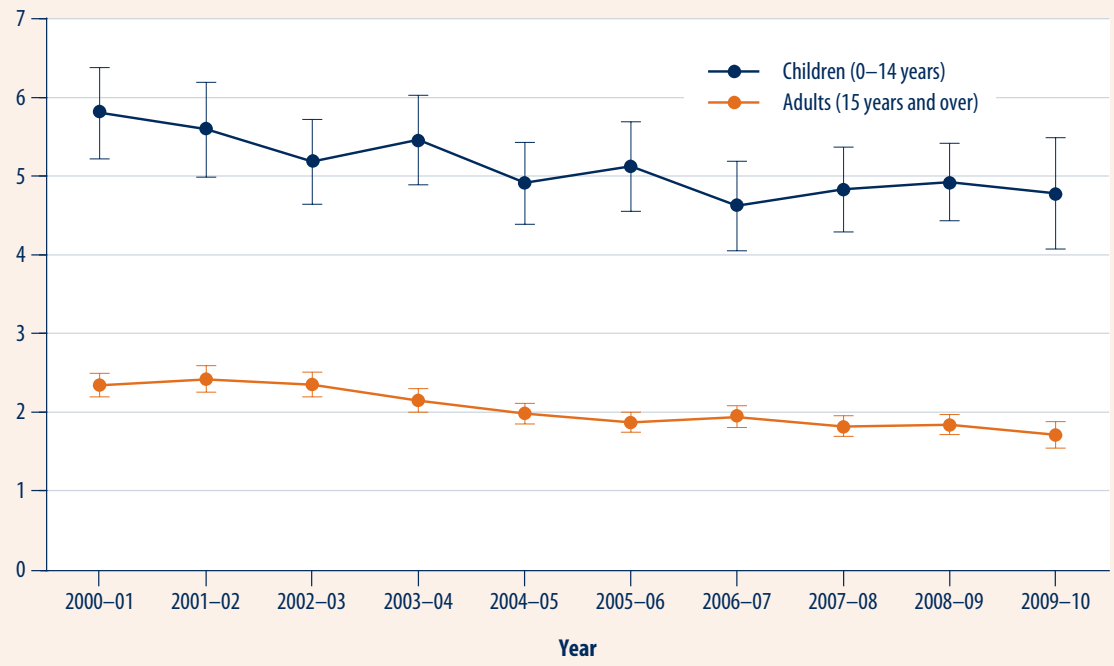
Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96.
2. BEACH survey year is April to March. See also Appendix 2, Table A2.5

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

Figure 5.2: General practice encounters for asthma per 100 population, adults and children, April 2000 to March 2010

The proportion of all GP encounters that include the management of asthma also declined over this time period with levels stabilising in the last 3 years, although the relative decrease is smaller than the absolute reduction in visits for asthma (Figure 5.3; see also Table A2.5). In 2009–10, encounters at which asthma was managed accounted for 4.8% of all GP encounters with children and 1.7% of all adult GP encounters.



Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96.
2. BEACH survey year is April to March. See also Appendix 2, Table A2.5

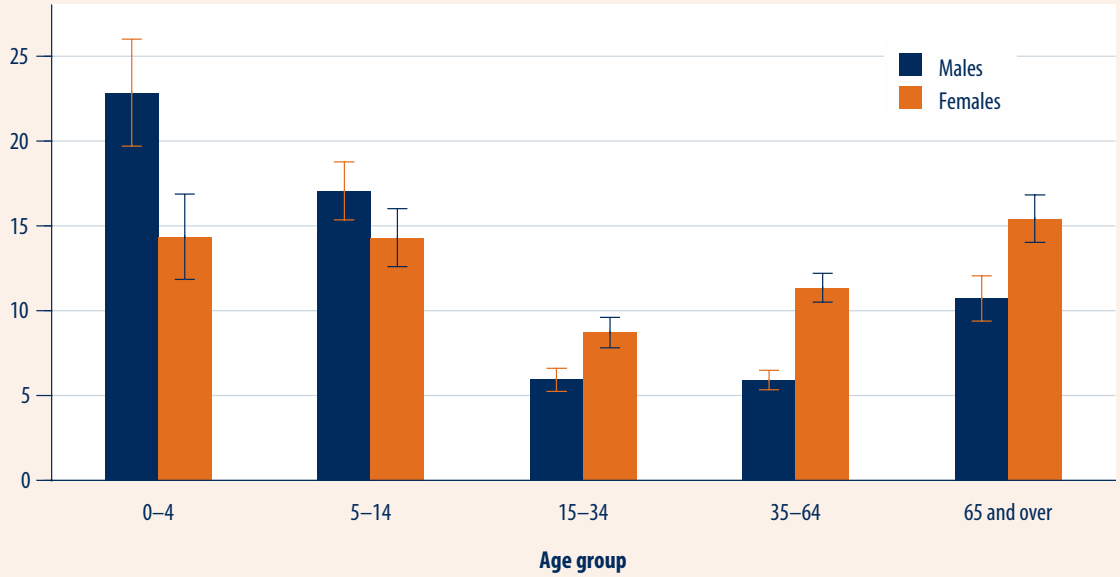
Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

Figure 5.3: Proportion of general practice encounters for asthma, adults and children, April 2000 to March 2010

5.1.3 Population subgroups

Age and sex

Among children, boys are more likely than girls to have asthma managed at a GP encounter, reflecting the higher prevalence of asthma among boys. After the age of 15 years, this trend is reversed and females have more GP encounters for asthma as a problem managed than males (Figure 5.4). This reflects the change in asthma prevalence during the teenage years (see Chapter 2, Section 2.6.1).



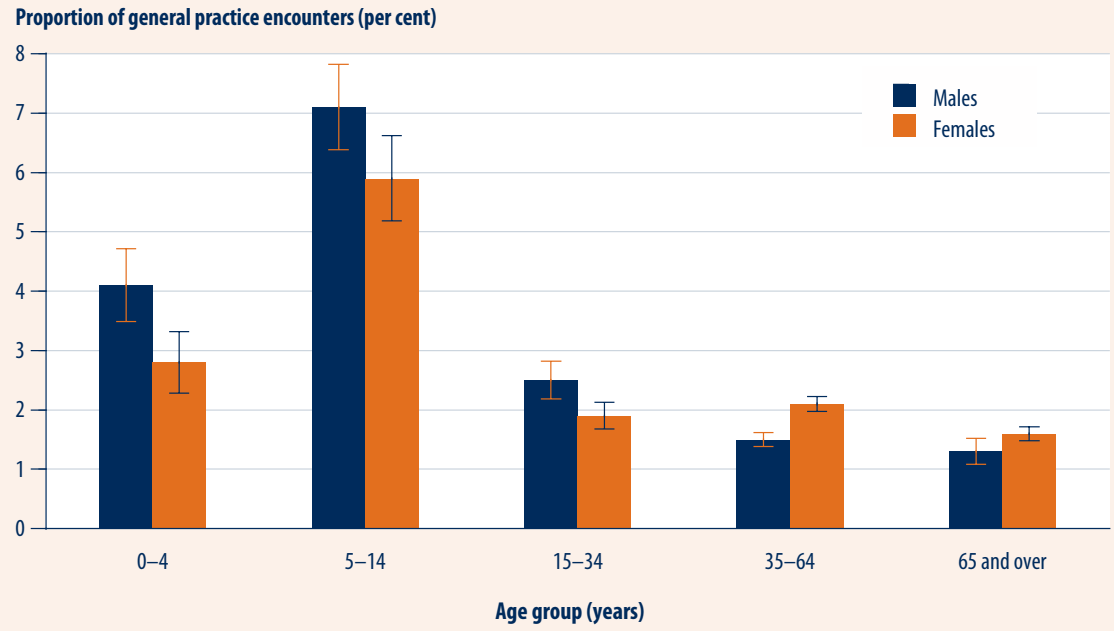
Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96.
2. BEACH survey year is April to March.

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

Figure 5.4: General practice encounters for asthma per 100 population, by age and sex, April 2007 to March 2010

Although the absolute rates of GP encounters where asthma was managed were highest in those aged 0–4 years among children and those aged 65 years and over among adults, people in these age groups also visited general practices relatively more commonly for reasons other than asthma. The proportion of all GP encounters where asthma was a problem managed was largest among those aged 5–14 years (7.1% in boys and 5.9% in girls) and the smallest in adults aged 65 years and over (1.3% in males and 1.6% in females) (Figure 5.5).



Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96.
2. BEACH survey year is April to March.

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

Figure 5.5: Proportion of general practice encounters that were for asthma, by age and sex, April 2007 to March 2010

General Practice visits among children

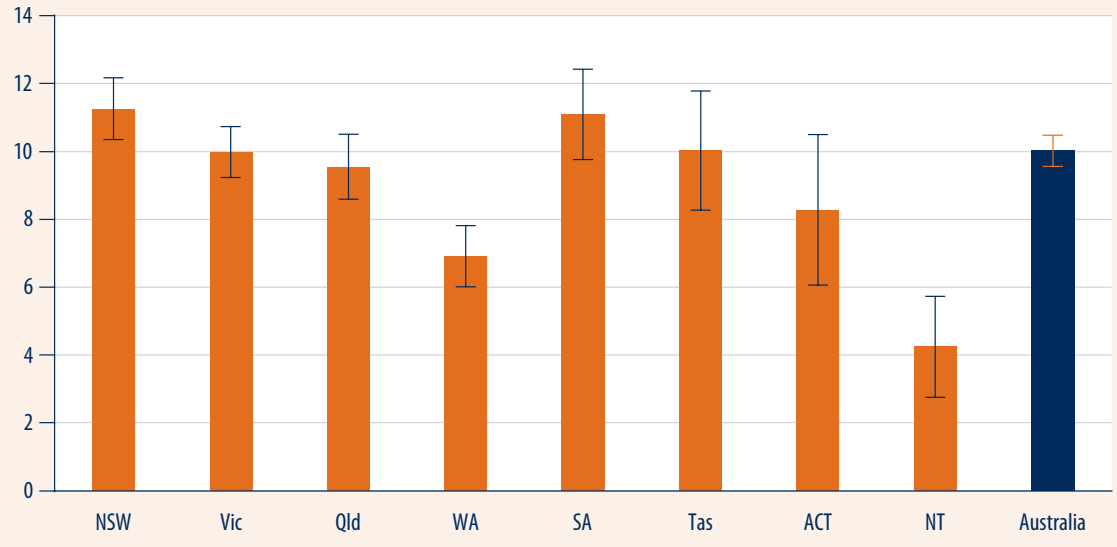
In a recent Victorian survey of approximately 5,000 families with a child with asthma, 57% (CI: 51.5–61.8%) of children were taken to a GP at least once in the previous 12 months because of worsening or out of control asthma (Victorian Child Health and Wellbeing Survey 2009, unpublished data).

Analysis of 2008 data from the Longitudinal Study of Australian Children (LSAC) showed that children aged 8–9 years with parent-reported current asthma were 2.56 times more likely to visit a GP than children without current asthma (CI: 1.9–3.4, $p<0.0001$). Between 2006 and 2008, the average number of GP visits among children of this age group who had current asthma was significantly higher (6.5 visits, CI: 6.0–7.0) than those without current asthma (4.7 visits, CI: 4.3–5.2). In this same period, 14.9% of children with current asthma had 13 or more GP visits compared to 6.8% of children without current asthma.

Similarly, children aged 4–5 years with parent-reported current asthma were 3.77 times more likely to visit a GP than children of the same age without current asthma (CI: 2.4–6.0, $p<0.0001$). Between 2006 and 2008, the average number of GP visits among children of this age group who had current asthma was significantly higher (11.7 visits, CI: 10.7–12.7) than those without current asthma (8.5 visits, CI: 7.5–9.5). Furthermore, 37.8% of children with current asthma had 13 or more GP visits compared to 25.1% of children without current asthma.

States and territories

The rates of general practice encounters where asthma was managed in Western Australia (7%) and the Northern Territory (4%) were lower than the national average (10%). There was little variation in rates of asthma managed at GP encounters from the national average among other states (Figure 5.6).



Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96.
2. BEACH survey year is April to March.

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

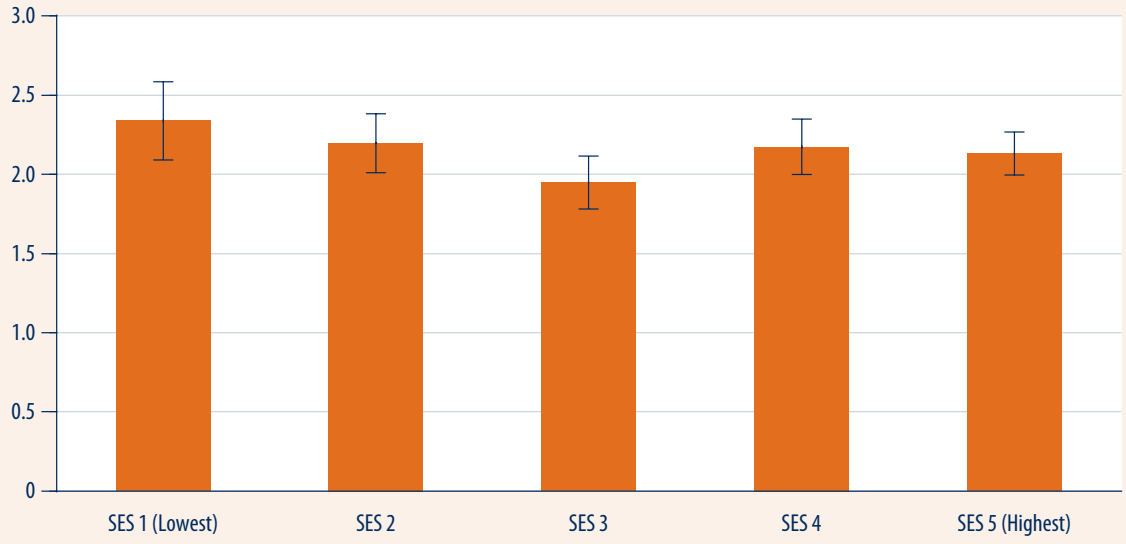
Figure 5.6: General practice encounters for asthma per 100 population, by state and territory, April 2007 to March 2010

Cities, regions and remote areas

The proportion of GP encounters where asthma was managed did not differ across *Major cities* (2.1%), *Inner regional* (2.3%), *Outer regional* (2.0%) or *Remote/Very remote* (2.3%) areas of Australia for the period April 2007 to March 2010 (p=0.2).

Socioeconomic status

It was reported that socioeconomically disadvantaged people have higher rates of overall GP consultations than those who are less disadvantaged (Charles et al. 2003b). However, analysis of recent BEACH data shows that for the period between April 2007 and March 2010, there was no significant trend in the proportion of GP encounters where asthma was managed by socioeconomic status of location of residence (p=0.2) (Figure 5.7). These results are in contrast to those previously reported for the period from April 2004 to March 2007, which showed that the proportion of GP encounters for asthma was lower among those living in areas of lower socioeconomic status (p=0.03) (ACAM 2008a).



SES= Socioeconomic status (See Appendix 1, Section A1.13.3)

Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96.
2. BEACH year is April to March.

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix A1.3.1 for details).

Figure 5.7: Proportion of general practice encounters for asthma, by socioeconomic status, April 2007 to March 2010

5.1.4 Practice Incentives Program: Asthma Cycle of Care

On 1 November 2006, the Practice Incentives Program (PIP): Asthma Cycle of Care replaced the Asthma 3+ Visit Plan, which had been in operation since 2001. The initiatives, both funded by the Australian Government, were introduced to promote better management of asthma in general practice (DoHA 2007).

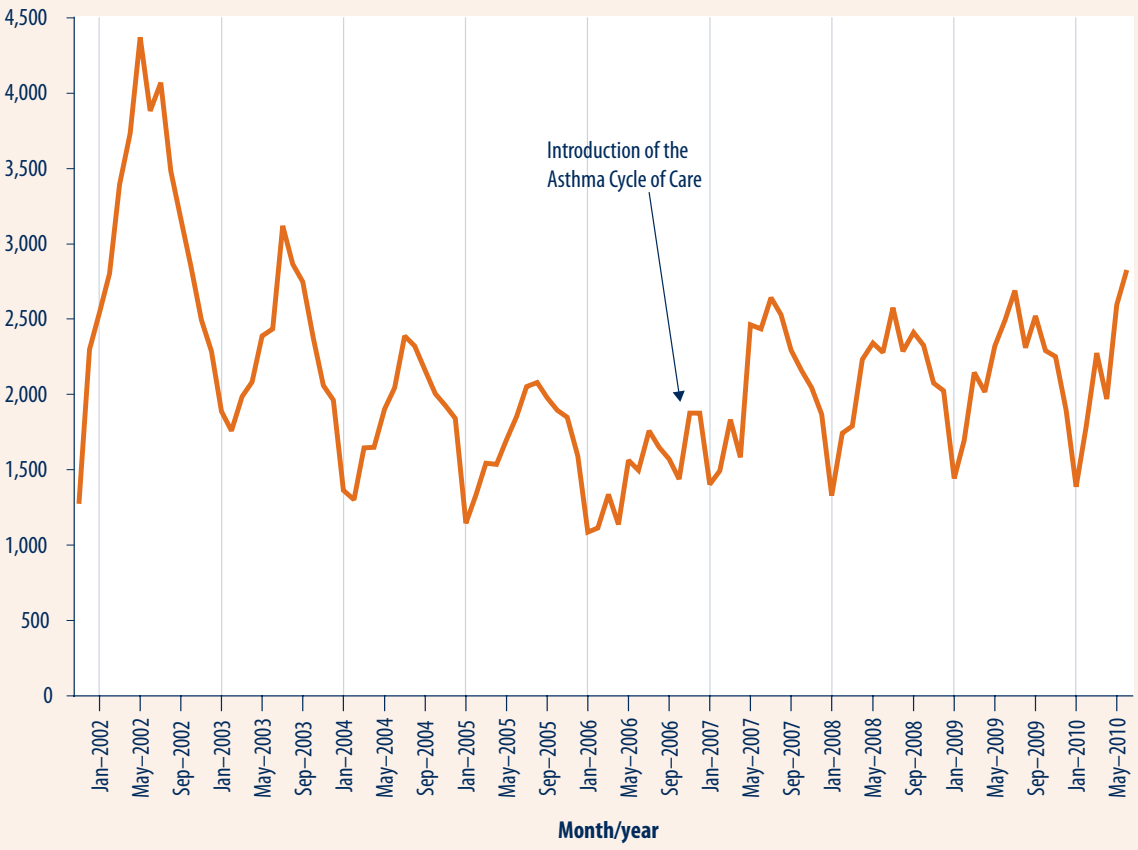
Claims for completed Asthma Cycles of Care can only be made by practices accredited by the Royal Australian College of General Practitioners, which participate in the PIP and have registered for the PIP Asthma incentive. GPs within a practice that have signed on for the Asthma Incentive receive a service incentive payment of $100 per year for each cycle of care completed for a patient. It is important to note that practices that do not register for the Asthma PIP but provide Asthma Cycles of Care or providers that are PIP registered but do not claim are not included in the data presented in this report.

The Asthma Cycle of Care is aimed at patients with moderate to severe asthma and entails the development and ongoing review of an asthma management plan. The Asthma Cycle of Care requires at least two visits over a 12-month period and at least one of the visits must have been planned at a previous consultation. The following five steps must be implemented during these two visits to ensure the Asthma Cycle of Care is successfully completed:

1. Document diagnosis and assessment of asthma severity and level of asthma control.
2. Review the patient's use of, and access to, asthma-related medication and devices.
3. Provide a written asthma action plan (or document alternative if the patient is unable to use a written action plan).
4. Provide asthma self-management education.
5. Review the written or documented asthma action plan.

The number of claims for payment under the Asthma 3+ Visit Plan gradually declined from 2002 to 2006 but after the commencement of the Asthma Cycle of Care in November 2006, the number of claims rose in the following year. Since then the number of claims each year has remained relatively stable (Figure 5.8). In 2009–10, 26,807 claims for completed Asthma Cycles of Care were lodged.

For the Asthma Cycle of Care and the Asthma 3+ Visit Plan, there has been a general trend for claims to peak during the winter months and for low rates of claims during December to March (Figure 5.8).



Notes

1. Claims are for asthma review visit classified codes 2546, 2547, 2552, 2553, 2558, 2559, 2664, 2666, 2668, 2673, 2675 & 2677.
2. The Asthma Cycle of Care replaced the Asthma 3+ Visit Plan in November 2006.
3. Shading refers to winter months (May–August).

Source: Medicare Australia, Medicare Benefits Schedule (MBS) online statistics.

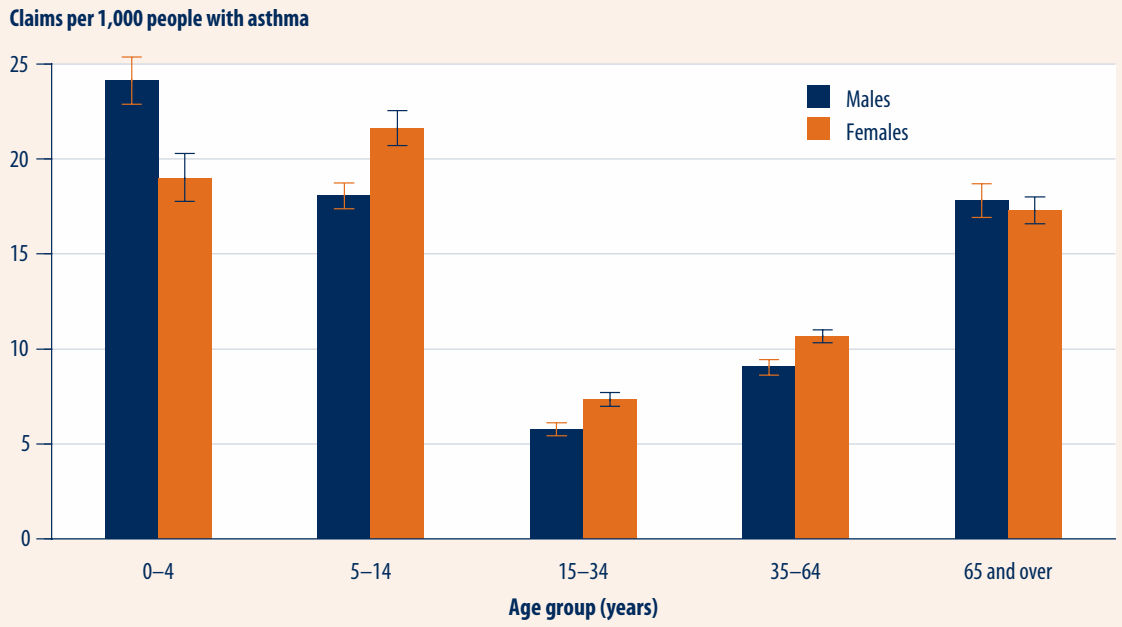
Figure 5.8: Number of claims for completed Practice Incentives Program (PIP) Asthma 3+ Visit Plan /Asthma Cycle of Care, all ages, November 2001 to June 2010

5.1.5 Claims for completed Asthma Cycles of Care in population subgroups

Age and sex

Among people with asthma, Asthma Cycle of Care claims were least likely to be lodged for young adults aged 15–34 years, with 6.6 claims per 1,000 people with asthma (Figure 5.9).

The highest rate of claims were for children, especially boys aged 0–4 years (24.1 per 1,000 people with asthma) and girls aged 5–14 years (21.6 per 1,000 people with asthma), and older Australians aged 65 years and over (17.6 per 1,000 people with asthma) (see Appendix 1, Section A1.8.1 for details of the Asthma Cycle of Care).



Note: Claims are for asthma review visit classified codes 2546, 2547, 2552, 2553, 2558, 2559, 2664, 2666, 2668, 2673, 2675 and 2677.
Sources: Derived from Department of Health and Ageing Medicare Benefits Schedule (MBS) statistics; ABS National Health Survey 2007–08.

Figure 5.9: PIP Asthma Cycle of Care claims per 1,000 people with asthma, 2009

States and territories

During 2009, the rate of claims for completed Asthma Cycles of Care for people with asthma varied widely by state and territory (Figure 5.10). New South Wales, Victoria and Tasmania had a higher rate of claims than the national average, while the rate of claims observed in the Australian Capital Territory, Queensland, Western Australia and the Northern Territory were lower than the national average.

Notes

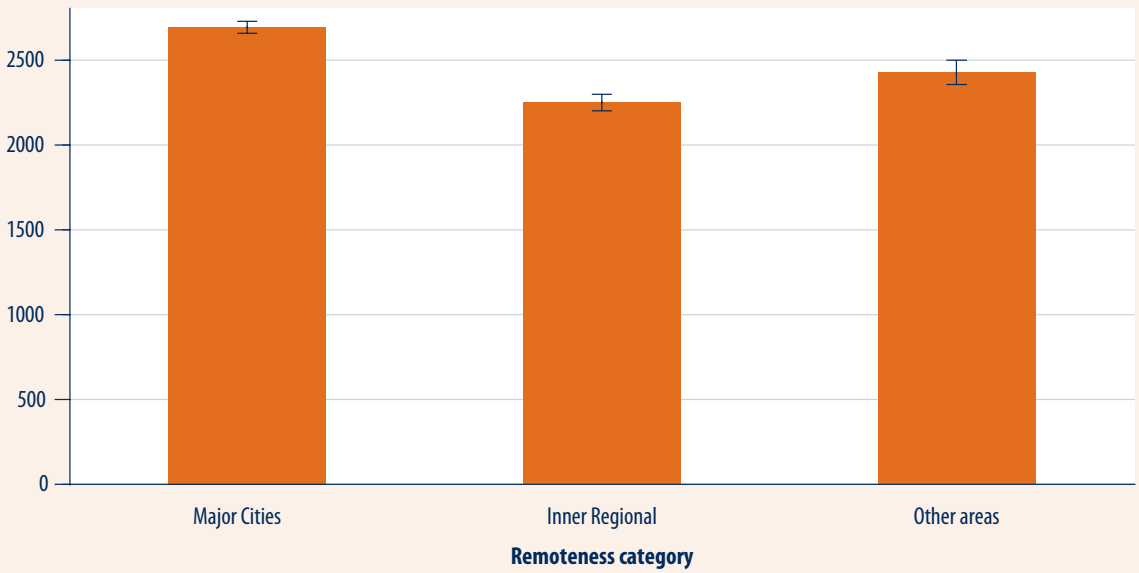
1. Claims are for asthma review visit classified codes 2546, 2547, 2552, 2553, 2558, 2559, 2664, 2666, 2668, 2673, 2675 and 2677.
2. Age-standardised to the Australian population as at June 2001.

Sources: Derived from Department of Health and Ageing Medicare Benefits Schedule (MBS) statistics; ABS National Health Survey 2007–08.

Figure 5.10: PIP Asthma Cycle of Care claims per 100,000 people with asthma, by state and territory, 2009

Cities, regions and remote areas

The highest rates of claims were observed for people with asthma residing in *Major cities* (2,692 per 100,000 population) and *Other areas* (2,427 per 100,000) of Australia (Figure 5.11). People with asthma living in *Inner regional* areas were 16% less likely than those living in *Major cities* to have an Asthma Cycle of Care claim lodged (p<0.0001).



Notes

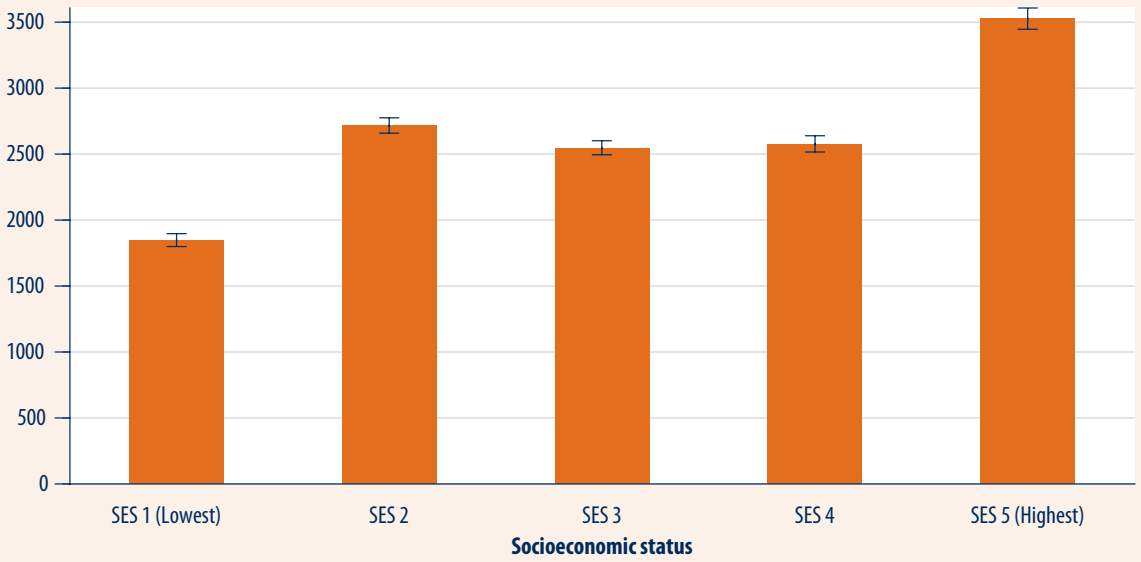
1. Claims are for asthma review visit classified codes 2546, 2547, 2552, 2553, 2558, 2559, 2664, 2666, 2668, 2673, 2675 and 2677.
2. Age-standardised to the Australian population as at June 2001.
3. 'Other areas' includes Outer regional, Remote and Very remote categories of remoteness.

Sources: Derived from Department of Health and Ageing Medicare Benefits Schedule (MBS) statistics; ABS National Health Survey 2007–08.

Figure 5.11: PIP Asthma Cycle of Care claims per 100,000 people with asthma, by remoteness, 2009

Socioeconomic status

The rate of claims for completed Asthma Cycles of Care for people with asthma increased with increasing levels of socioeconomic status (Figure 5.12). People with asthma living in areas of lowest socioeconomic status were 48% less likely than those living in areas of highest socioeconomic status to have an Asthma Cycle of Care claim lodged (p<0.0001).



SES = Socioeconomic status (see Appendix 1, Section 1.13.3)

Notes

1. Claims are for asthma review visit classified codes 2546, 2547, 2552, 2553, 2558, 2559, 2664, 2666, 2668, 2673, 2675 & 2677.
2. Age-standardised to the Australian population as at June 2001.

Sources: Derived from Department of Health and Ageing Medicare Benefits Schedule (MBS) statistics; ABS National Health Survey 2007–08.

Figure 5.12: PIP Asthma Cycle of Care claims per 100,000 people with asthma, by socioeconomic status, 2009

5.1.6 Asthma procedures, treatments and referrals in general practice

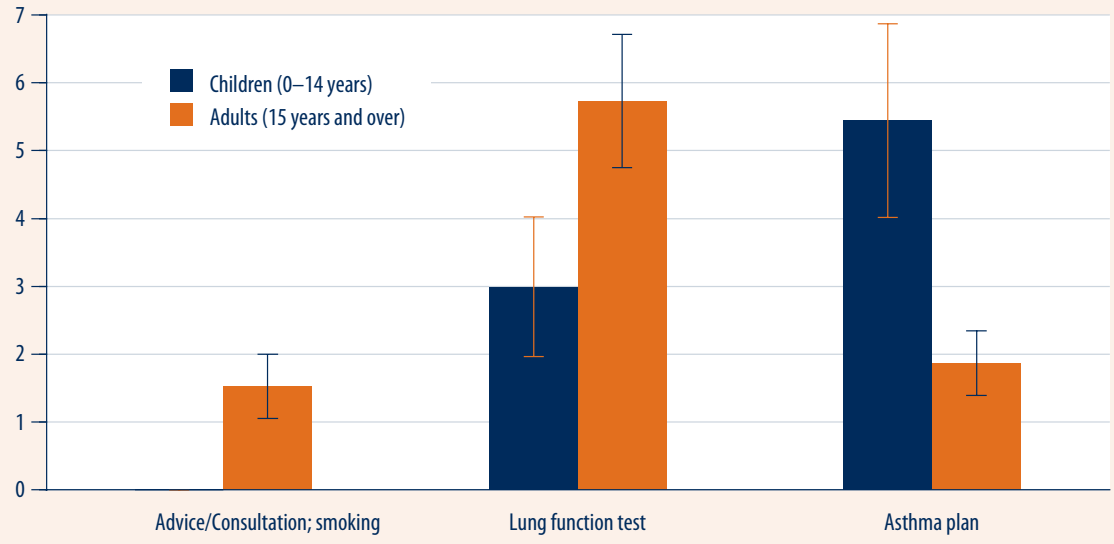
Between April 2007 and March 2010, there were 295,200 encounters recorded in the BEACH survey of general practice. Asthma was managed in 6,387 (2.1%, CI: 2.1–2.2) of these encounters. Reported here are the procedures and referrals for the management of asthma that took place during these 6,387 encounters. For more details about BEACH data and methods, see Appendix 1, Section A1.3

Procedures and treatments

Between 2007 and 2010, the most common procedures provided by GPs for asthma management were spirometry (lung function testing) and provision of an asthma action plan. Over this period, children had an asthma action plan provided in 5.4% of GP encounters for the management of asthma. Among adults, asthma action plans were provided less frequently (1.9% of asthma encounters).

Lung function testing was performed in 3.0% of GP encounters for the management of asthma for children (Figure 5.13), while among adults the procedure was done more frequently (5.7%). Potential barriers to the use of lung function testing among GPs include lack of suitable equipment, low levels of confidence in their ability to perform and interpret the procedure and lack of time required to undertake the procedure (Dennis et al. 2010).

GPs also reported providing advice on smoking at 1.5% of all adult encounters for the management of asthma. This rate is relatively low considering 22.9% of people with asthma are current smokers (2007–08 NHS) and 15.3% of adults who visited a GP in 2008–09 are daily smokers (AIHW: Britt et al. 2009). This implies that GPs either fail to ask or advise their patients who have asthma to stop smoking or that people with asthma who smoke do not visit their GP.



Note: Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96. Lung function test includes all procedures listed under rubric R39—that is, peak flow, pulmonary function, spirometry, lung function, physical function, respiratory, forced expiratory volume in 1 second (FEV1) and respiratory function.

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

Figure 5.13: Procedures, other treatments and counselling for asthma in general practice, April 2007 to March 2010

Among 247 GPs surveyed about their management of patients with moderate to severe asthma, 11.7% stated that they routinely performed lung function tests, 13.0% routinely provided written asthma action plans, 23.1% routinely assessed asthma severity, and 30.0% reviewed inhaler use (Barton et al. 2009). In contrast to the BEACH data above, this study also reported that just over half of GPs routinely asked patients with moderate to severe asthma about smoking in the last 6 months. This higher proportion may reflect a greater severity of asthma among study participants. However, the difference may also be attributable to differences in the way the data were ascertained.

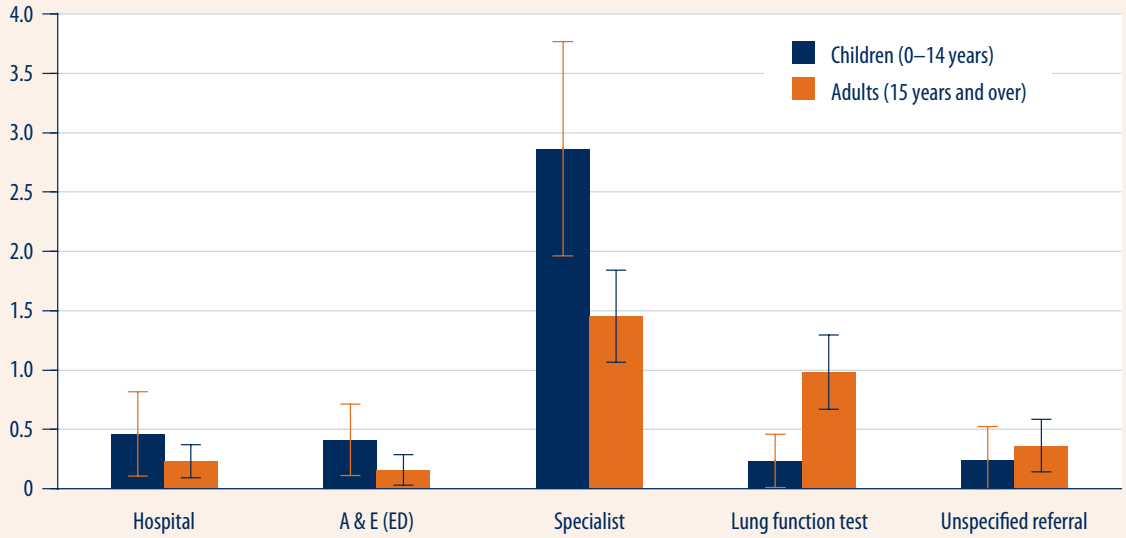
In Western Australia, a large proportion of GPs (40.6%, *N*=188) reported the use of both peak expiratory flow meters and spirometry as tools for monitoring childhood asthma, while 10.2% used spirometry only (Calogero et al. 2009).

Referrals

General practice encounters for the management of asthma rarely resulted in a recorded referral to outside services (Figure 5.14). Outside services for asthma are either for acute care (hospital and emergency department) when people are experiencing asthma symptoms or exacerbations, or for specialist care and respiratory function tests, which are most likely requested for more long-term asthma problems.

GPs referred children and adults to hospital (including the ED) for the management of asthma in less than 1% of all asthma-related encounters. The referral rates to hospital, ED and specialists for the management of asthma were higher in children than in adults. Children were referred to a hospital in 0.5% of all GP encounters where asthma was managed, and to the ED in 0.4%. Among adults, 0.2% were referred to hospital and 0.2% to the ED. Children were also more frequently referred to a specialist (2.9%) for the management of asthma than adults (1.5%). Adults were four times more likely than children to be referred for lung function tests for the management of asthma.

Proportion of general practice encounters for asthma (per cent)



A&E = accident and emergency department

Note: Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96. Lung function test includes all procedures listed under rubric R39.

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

Figure 5.14: Referrals provided during asthma-related general practice encounters, April 2007 to March 2010

Summary

Between 2000–01 and 2009–10, the rate of general practice encounters where asthma was managed among children declined by more than one quarter.

The highest rate of general practice encounters where asthma was managed was in boys aged 0–4 years and the lowest rate was among males aged 15–64 years.

Spirometry or other lung function testing was performed in 5.7% of asthma-related GP encounters for the management of asthma. Asthma action plans were more commonly provided for children than adults. GPs provided very few referrals relating to asthma management. GPs provided advice on smoking at 1.5% of all adult GP encounters for the management of asthma.

Since the introduction of the PIP Asthma Cycle of Care (which superseded the Asthma 3+ Visit Plan) in November 2006, the rate of claims for completing best practice care for patients with moderate to severe asthma through the Asthma Cycle of Care increased initially but has since remained relatively stable.

Provision of Asthma Cycle of Care programs is highest for children and older Australians with asthma. Asthma Cycle of Care programs are least likely to be completed for people aged 15–34 years, those living in *Inner regional* areas and those living in areas of lower socioeconomic status.

5.2 Hospitalisations and emergency department visits

5.2.1 Emergency department visits

This section presents the time trend in data for asthma obtained from the New South Wales (NSW) Emergency Department Data Collection (EDDC). Information on emergency department (ED) attendance for asthma is available for NSW, Victoria and Western Australia. However, the method of data collection differs between these states and cannot be aggregated. For this reason we describe ED attendance for asthma in NSW only.

Since exacerbations are more common in severe or poorly controlled asthma, rates of ED visits for asthma are often considered to reflect the prevalence of severe or poorly controlled asthma in the community (Vollmer et al. 2002). Some people, with consistently very poorly controlled asthma, have frequent ED visits for asthma (Haselkorn et al. 2010).

The occurrence of ED visits for asthma may be a useful indicator of the effects of:

- interventions to improve disease control in patients with asthma (Bateman et al. 2004)
- environmental exposures on asthma control (Jalaludin et al. 2008; Forbes et al. 2007).

Data on ED attendance may also be used to inform policy and guide the management of people who attend EDs frequently (LaCalle & Rabin 2010).

Going to an ED is only one of a range of alternatives available for managing exacerbations of asthma. Variation in ED visit rates for asthma may, in part, be attributable to variation in access to general practitioner care (including after hours and home visit accessibility) and in the provision and use of asthma action plans for worsening asthma. The accessibility of ED care itself may influence the likelihood that people with worsening of asthma will seek this mode of care.

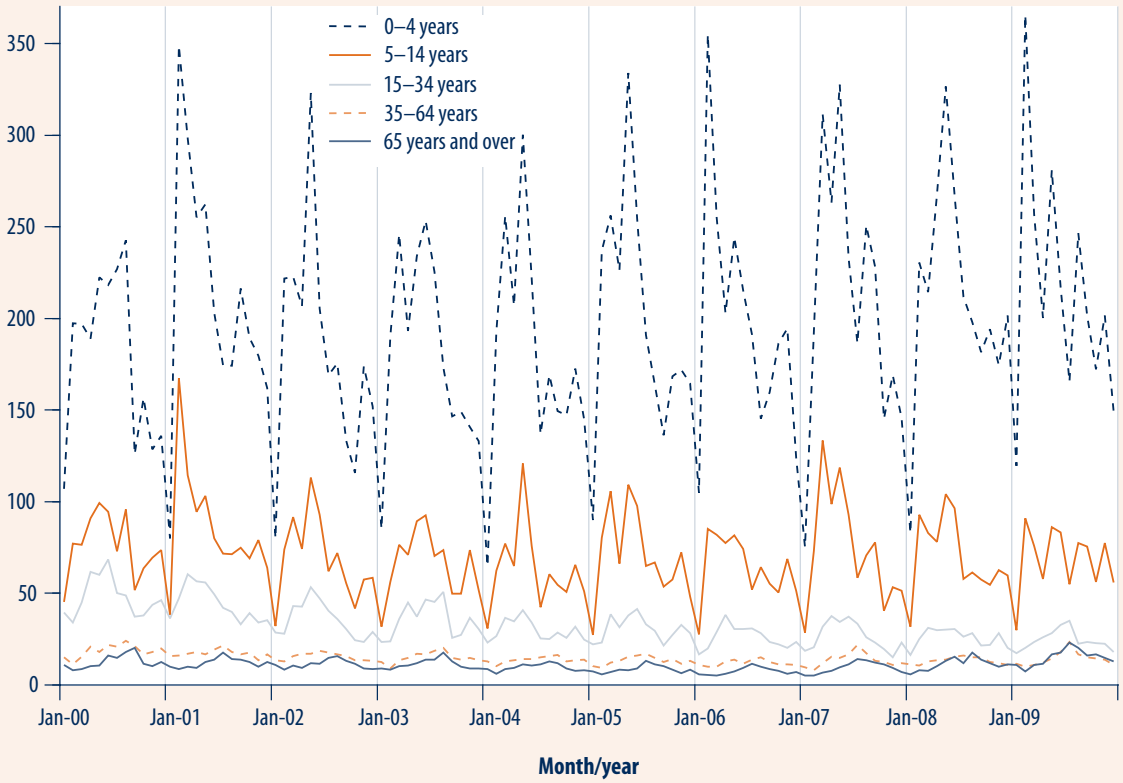
Although ED visits generally signify the occurrence of an exacerbation of asthma, not all ED visits for asthma are attributable to exacerbations. There is evidence to show that some people use EDs as a source of routine primary care (Ford et al. 2001).

An Australian and New Zealand study reported asthma as the 4th most frequent diagnosis in ED visits by children. The most frequent diagnoses were acute gastroenteritis, acute viral illness and acute upper respiratory tract infection. Among those aged 0–18 years, asthma represented 3.5% of all ED presentations in 2004 (Acworth et al. 2009).

Month-to-month variation in ED visit rates

There are marked month-to-month fluctuations in the rate of ED visits for asthma, particularly among children under the age of 15 years (Figure 5.15). The lowest rate of ED visits for asthma consistently occurred in January when there was also the least difference between age groups. At other times of the year, the rate of visits to an ED for asthma was much higher among children aged 0–14 years than in all other age groups.

Both the timing and the size of peaks in rates of ED visits varied with age, suggesting age-related differences in response to seasonal factors (Figure 5.15). Among children under the age of 15 years, the peak ED visit rate was in late summer, with several very large peaks occurring, most notably in February 2001, 2006 and 2009. Peaks in ED attendance rates for asthma among children also occurred in May 2002, 2004, 2005, 2007 and 2008.



Notes

1. As the coverage of the NSW emergency department (ED) data are less than 100%, these rates will be an underestimate of the true ED visit rate among people with asthma.
2. Data contains a mix of diagnoses coded using International Classification of Diseases, 9th and 10th revisions (ICD-9 and ICD-10) and SNOMED-CT. Comparability factors, calculated from hospitalisation data (see Appendix 1, Section A1.4.1) have been used to adjust for the changes in coding from ICD-9 to ICD-10. ED visits coded to ICD-9 were converted to ICD-10 using the following conversions: ages 0–4 years, no conversion; 5–34 years, converted by a factor of 1.0326; 35–64 years, converted by a factor of 0.7938; 65 years and over, converted by a factor of 0.4813. The NSW population was adjusted to reflect only those covered by the 43 EDs included in the data (60.13%).

Source: NSW Emergency Department Data Collection, Centre for Epidemiology and Research, NSW Department of Health.

Figure 5.15: Emergency department visits for asthma per 100,000 population, by age and month, New South Wales, January 2000 to December 2009

The peaks in ED visits among Australian children, similar to hospital admissions for asthma, are strongly related to the timing of return to school, consistent with international studies (Johnston & Sears 2006). Current evidence supports a role for respiratory viral infections and allergen exposure in these exacerbation peaks (Johnston & Sears 2006). Among people aged 65 years and over, and to a lesser extent those aged 35–64 years, the fluctuations in ED visit rates were less marked. Small peaks in ED visit rates for asthma among adults tended to occur in late autumn and winter, consistent with known peaks in respiratory viral infections in adults.

Discharge destination

In 2009, there were 18,824 ED visits for asthma in New South Wales from the 43 Emergency Departments included in this analysis. Among all people attending an ED for asthma in New South Wales in 2009, 38% were admitted to hospital rather than discharged home. The rate of admission to hospital for asthma from the ED was higher among children aged 0–14 years (43%) than among people aged 15 years and over (30%).

5.2.2 Hospitalisations

Hospitalisation for asthma is required when exacerbations are life-threatening or when they cannot be managed at home.

The rate of hospitalisation among people with asthma in Australia is low by comparison with other countries. An Australian study found that 3.8% of adults and 4.9% of children with asthma reported having been hospitalised for the condition in the past 12 months (Marks et al. 2007). This was lower than the rates reported in the Global Asthma Insights and Reality surveys conducted in North America, Europe and Asia, where rates ranged from 7.0% for western Europe to 19.1% for central and eastern Europe (Rabe et al. 2004).

Differences in the number of hospitalisations for asthma may be due to differences in the severity and prevalence of the disease in the community, cultural behaviour in accessing health services, the effectiveness of disease management or the tendency to diagnose asthma. The use of hospital care for the management of exacerbations may also be influenced by the relative accessibility of hospital services and of alternative services such as general practitioners, especially after hours (Phelan et al. 2002; Phelan et al. 1993). Differences in admission criteria and administrative policies also affect hospital usage data.

The data for this section are derived from the AIHW National Hospital Morbidity Database. In these data, the term 'hospital separation' refers to the formal process by which a hospital records the completion of treatment or care for an admitted patient. This includes completion due to discharge, death, transfer to another hospital or change in the type of care. Each separation represents one episode of hospitalisation (or admission). For more information on this database, see Appendix 1, Section A1.10.

There were 36,703 separations of people admitted to hospital with a principal diagnosis of asthma in 2008–09 in Australia. Asthma accounted for 0.45% of all hospital separations during that period.

Time trends in hospital use for asthma

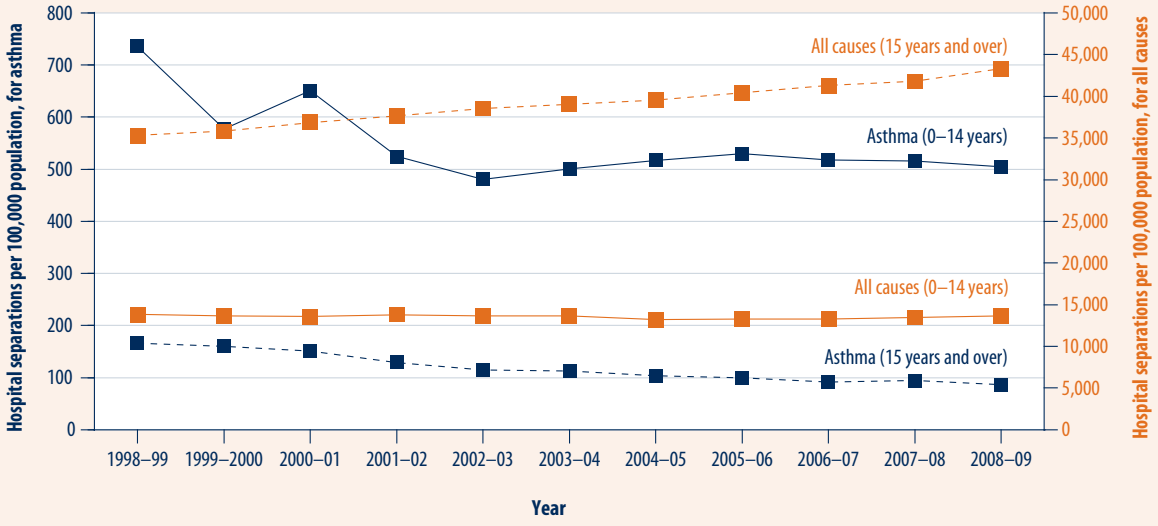
In 2008–09, the overall hospital separation rate for asthma was 172 per 100,000 population. The rate among children aged 0–14 years (505 per 100,000 population) was markedly higher than the rate among people aged 15 years and over (86 per 100,000 population).

There was a substantial reduction in the age-standardised rate of hospitalisation for asthma in both adults (31%) and children (35%) during the period between 1998–99 and 2002–03. However, rates have remained relatively stable since (Figure 5.16; see also Appendix 2, Table A2.6). The time trends in rates of hospitalisation for asthma are different to the time trends for all-cause hospitalisations over the same period. Since 1998–99, all-cause hospitalisations among children have remained relatively stable, while among adults the rate has increased steadily over time. These results are consistent with the overall significant increase in the number of hospital separations between 1998–99 and 2008–09 (DoHA 2010).

The decline in hospital admissions for asthma is not attributable to any parallel reduction in the prevalence of asthma over this period. It is possible that the decrease in hospitalisations for asthma is due to more effective long-term or preventative management of asthma or more effective out-of-hospital management of disease exacerbations. It is also possible that there was a decrease in the severity of asthma over this period, due to environmental change. It is not possible to attribute the observed trend with any degree of certainty to any of these factors.

In 2008–09, the average length of stay among people admitted to hospital with asthma was 2.5 days. On average, people aged 15 years and over tended to stay in hospital longer (3.7 days) than children (1.6 days).

Among adults, the average length of stay has declined since 1998–99, both for asthma specifically and for all causes (Figure 5.17). Among children, the average length of stay for asthma has gradually decreased since 1998–99 in contrast to the average length of stay for all causes, which has remained stable.

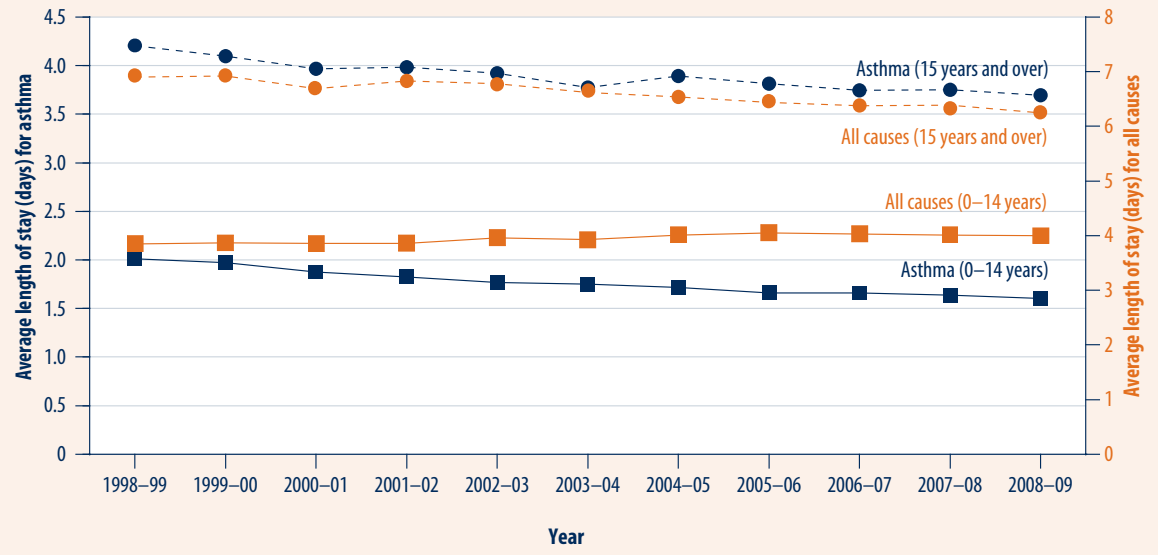


Notes

1. Age-standardised to the Australian population as at 31 December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) code J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.16: Hospital separations for asthma and all causes per 100,000 population, by broad age group, 1998–99 to 2008–09



Notes

1. Separations for which care type was reported *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM), codes J45 and J46.
3. Excludes same day separations, includes patient days longer than 120 days.

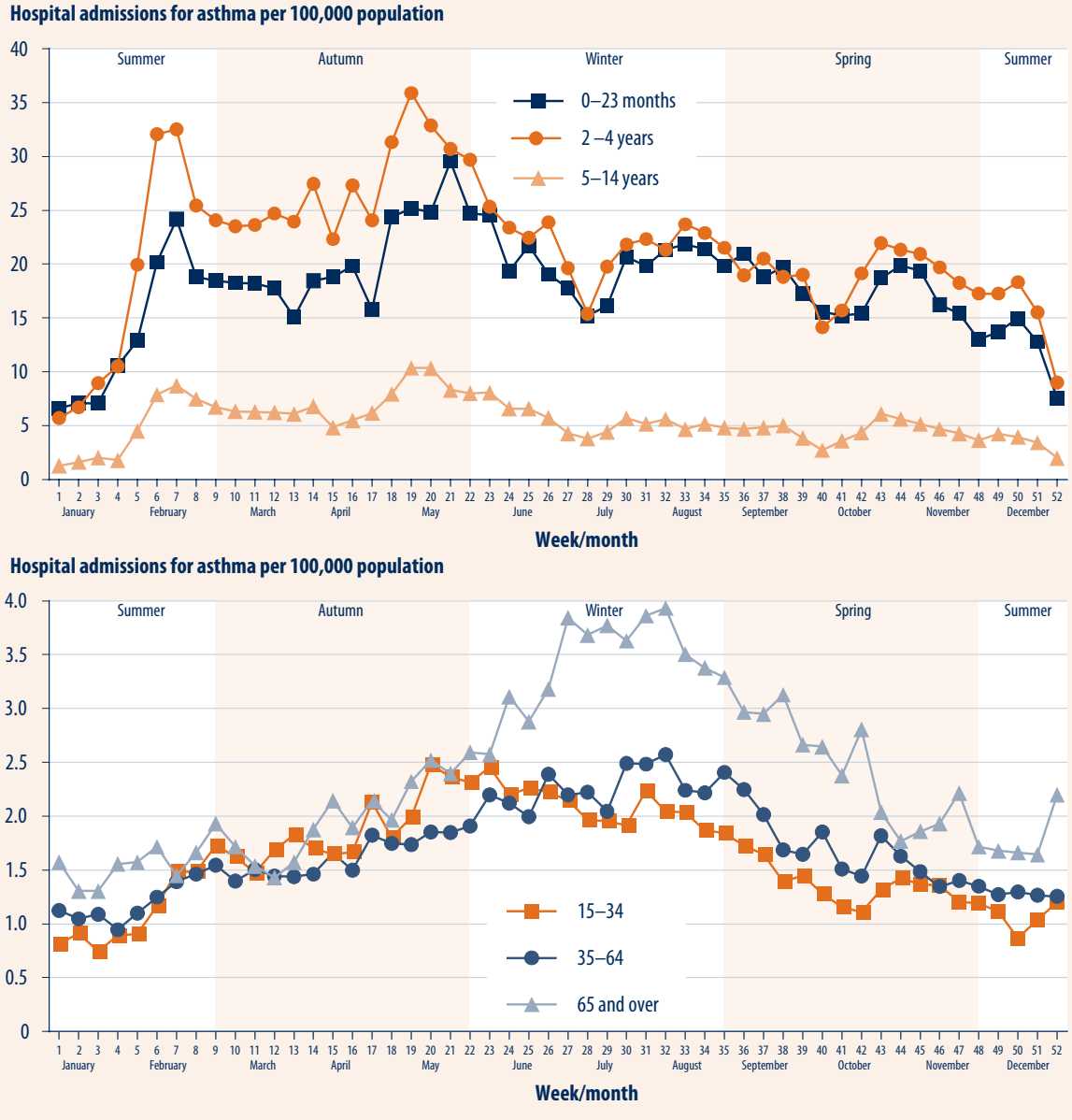
Source: AIHW National Hospital Morbidity Database.

Figure 5.17: Average length of stay for asthma and all causes, by broad age group, 1998–99 to 2008–09

Seasonal variation

Among children, the peaks for hospitalisations attributed to asthma, like those for ED visits, occur in late summer and autumn (Figure 5.18). The reason for these seasonal peaks is not certain, though they are likely to be related to a high prevalence of the common cold (and other viral respiratory infections) in children around this time.

Among adults, hospitalisation rates for asthma are highest in the winter months and early spring, particularly among those aged 65 years and over (Figure 5.18), which probably reflects the impact of the winter rise in respiratory tract infections.



Notes

1. Admissions for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. Data are for admissions (not separations).
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.18: Seasonal variation in hospital admission rates for asthma, by age, children and adults, 2007 and 2008

Large seasonal peaks in hospital admission rates for children have been observed in both the Northern and Southern Hemispheres in late summer. In New South Wales, it was noted that these peaks coincide with the return to school after the holidays (Lincoln et al. 2006). It has been reported that peaks in hospital admissions for asthma are reached in February within 3.5 weeks of returning to school from the long summer holiday. Smaller peaks in hospital admission rates were also observed in May after the shorter school holiday break (Lincoln et al. 2006).

Studies conducted in the Northern Hemisphere also observed increased asthma hospitalisation rates in children in early autumn, with consistent timing after school holidays (Van Dole et al. 2009; Johnston 2007; Johnston et al. 2005). A Canadian study reported large peaks of hospital admissions for asthma 2 to 3 weeks after school return from summer vacation in Canada, Sweden, England and Scotland. Furthermore, similar seasonal patterns of hospital admissions for asthma were observed in New Zealand following school return after summer vacation (Johnston & Sears 2006).

The post-summer holiday asthma epidemics among children are thought to be related to viral infections and allergen exposure, perhaps enhanced by the increase in social contacts at this time (Lincoln et al. 2006) and reduced compliance with asthma treatment during the summer period (Spahn et al. 2009; Van Dole et al. 2009). Other factors considered, including weather changes and airborne pollutants, do not explain the consistency of the observed timing in each geographic location.

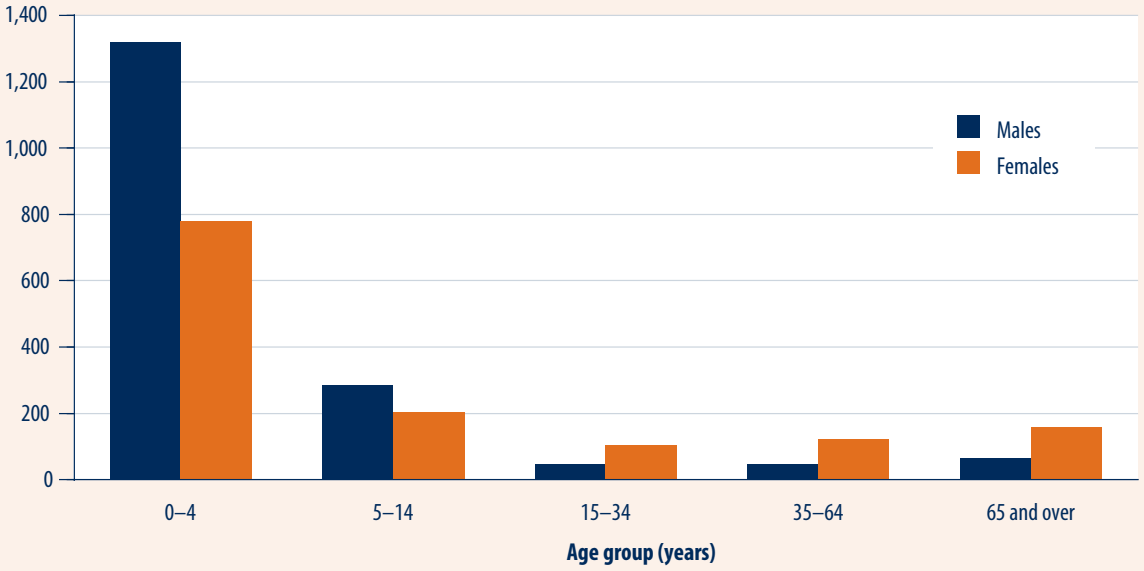
Seasonal patterns of asthma hospitalisation have also been observed among adults, however at different times of the year and to a lesser extent. Among Canadian adults, hospitalisations for asthma are at their highest levels during the winter months, particularly shortly after Christmas (Johnston 2007). These seasonal differences between children and adults suggest that there are different mechanisms and various unknown factors that play a role in asthma exacerbations that are severe enough to require hospitalisation.

Population subgroups

Age and sex

The highest rate of hospital separations for asthma was observed in children aged 0–4 years, particularly boys where the rate was 1,320 per 100,000 population in 2008–09.

Boys aged 0–14 years were more likely to be admitted to hospital for asthma than girls and, after the age of 15 years, females had a higher rate than males (Figure 5.19). This reflects the higher prevalence of asthma in boys than girls and the higher prevalence in women than men.



Notes

1. Age-standardised to the Australian population as at December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.19: Hospital separations for asthma per 100,000 population, by age and sex, 2008–09

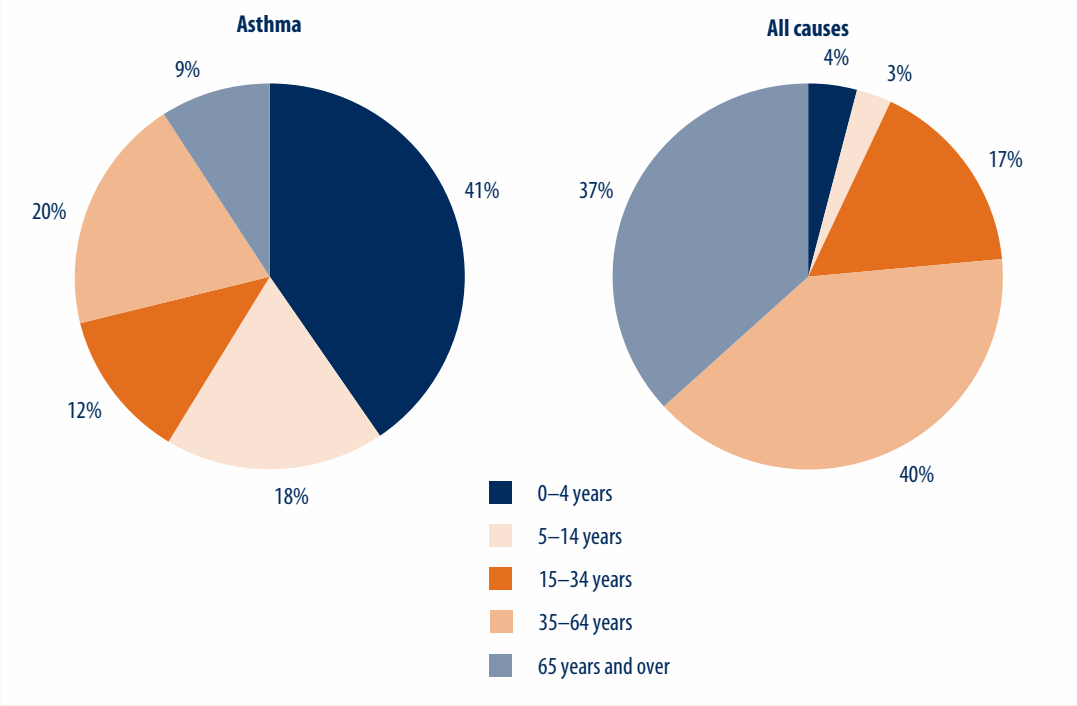
From the age of 5–13 years, boys have higher hospital separation rates for asthma than girls. Both the rates and the difference in rates between boys and girls gradually decline until age 13 years, when the rates are not significantly different. From the age of 14 years, the hospital separation rate for asthma continues to decline among boys and reaches a stable level at 15–18 years. Among girls, the rate starts to rise after 14 years and girls have higher rates of hospital separations for asthma than boys from this age. A similar gender pattern of asthma hospitalisation was observed in 2006–07 in Australia (ACAM 2008a).

This sex difference is consistent with international studies. Rates of hospital admissions for asthma between 1995 and 1999 in Canada and New Zealand declined dramatically throughout childhood where they were twice as high in boys as girls. Between the ages of 13–14 years a crossover of rates occurred and thereafter, the risk of hospital admission for asthma among women is double that of men (Johnston & Sears 2006).

A Canadian study supported these findings of higher asthma hospitalisation rates among females aged 15 years and over compared with males of the same age. Females aged 20–44 years had a hospitalisation rate 3 times higher than among males (Klomp et al. 2008).

Although these sex differences were consistently observed, the mechanism remains unclear.

Compared with the general hospitalised population, those hospitalised for asthma are much younger. In 2008–09, more than half (59%) of all hospital separations for asthma were for children aged 0–14 years (Figure 5.20). The proportion of all-cause hospital separations attributed to children was only 7%. In contrast, hospitalisations among people aged 65 years and over represented a much larger proportion of all-cause hospital separations than asthma separations (37% compared with 9%, respectively).



Notes

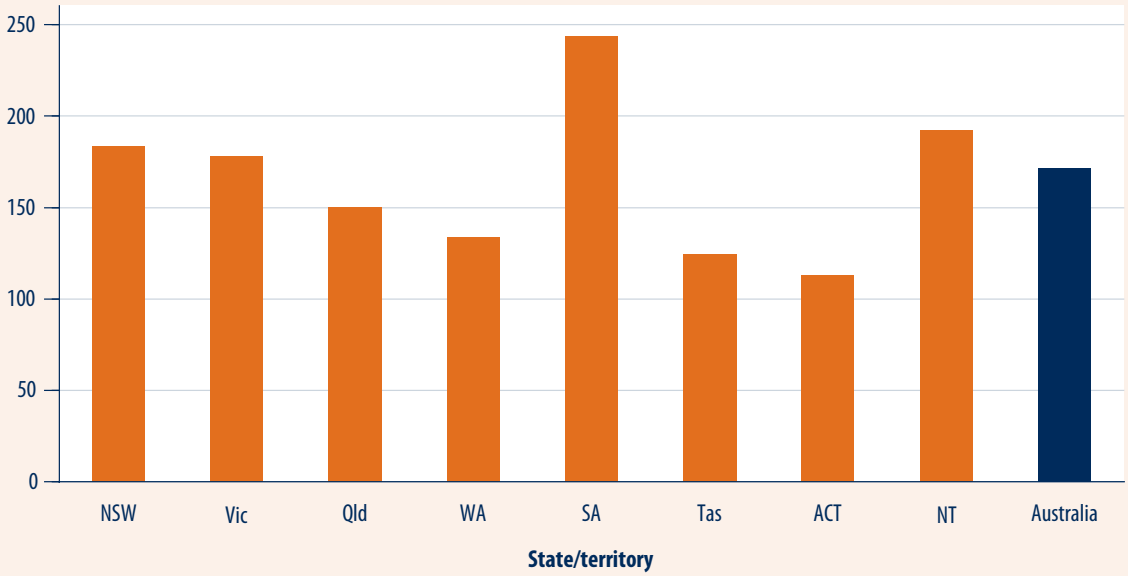
1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.20: Age distribution for hospital separations for asthma and all causes, 2008–09

States and territories

In 2008–09, overall, the rate of hospitalisation for asthma was significantly higher in South Australia (244 per 100,000 population) and lower in the Australian Capital Territory (113 per 100,000 population) compared with other states and territories (Figure 5.21). Compared with the national average, South Australia, New South Wales, Victoria and the Northern Territory had higher rates of hospitalisation while Queensland, Western Australia, Tasmania and the Australian Capital Territory had lower rates.



Notes

1. Age-standardised to the Australian population as at December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

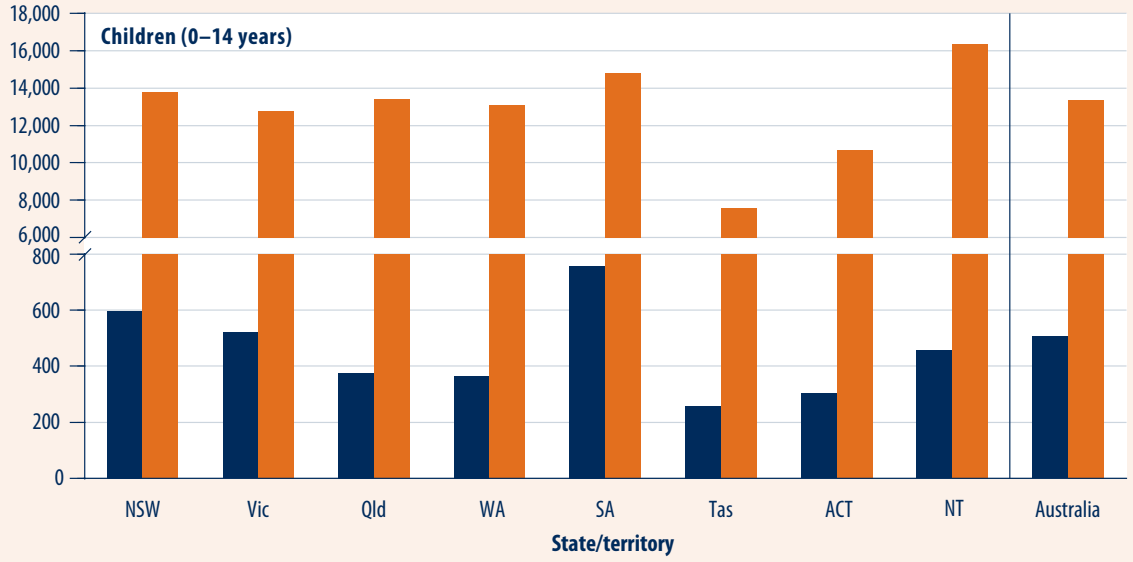
Source: AIHW National Hospital Morbidity Database.

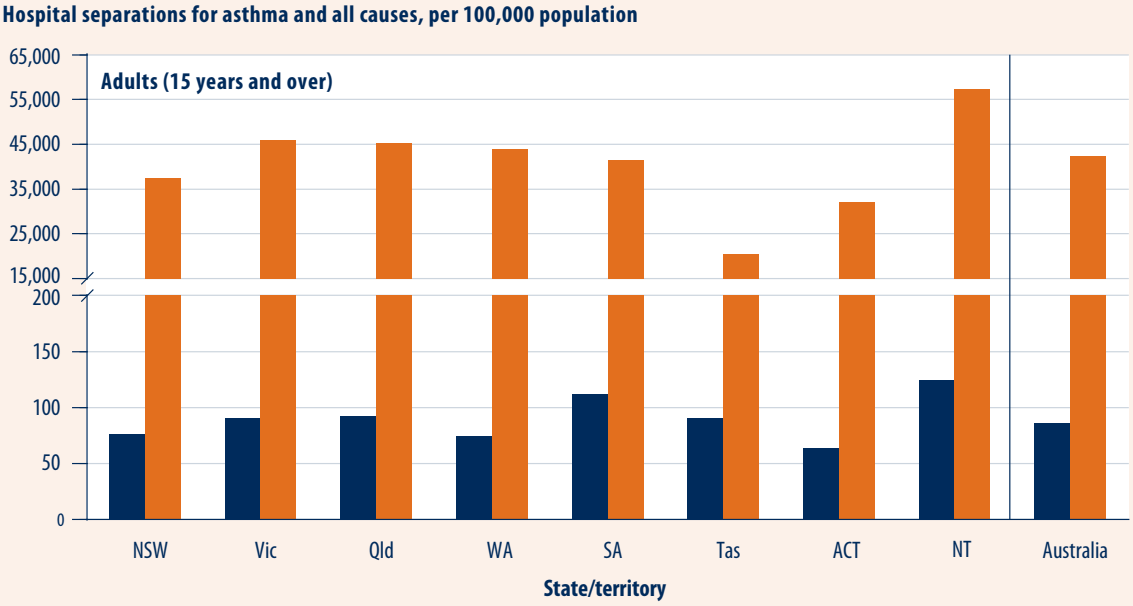
Figure 5.21: Hospital separations for asthma per 100,000 population, all ages, by state and territory, 2008–09

Among children aged 0–14 years, hospital separation rates for asthma in 2008–09 were lower than the national average in Queensland, Western Australia, Tasmania, and the Australian Capital Territory and were higher than the average in New South Wales and South Australia. Asthma represented a higher proportion of all-cause separations among children in South Australia (5. 1%) and New South Wales (4.4%) than in the other states and territories. In Queensland, Western Australia and the Northern Territory, asthma accounted for only 2.8% of all-cause separations among children during 2008–09 (Figure 5.22).

Among adults aged 15 years and over, there was less variation in rates of hospital separations for asthma between the states and territories, although the rates in the Northern Territory, South Australia and in Tasmania were above the national average. Asthma represented a higher proportion of all-cause separations in Tasmania (0.41%) than in the other states and territories. In Western Australia, asthma accounted for only 0.20% of all-cause separations among adults during 2008–09 (Figure 5.22).

The higher rates in South Australia are most evident in children and are not fully explained by the significantly higher rate of all-cause hospitalisation in that state.





Notes

1. Age-standardised to the Australian population as at 30 June 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

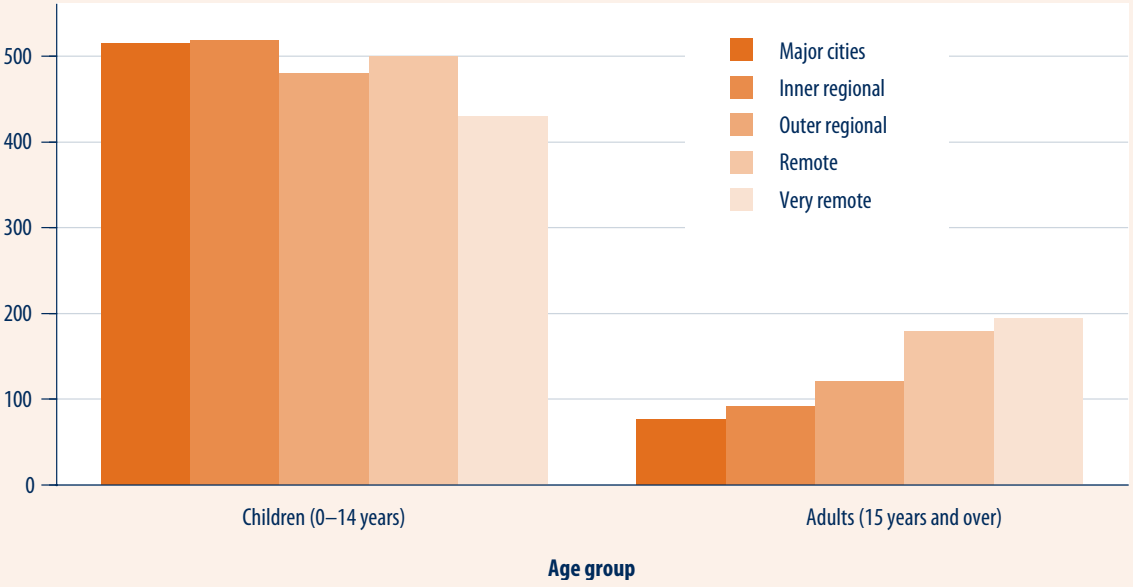
Figure 5.22: Hospital separations for asthma and all causes per 100,000 population among children and adults, by state and territory, 2008–09

Cities, regions and remote areas

In 2008–09, the overall hospital separation rate for asthma was 167 per 100,000 people living in *Major cities* and 242 per 100,000 people living in *Very remote* areas of Australia. However, children aged 0–14 years living in *Major cities* had a higher hospital separation rate for asthma than those living in *Very remote* areas ($p<0.0001$) (Figure 5.23). In contrast, the hospital separation rate for asthma among people aged 15 years and over increased with increasing remoteness. The rate was significantly higher among those residing in *Very remote* areas compared with those residing in *Major cities* ($p<0.0001$).

This pattern among people aged 15 years and over is consistent with the regional variation observed for all-cause hospital separations (AIHW 2009a), and may reflect access to care.

Hospital separations per 100,000 population



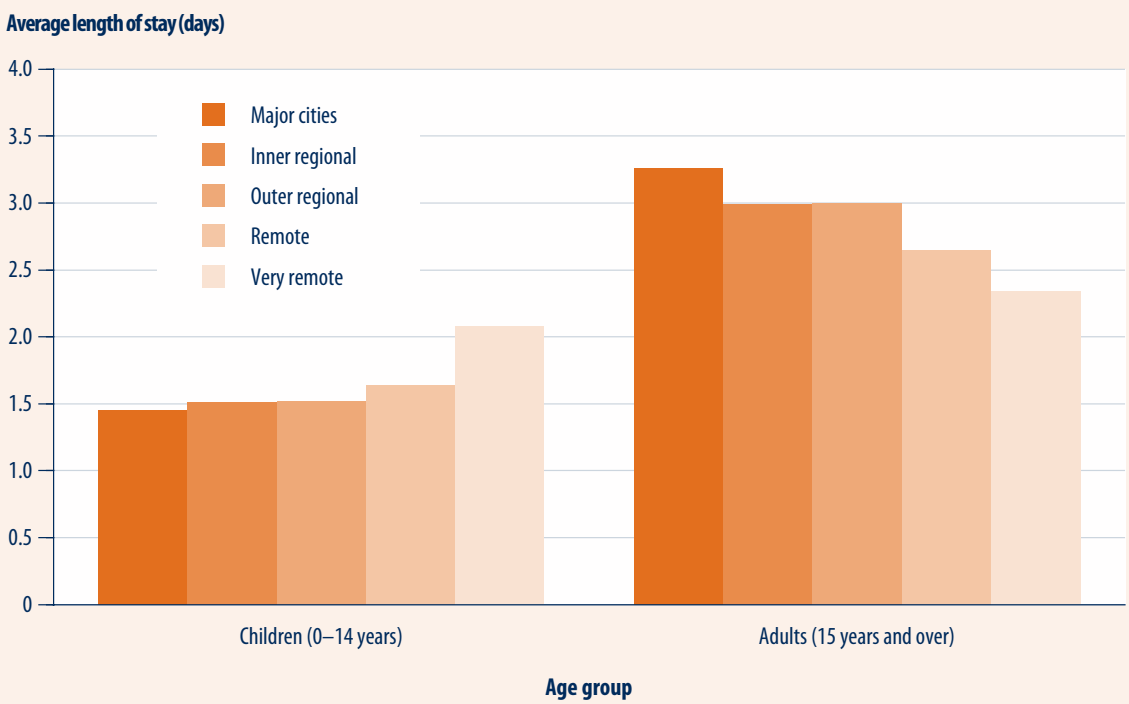
Notes

1. Age-standardised to the Australian population as at 30 June 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.
4. 2006 Statistical local area boundaries were used to map to Australian Standard Geographical Classification (ASGC) level of remoteness (see Appendix 1.13.4)

Source: AIHW National Hospital Morbidity Database.

Figure 5.23: Hospital separations for asthma per 100,000 population, by age and remoteness, 2008–09

Among adults, there was a significant association between the average length of stay for asthma and remoteness of residence (Figure 5.24). Adults residing in *Major cities* had a longer length of stay for asthma (3.3 days) than adults who resided in *Very remote* areas (2.3 days; p<0.05).



Notes

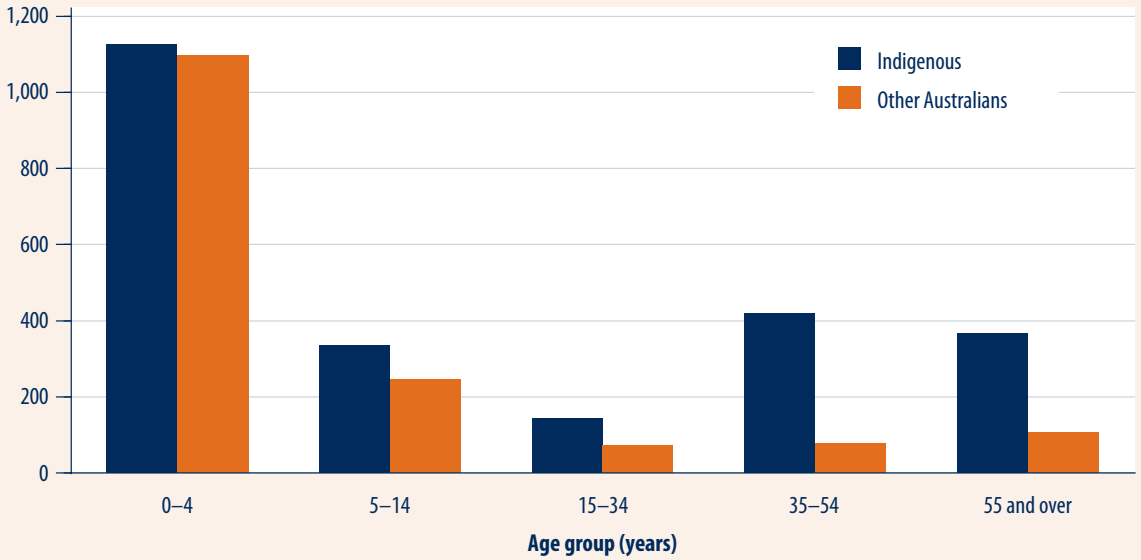
1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.24: Average length of stay for asthma, by age and remoteness, 2008–09

Aboriginal and Torres Strait Islander Australians

Among Aboriginal and Torres Strait Islander Australians, the hospital separation rate for asthma was highest in children aged 0–4 years (Figure 5.25). Among people aged 5 years and over, Indigenous Australians had higher hospital separation rates for asthma than other Australians. This difference was greatest in those aged 35 years and over.



Notes

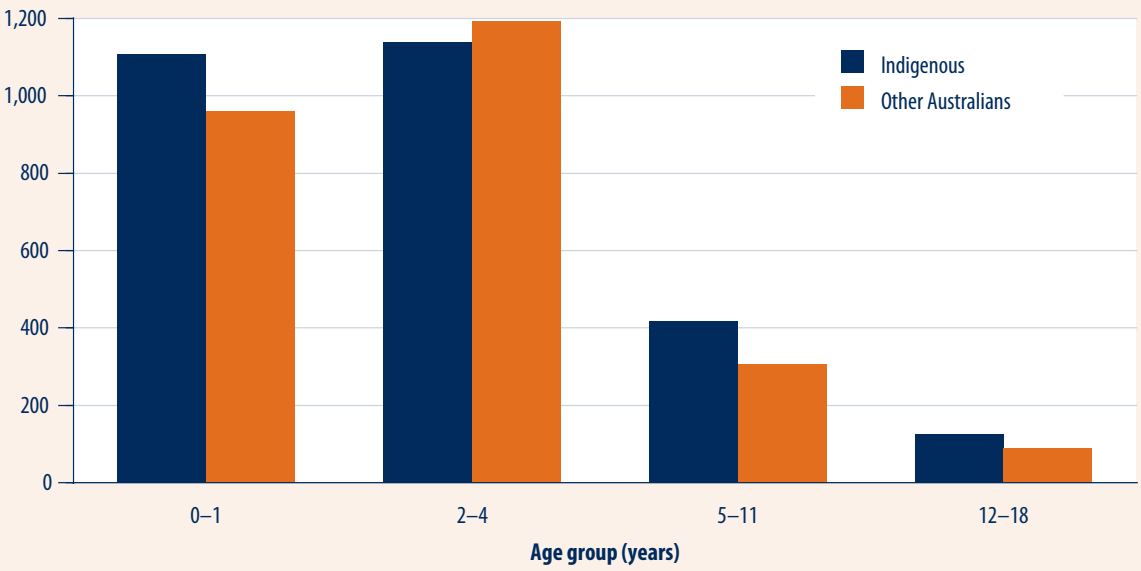
1. Age-standardised to the Australian population as at June 2001.
2. Data are included only for those states/territories for which Indigenous identification was considered reliable, that is, New South Wales, Victoria, Queensland, Western Australia, South Australia and the Northern Territory (public hospital only for the Northern Territory). The data are not necessarily representative of the jurisdictions excluded.
3. 'Other Australians' include people classified as non-Indigenous plus those who did not state their Indigenous status. People who did not state their Indigenous status comprised 1.3% of hospital separations among 'other Australians'.
4. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
5. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.25: Hospital separations for asthma per 100,000 population, by age and Indigenous status, 2008–09

The median length of stay was the same for Indigenous and other Australians (2 days). That is 50% of hospital separations for asthma had a length of stay of 2 days or less.

Indigenous children aged 0–18 years had a higher hospital separation rate for asthma (488 per 100,000 population) than other Australian children (426 per 100,000 population) ($p<0.0001$) (Figure 5.26). The disparity was greatest amongst those aged 5–11 years where the rate was 419 per 100,000 population among Indigenous children versus 308 per 100,000 population among other Australian children ($p<0.0001$).



Notes

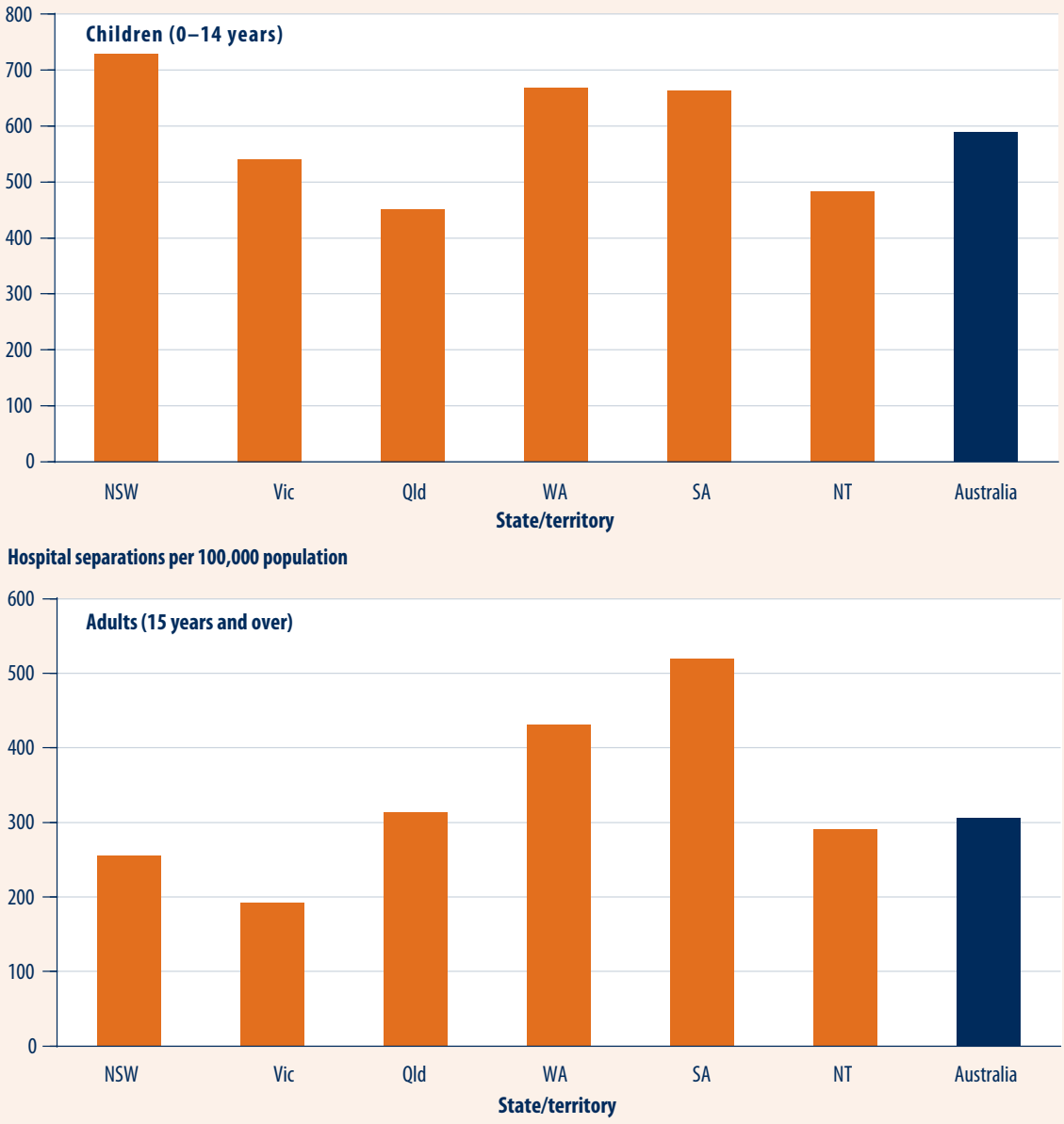
1. Age-standardised to the Australian population as at June 2001.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.
3. 'Other Australians' include people classified as non-Indigenous plus those who did not state their Indigenous status.
4. Rates for this figure are based on different populations than Figure 5.25 and Figure 5.27 since 1-year age groups were required.
5. Populations for this figure are 2007 projected Aboriginal and Torres Strait Islander population estimates based on the 2001 census.
6. Data are included only for those states/territories for which the Indigenous identifier was considered reliable, that is, New South Wales, Victoria, Queensland, Western Australia, South Australia and the Northern Territory (public hospitals only for the Northern Territory). The data are not necessarily representative of the jurisdictions excluded.
7. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

Source: AIHW National Hospital Morbidity Database.

Figure 5.26: Hospital separations for asthma per 100,000 population, by Indigenous status, children aged 0–18 years, 2008–09.

In 2008–09, Indigenous children under 15 years of age from Queensland had a lower hospital separation rate for asthma than the average of the six jurisdictions, while New South Wales had a higher rate than the average (Figure 5.27).

Among Indigenous Australians aged 15 years and over, the hospital separation rate for asthma in South Australia and Western Australia were significantly higher than the average ($p<0.0001$) and the rate in Victoria was significantly lower than the average of the six jurisdictions ($p<0.01$).



Notes

1. Age-standardised to the Australian population as at 30 June 2001.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.
3. Data are included only for those states/territories for which the Indigenous identification was considered reliable, that is, New South Wales, Victoria, Queensland, Western Australia, South Australia and the Northern Territory (public hospitals only). The data are not necessarily representative of the jurisdictions excluded.
4. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

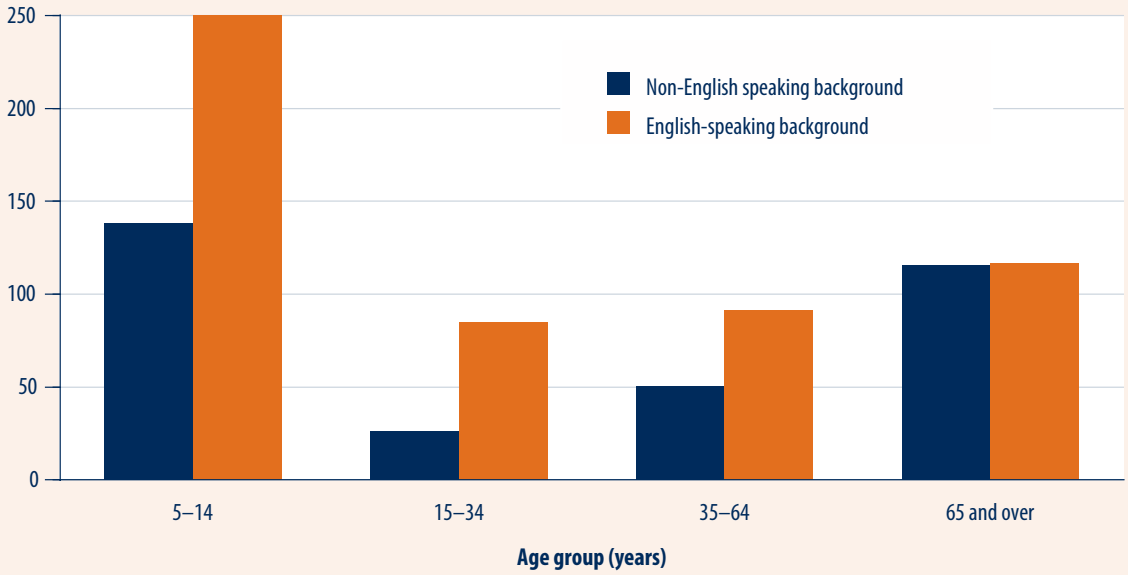
Source: AIHW National Hospital Morbidity Database.

Figure 5.27: Hospital separations for asthma per 100,000 population among Indigenous Australians, by broad age group and state and territory, 2008–09

Country of birth

Overall, the hospital separation rate for asthma among those aged 5 years and over was higher among those from an English-speaking background (116 per 100,000 population) than among those from a non-English-speaking background (65 per 100,000 population) ($p<0.0001$).

The disparity in hospitalisations for asthma according to country of birth diminished with age (Figure 5.28). Among those aged 65 years and over, there was no difference in the hospital separation rate for asthma according to country of birth ($p=0.9$).



Notes

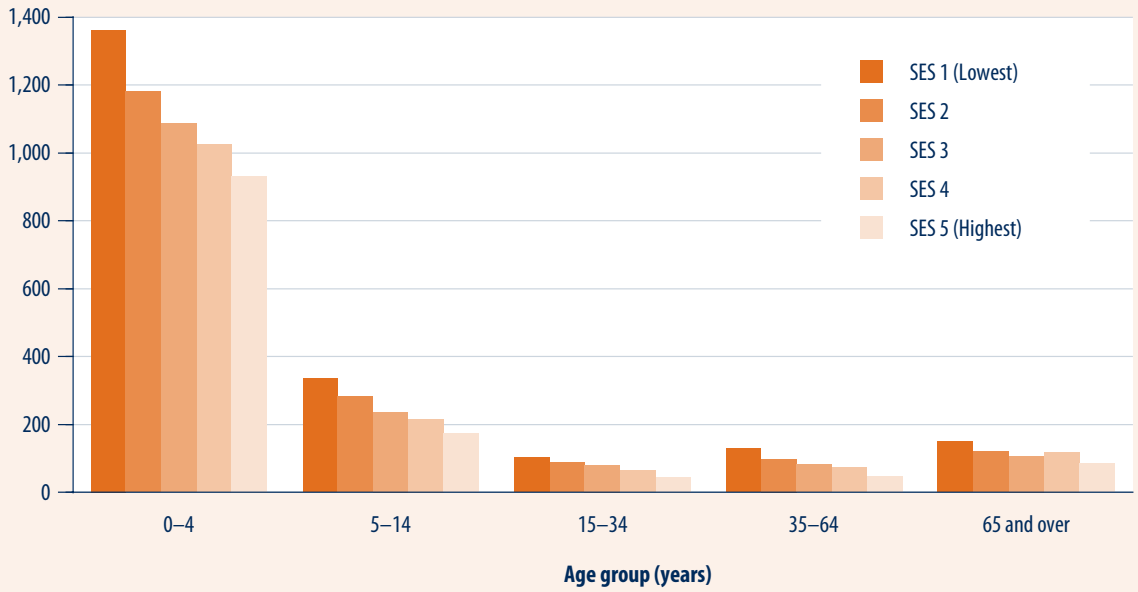
1. Age standardised to the Australian population as at 30 June 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.
4. English-speaking background includes anyone born in Australia, New Zealand, Canada, United Kingdom, Ireland, United States of America, South Africa or Zimbabwe. Non-English-speaking background includes all those born in other countries. See Appendix 1, Section A1.13.2 for further information on country-of-birth classifications.

Source: AIHW National Hospital Morbidity Database.

Figure 5.28: Hospital separations for asthma per 100,000 population, by broad age group and country of birth, people aged 5 years and over, 2008–09

Socioeconomic status

Hospital separations for asthma increased with decreasing socioeconomic status ($p<0.0001$) (Figure 5.29). Overall, the hospital separation rate for asthma was significantly higher among those residing in areas with the lowest socioeconomic status (234 per 100,000 population) compared with those residing in areas with the highest socioeconomic status (128 per 100,000 population) ($p<0.0001$). This trend was observed for all age groups.



SES = Socioeconomic status (see Appendix 1, Section A1.13.3)

Notes

1. Age standardised to the Australian population as at 30 June 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.29: Hospital separations for asthma per 100,000 population, by age group and socioeconomic status, 2008–09

5.2.3 Comorbidities in patients admitted to hospital with asthma

The presence of one or more comorbid conditions in people with asthma is likely to compromise their quality of life and may complicate management of the disease. In this section we investigate comorbidities by looking at the presence of additional diagnoses in people admitted to hospital with a principal diagnosis of asthma. It should be noted that conditions or disorders that do not affect the course of hospital care or the treatment received by the patient during their hospital stay are not recorded as additional diagnoses in the National Hospital Morbidity Database.

In 2008–09, 44% of patients admitted to hospital with a principal diagnosis of asthma had at least one comorbidity reported during their hospital stay. The proportion of patients hospitalised for asthma with at least one comorbidity increased with age from 40% among those aged 0–14 years to 62% among those aged 65 years and over. More females (46%) than males (41%) hospitalised for their asthma had at least one comorbid condition.

As expected, the presence of comorbidity is associated with a prolonged length of stay. The median length of stay for asthma was 2 days among those with at least one comorbidity compared with 1 day for those with no comorbidity (excluding same-day patients and those with length of stay of more than 120 days).

Respiratory comorbidities

A quarter of all people hospitalised due to asthma in 2008–09 had an acute respiratory infection (ICD-10-AM codes J0–J22) listed as an additional diagnosis.

Respiratory infections occurred frequently as an associated diagnosis among children admitted to hospital with asthma. Thirty percent of all children aged 0–14 years who were hospitalised with asthma in 2008–09 had acute respiratory infections recorded as an additional diagnosis (Table 5.1).

The occurrence of respiratory infections was also common in other age groups, with 26%, 23% and 24% of asthma admissions in people aged 15–34 years, 35–64 years and 65 years and over, respectively, being associated with such infections.

As not all cases of respiratory infection are reported and some may have resolved before the hospital admission, it is likely that these data underestimate the role of respiratory infections as triggers for exacerbations leading to hospitalisation. Furthermore, prospective studies have indicated that respiratory viruses are associated with around 80% of asthma exacerbations in children (Johnston et al. 1995) and up to 75% in adults (Wark et al. 2002).

Other obstructive lung disease often coexists with a diagnosis of asthma, particularly among older people. Among people aged 65 years and over who were admitted to hospital with asthma, 3.5% had COPD or emphysema and 1.7% had bronchiectasis as reported comorbid conditions.

Other comorbidities

This section examines the prevalence of several, specific comorbidities among people hospitalised with a principal diagnosis of asthma (Table 5.1). Among young adults aged 15–34 years admitted to hospital with asthma, mental and behavioural disorders were a common comorbidity, particularly among females. The prevalence of diabetes as an additional diagnosis increased with age among adults from 1.0% to 5.2% to 10.1% among those aged 15–34 years, 35–64 years and 65 years and over, respectively. 'Heart, stroke and vascular disease' was listed as an additional diagnosis in 9.5% of asthma admissions among those aged 65 years and over.

Table 5.1: Comorbidities in people admitted to hospital with asthma, by age and sex, 2008–09

Age group	Comorbidity	Proportion of all asthma separations		
		Males	Females	Persons
0–14 years	Respiratory infections	29.4	29.6	29.5
	COPD	0.06	–	0.05
	Bronchiectasis	0.04	–	0.04
	Non-infectious upper respiratory conditions	0.5	0.6	0.5
	Diabetes mellitus	0.2	0.2	0.2
	Heart, stroke and vascular disease	–	–	–
	Arthritis and osteoporosis	–	–	–
	Mental and behavioural disorders	0.5	0.8	0.6
15–34 years	Respiratory infections	25.2	26.0	25.7
	COPD	0.4	0.7	0.6
	Bronchiectasis	0.2	0.1	0.1
	Non-infectious upper respiratory conditions	0.4	1.2	0.9
	Diabetes mellitus	0.6	1.2	1.0
	Heart, stroke and vascular disease	–	0.1	0.1
	Arthritis and osteoporosis	0.3	0.2	0.2
	Mental and behavioural disorders	1.3	3.0	2.4
35–64 years	Respiratory infections	21.1	23.1	22.6
	COPD	2.2	2.3	2.3
	Bronchiectasis	0.6	1.2	1.0
	Non-infectious upper respiratory conditions	1.7	1.7	1.7
	Diabetes mellitus	3.7	5.9	5.2
	Heart, stroke and vascular disease	1.8	1.3	1.4
	Arthritis and osteoporosis	0.8	0.6	0.7
	Mental and behavioural disorders	3.2	3.9	3.7
65 years and over	Respiratory infections	22.2	25.0	24.2
	COPD	3.6	3.4	3.5
	Bronchiectasis	1.1	1.9	1.7
	Non-infectious upper respiratory conditions	1.2	1.5	1.4
	Diabetes mellitus	9.3	10.3	10.1
	Heart, stroke and vascular disease	8.3	9.6	9.5
	Arthritis and osteoporosis	1.2	2.1	1.9
	Mental and behavioural disorders	1.2	3.5	2.9

– nil or rounded to zero

Notes

1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. Asthma was classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.
3. Comorbidities were classified as follows: acute lower respiratory infections (J00–J22); chronic obstructive pulmonary disease (COPD) (includes emphysema and bronchitis) (J40–J44); bronchiectasis (J47); non-infectious upper respiratory conditions (includes rhinitis, sinusitis, laryngitis) (J30–J39); diabetes mellitus (includes Type I and Type II) (E10–E14); heart, stroke and vascular disease (I20–I25, I60–I69, I50, I70–I79); arthritis and osteoporosis (M00–M25,M80–M82); and mental and behavioural disorders (F30–F39, F40–F48, F90–F98). Of all people hospitalised for asthma in 2008–09, 44% had at least one of the selected comorbid conditions.

Source: AIHW National Hospital Morbidity Database.

Asthma as an additional diagnosis in people admitted to hospital with other conditions

Asthma was an additional diagnosis in 17,460 hospital separations in 2008–09, representing 0.2% of all hospital separations in that year where asthma was not the principal diagnosis (8,111,745 separations).

For patients admitted to hospital with an additional diagnosis of asthma in 2008–09, the most common principal diagnosis was influenza, pneumonia or other acute lower respiratory tract infection. Admissions with these lower respiratory tract infections accounted for 22% of separations where asthma was recorded as an additional diagnosis.

In comparison, during the same year, hospital admissions with a principal diagnosis of COPD or bronchiectasis had asthma recorded as an additional diagnosis in 1.4% and 0.9% of separations, respectively. People aged 15–34 years (3.5%) were more likely than older people (0.3%), and females (0.6%) were more likely than males (0.3%), to have asthma recorded as an additional diagnosis when COPD was the principal diagnosis. For those with bronchiectasis as principal diagnosis, those aged 35–64 years (4.8%) were more likely than people aged 65 years and over (3.0%), and females (4.1%) were more likely than males (2.6%) to have asthma recorded as an additional diagnosis.

The most common principal diagnosis associated with an additional diagnosis of asthma among people aged 0–14 years and 35 years and over was influenza, pneumonia or other acute lower respiratory tract infection.

Among people aged 15–34 years the most common principle diagnosis was pregnancy, childbirth and puerperium (the period directly after childbirth where the uterus returns to normal size). Presumably, these reflect the relative importance of these conditions as causes of hospitalisation in these age groups.

Summary

Children have high rates of hospitalisation for asthma compared with adults, but adults tend to stay in hospital for asthma longer than children.

There was an overall reduction in the rate of hospital admissions for asthma among children (47%) and among adults (32%) between 1993–94 and 2002–03. Since that time hospitalisation rates have remained stable.

Children contribute a far greater proportion of hospital admissions for asthma (57%) than of all-cause hospital admissions (7%).

Peaks in hospitalisation rates for asthma occur during winter among adults, while among children, the rate of hospitalisation for asthma is highest in February and May. A broadly similar seasonal pattern is observed in emergency department attendances.

Boys have higher rates of hospitalisation for asthma than girls. However, from age 14 years onwards, this trend is reversed and females have a higher rate of hospitalisation for asthma than males. These patterns are consistent with those observed for asthma prevalence and the rate of GP encounters for asthma.

Among adults, the hospital separation rate for asthma increases with increasing geographic remoteness. This trend is reversed among children, where the hospital separation rate for asthma decreases with increasing remoteness.

Hospital separations for asthma are higher among those from an English-speaking background and those residing in areas with lower socioeconomic status.

The hospital separation rate for asthma among Aboriginal and Torres Strait Islander Australians was higher than other Australians from age 5 years and over.

Respiratory infections and asthma are commonly associated causes of admission to hospital.

5.3 Invasive mechanical ventilation

A small proportion of people with severe exacerbations of asthma either stop breathing altogether or decrease their breathing to such an extent that they are at risk of stopping breathing. This represents a severe, imminently life-threatening event and can only be averted by the introduction of artificial mechanical ventilation via an endotracheal tube attached to a positive pressure ventilator, otherwise known as a 'life-support machine'. This procedure is sometimes referred to as invasive mechanical ventilation to distinguish it from a non-invasive form of ventilation that is used in less severe circumstances. Both invasive and non-invasive mechanical ventilation are also referred to as 'assisted ventilation'.

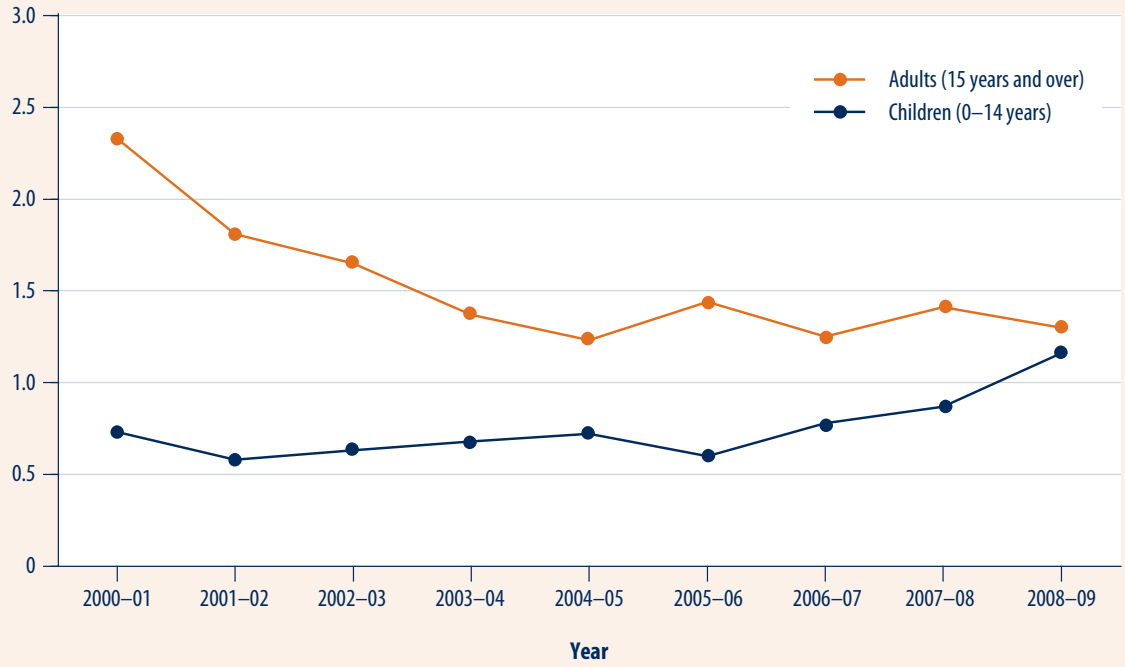
Monitoring trends and differentials in the occurrence of this event, which is routinely recorded in hospital statistics, provides insights into the epidemiology of severe, life-threatening asthma and, possibly, asthma deaths. This section presents data relating to the use of invasive mechanical ventilation among patients admitted with a principal diagnosis of asthma. A list of all the procedure codes included in these analyses is provided in Appendix 1 (Section A1.10.4).

Between 2003–04 and 2008–09, 1,527 people admitted to hospital with a principal diagnosis of asthma received invasive mechanical ventilation. In 2008–09, the overall age-adjusted rate of invasive mechanical ventilation for asthma was 13.3 per 1,000 hospital separations for asthma.

5.3.1 Time trends

Between 2000–01 and 2004–05, there was a gradual decline in the hospital separation rate for asthma receiving invasive mechanical ventilation among people aged 15 years and over and the rate has remained relatively stable since then (Figure 5.30). In 2008–09, the rate among people aged 15 years and over was 1.30 per 100,000 population.

Among children the rate of invasive mechanical ventilation was lower than that for adults between 2000–01 and 2007–08 but was similar in 2008–09. In 2008–09 the rate of invasive mechanical ventilation in children was 1.16 per 100,000 population.



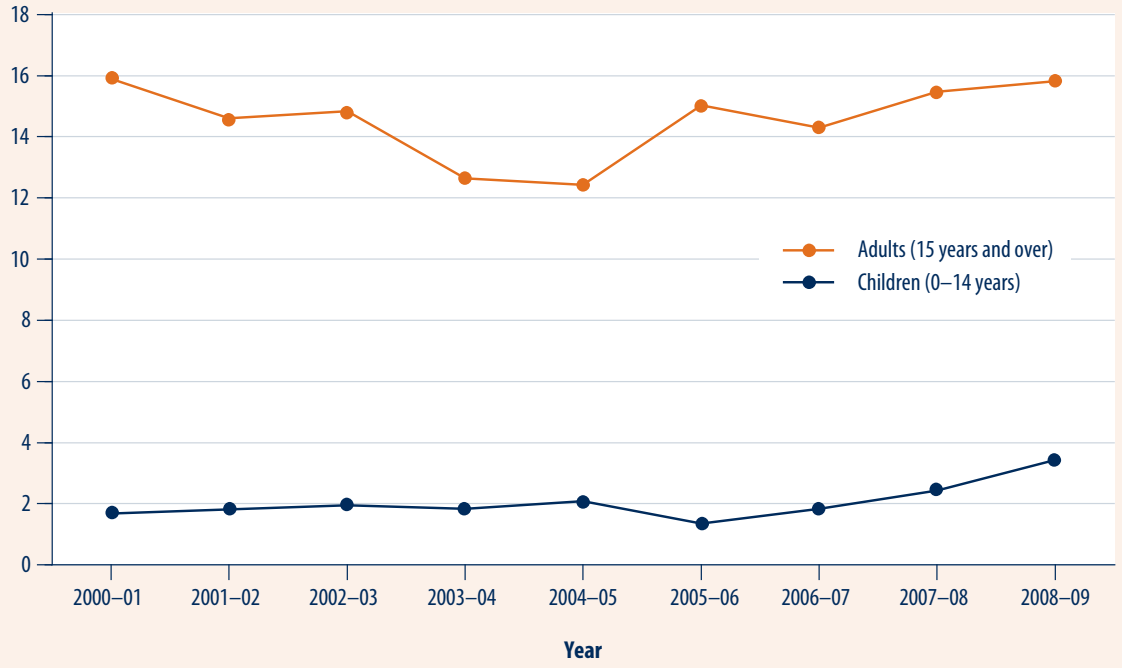
Notes

1. Age-standardised to the Australian population as at 31 December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.30: Hospital separations for asthma with invasive mechanical ventilation per 100,000 population, by age group, 2000–01 to 2008–09

The proportion of adults and children admitted with asthma who received invasive mechanical ventilation is shown in Figure 5.31. There was a gradual decline in the proportion of separations for adults admitted with asthma who received invasive mechanical ventilation between 2000–01 and 2004–05 but the proportion has since increased, reaching 15.8 per 1,000 asthma separations in 2008–09. Over the same period, there was little change in the proportion of separations for children aged 0–14 years who received invasive mechanical ventilation during a hospital stay for asthma. In 2008–09, the proportion of separations for children who received invasive mechanical ventilation was 3.4 per 1,000 asthma separations.



Notes

1. Age-standardised to the Australian population as at 31 December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.31: Proportion of hospital separations for asthma with invasive mechanical ventilation, by age group, 2000–01 to 2008–09

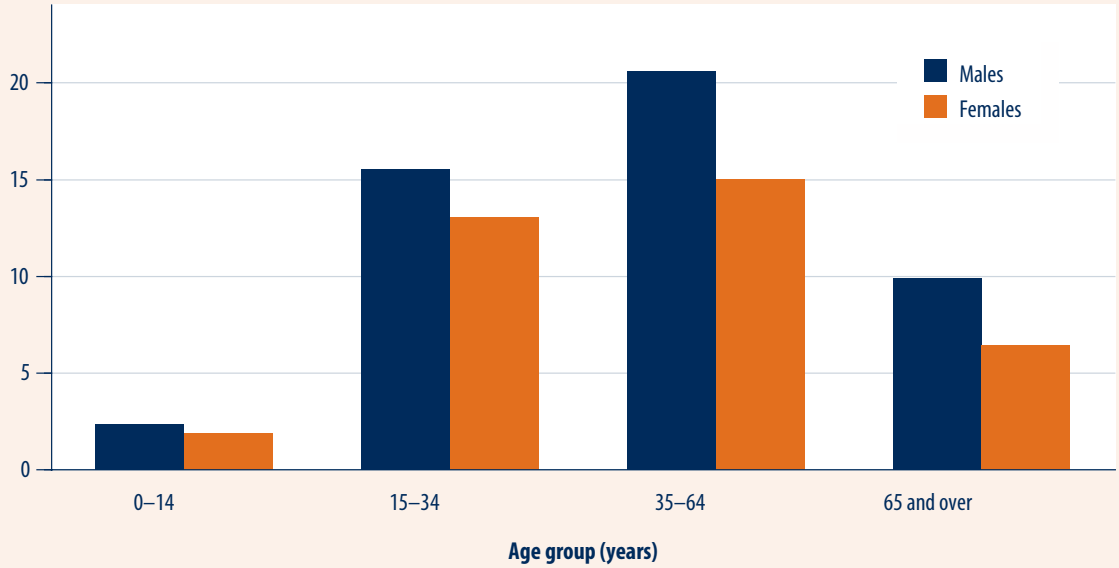
Between 1996 and 2003, 36.1% of patients admitted to an intensive care unit (ICU) with the diagnosis of asthma (*n*=1,898) received invasive mechanical ventilation during the first 24 hours (derived from the Australian and New Zealand Intensive Care Society Adult Patient Database). Although the number and proportion of adult patients admitted to ICU with asthma decreased during this 8-year period, the proportion of ICU admissions receiving invasive mechanical ventilation in the first 24 hours remained unchanged (Stow et al. 2007)

5.3.2 Population subgroups

Age and sex

The rate of hospital separations for asthma that were associated with a period of invasive mechanical ventilation was highest among young and middle-age adults (Figure 5.32). Patients aged 65 years and over with asthma were significantly less likely than those aged 15–64 years to have undergone invasive mechanical ventilation ($p<0.0001$). While this may indicate less severe disease among patients in this older age group, an active decision on the part of patients, families and clinicians not to instigate invasive mechanical ventilation in some patients approaching the end of life may also have contributed to this trend.

Among children, the rate of invasive mechanical ventilation did not differ between males and females. However, among people aged 35–64 years the rate of invasive mechanical ventilation was 1.4 times higher in males compared with females ($p<0.0001$). Among those aged 65 years and over, the rate of invasive mechanical ventilation use was 1.5 times higher among males than females ($p=0.01$). There was no significant sex difference in the rate of invasive mechanical ventilation in the younger age groups (aged 0–14 and 15–34 years).



Notes

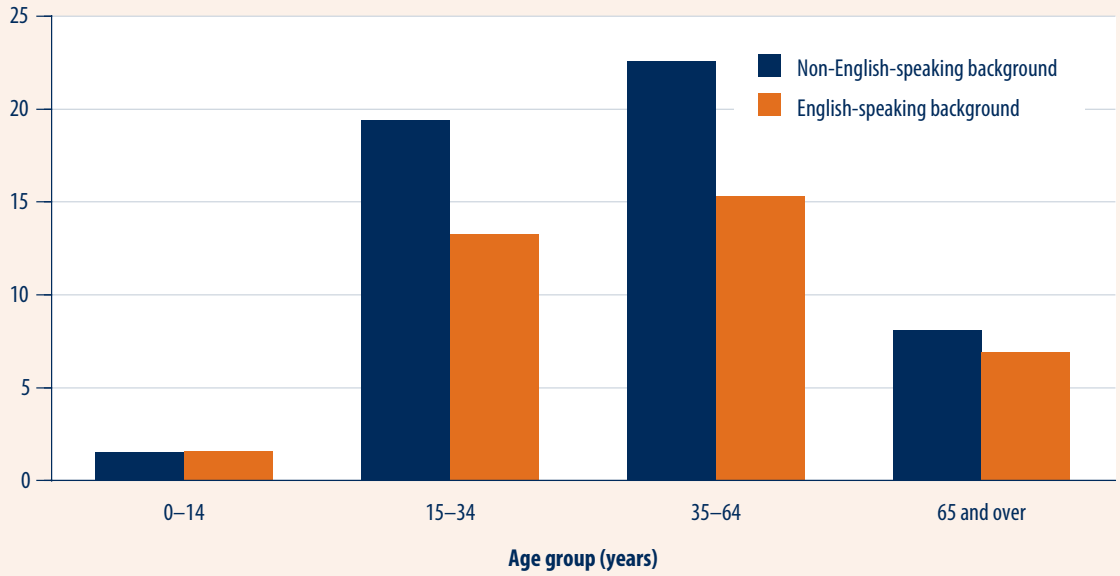
1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.

Source: AIHW National Hospital Morbidity Database.

Figure 5.32: Rate of hospital separations for asthma with invasive mechanical ventilation, by age and sex, 2003–04 to 2008–09

Country of birth

Adults aged 35–64 years of non-English-speaking background were 1.5 times (p=0.0002) more likely to receive invasive mechanical ventilation during a hospital separation for asthma than those of the same age from an English-speaking background (Figure 5.33). This may reflect more severe disease and, possibly, delayed implementation of effective treatment for exacerbations in adults of non-English-speaking background.



Notes

1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45 and J46.
3. English-speaking background includes anyone born in Australia, New Zealand, Canada, United Kingdom, Ireland, United States of America, South Africa or Zimbabwe. Non-English-speaking background includes all those born in other countries.

Source: AIHW National Hospital Morbidity Database.

Figure 5.33: Rate of hospital separations for asthma with invasive mechanical ventilation, by age and country of birth, 2003–04 to 2008–09

5.3.3 Length of stay and in-hospital mortality

While invasive mechanical ventilation for asthma is a relatively rare event, people who are admitted to hospital with asthma and who receive mechanical ventilation have a longer length of stay and a greater risk of dying in hospital compared with other patients admitted with asthma, consistent with invasive ventilation being a marker for the most severe exacerbations.

Between 2000–01 and 2008–09, there were 2,501 separations of people admitted to hospital with a principal diagnosis of asthma who received invasive mechanical ventilation. The average length of stay over this period was much longer among those who received invasive mechanical ventilation (9.1 days) than among those who did not receive the procedure (2.3 days). Of those who received invasive mechanical ventilation, 8.2% died in hospital compared with 0.1% of those who were hospitalised with asthma but did not receive invasive mechanical ventilation.

Similar conclusions were drawn from an analysis of the Australian and New Zealand Intensive Care Society Adult Patient Database. This analysis found that, between 1996 and 2003, people with asthma who underwent invasive mechanical ventilation in intensive care units were 3.5 times more likely to die compared with non-ventilated asthma patients in intensive care. The authors also found that mortality among ventilated patients declined over this period (Stow et al. 2007).

Children aged 0–14 years accounted for a minority (4.7%) of hospital deaths among those who received invasive mechanical ventilation while 7.1% occurred in people aged 15–64 years.

Overall, those aged 65 years and over were 3.2 times more likely to die in hospital after undergoing invasive mechanical ventilation than those aged 15–64 years ($p<0.0001$).

Summary

The use of invasive mechanical ventilation signifies active management of a severe, life-threatening exacerbation of asthma. It is a rare event among people admitted with asthma; only 274 out of 36,703 people admitted with asthma received invasive mechanical ventilation during 2008–09.

Patients who received invasive mechanical ventilation for asthma in 2008–09 had a much longer average length of stay (7.9 days) and a higher rate of mortality in hospital (9.9%) than those who did not receive the procedure during their asthma admission (2.1 days and 0.1%, respectively).

In 2008–09, the rate of invasive mechanical ventilation for asthma was similar for children and adults.

Adults aged 35–64 years from non-English-speaking backgrounds who are admitted to hospital with asthma are more likely to receive invasive mechanical ventilation than people from English-speaking backgrounds.

5.4 Health-care expenditure due to asthma

Understanding the contribution of asthma to direct health-care expenditure aids understanding of the economic impact of the disease. Furthermore, knowledge of the relative contribution of the various health-care sectors (admitted patient, out-of-hospital medical care and prescription pharmaceuticals) to overall asthma-related expenditure assists in planning interventions to optimise this expenditure.

Health expenditure is a term used to describe the actual amount spent on health-care services. Here, data from the AIHW Disease Expenditure Database are used to describe health expenditure for asthma in Australia. All health expenditure data reported here represent allocated, recurrent health expenditure.

For the purposes of this report, the term 'total allocated health expenditure' will be used to refer to the sum of total allocated health expenditure for all health conditions while 'asthma expenditure' is the component of total allocated health expenditure that is attributed to health care for asthma.

The 2004–05 financial year is the most recent data available on health-care expenditure attributed to asthma. In 2004–05, asthma expenditure was $606 million. This represented 1.2% of total allocated health expenditure in that year.

5.4.1 Expenditure by health sector

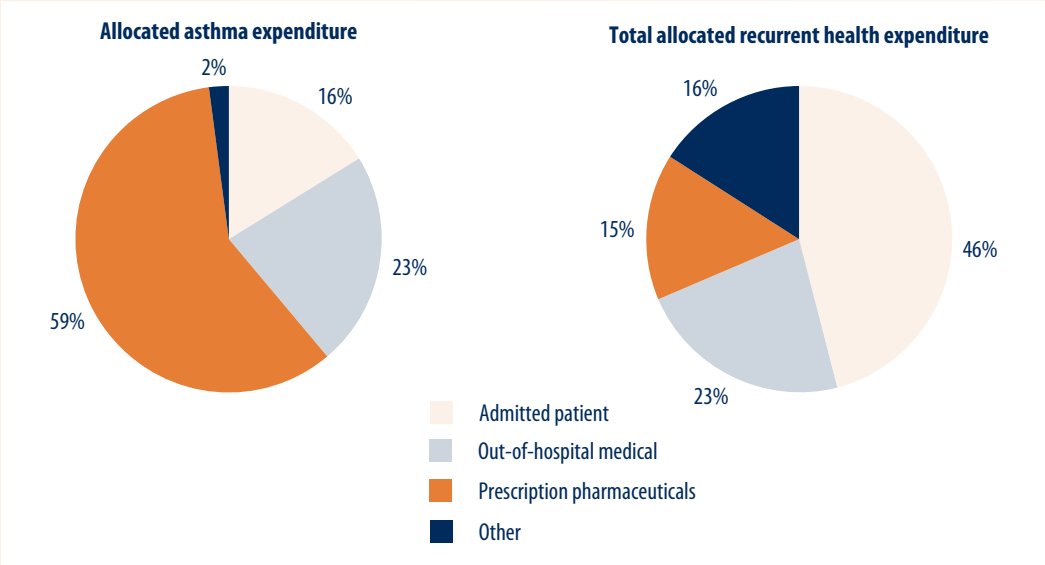
Health expenditure presented here is assigned to one of four sectors:

1. 'Admitted patient' comprises public and private hospital services expenditure for admitted patients (same-day as well as overnight admissions). This category also includes expenditure for medical services provided to private admitted patients in hospitals.
2. 'Out-of-hospital medical' is primarily care in the community from general practitioners as well as specialists, imaging and pathology services. Specifically, it includes MBS unreferred attendances, imaging, pathology, specialist, other medical MBS and any other medical services expenditure for 2004–05 reported in *Health expenditure Australia 2005–06* that has not been counted elsewhere.
3. 'Prescription pharmaceuticals' includes expenditure on benefit paid pharmaceuticals (Pharmaceutical Benefits Scheme (PBS) and Repatriation Pharmaceutical Benefits Scheme (RPBS) pharmaceuticals), under-copayment prescriptions and private prescriptions.

4. 'Other' expenditure comprises expenditure on optometrical services, dental, community mental health, public health cancer screening and research. For asthma expenditure, the category 'other' only comprises expenditure on research, since the other components are not applicable.

Methods for allocating expenditure to these sectors are provided in more detail in Appendix 1, Section A1.5.

Over half (59%) of all asthma expenditure in 2004–05 was attributed to prescription pharmaceuticals (Figure 5.34). This was substantially higher than the proportion of total health expenditure attributed to prescription pharmaceuticals (15%). Alternatively, a substantially lower proportion of asthma expenditure was attributed to admitted patient hospital care (16%) compared with total allocated health expenditure (46%).



Source: AIHW disease expenditure database.

Figure 5.34: Allocated expenditure for asthma and total recurrent health expenditure, by sector, 2004–05

5.4.2 Other economic impacts of asthma

Direct health expenditure for asthma care is only one component of the costs of asthma. However, at present there are few data on other aspects of the economic burden of asthma: for example, personal expenditure related to asthma and costs incurred by families and carers of people with asthma.

The impact of asthma on social and economic participation, including ability to work or study, engage in social interaction and perform other expected roles, also contributes to the economic burden attributable to asthma.

Methods to value individual components of these 'indirect' costs in financial terms are controversial and not universally regarded as valid (Drummond et al. 1997). The nature of these costs is such that they often do not relate exclusively to asthma, and the component attributable to asthma cannot be reliably determined.

One approach to quantifying the economic impact of asthma, and other diseases, more broadly than simply measuring direct health-care expenditure, is the 'burden of disease approach', which was implemented in the Global Burden of Disease Study (Murray & Lopez 1994). In this approach, the impact of disease is quantified in terms of impact on survival ('years of life lost') and impact on functional capacity ('years of life disabled'). The combined effect of both of these impacts is summarised as disability-adjusted life years (DALYs), which quantify the burden attributable to a specific disease. One DALY represents one year of lost 'good health'. It is a summary measure that reflects the overall impact of a particular disease due to morbidity and mortality. The DALY is one measure for capturing the indirect costs of specific diseases by quantifying the impact on an individual's experience of life in less-than-ideal good health (Mathers et al. 1999).

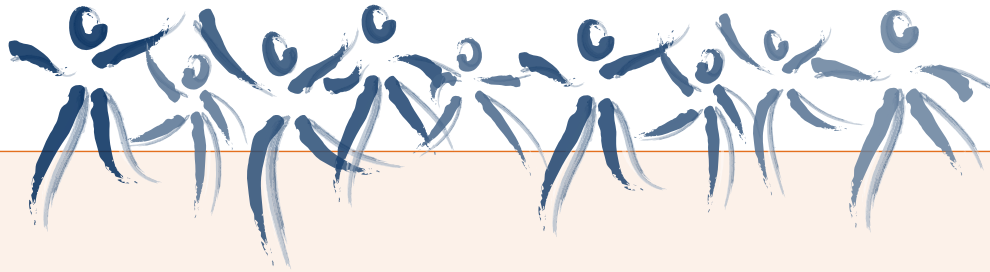
In 2003, asthma was estimated to account for 2.4% of the total disease burden in Australia as measured by DALYs (Begg et al. 2007). For more information on the burden of disease due to asthma in Australia see (ACAM 2009b).

The cost to individuals of having asthma was also estimated in the cohort study of people with asthma in New South Wales described earlier (Kenny et al. 2005). The median costs per person were $89 per year (range $0 to $4,882). The median costs included $8 for services and $40 for medications and asthma-related equipment (Kenny et al. 2005).

Summary

There are substantial health costs both to government and to individuals attributable to asthma care. The distribution of these costs is very different for asthma than for total health expenditure. In particular, relatively more money is spent on pharmaceuticals than hospitals.

6. Management



Key points

Asthma action plans

- The majority of people with asthma do not have a written asthma action plan, despite national guidelines over the last 20 years recommending their use for people with asthma.
- Adults, particularly young adult males, are less likely to possess a written asthma action plan than children.

Medications used to treat asthma

- Drug therapy is the mainstay of asthma management.
- The supply of medications used to treat asthma and other respiratory disorders remained stable between 2005 and 2009.
- The dispensing of medications for asthma (inhaled and oral corticosteroids, long-acting beta-agonists and short-acting beta-agonists) increases with age.
- Most adults and children with asthma are dispensed inhaled corticosteroids intermittently, despite treatment guidelines recommending regular use in people with persistent asthma.
- Among adults who received any inhaled corticosteroid medications, 30% were dispensed these medications only once in 2009.
- Over 80% of inhaled corticosteroids are supplied in combination with long-acting beta-agonists, despite guidelines recommending that in asthma, these medications should only be used in patients whose asthma is not well-controlled with inhaled corticosteroids alone.
- Prescriptions for combination formulations containing inhaled corticosteroids and long-acting beta-agonists are relatively common among children, despite treatment guidelines recommending against their use in most children.
- Among adults, the majority of inhaled corticosteroids are prescribed in combination with long-acting beta-agonists.
- In data sources available, there is no way of distinguishing medications dispensed for asthma from those for other obstructive lung diseases, such as COPD.

Introduction

This chapter will review data relating to the use of effective asthma management strategies and their implementation in the Australian population. The two elements of asthma management that are discussed here are the possession of *written asthma action plans* and regular *use of medications* that control the disease and prevent exacerbations. Based on evidence accumulated in the last 2 decades, these represent key elements in the effective management of the condition.

6.1 Written asthma action plans

A written asthma action plan enables people with asthma to recognise deterioration in their condition promptly and respond appropriately, by integrating changes in symptoms or peak expiratory flow measurements with written instructions to adjust medication. The aim of a written asthma action plan is to enable early intervention and to prevent or reduce the severity of acute asthma episodes.

It was found that ownership of a written asthma action plan reduces mortality due to asthma (Abramson et al. 2001). Provision of a self-management plan that includes a written asthma action plan, self-monitoring and regular review reduces the need for extra medication, urgent visits to doctors and hospitalisations, with a small improvement in lung function (Gibson et al. 2009).

Written asthma action plans have formed part of national guidelines for the management of asthma since 1989 (Woolcock et al. 1989) and have been promoted in public education campaigns by the National Asthma Council Australia (NAC 2006).

6.1.1 Possession of written asthma action plans

Less than one-quarter (21.3%) of Australians with current asthma identified in the National Health Survey reported possessing a written asthma action plan in 2007–08 (Table 6.1).

Recent estimates of the possession of asthma action plans from state health surveys vary (Table 6.1). Relatively high rates of possessing a written asthma action plan were reported among children in New South Wales in 2007–08 (54.1%) and Victoria in 2009 (67.0%). Among adults, Victoria reported high rates (55.9%) of written asthma action plan possession in 2007 (Table 6.1). Estimates of asthma action plan possession among adults with asthma in New South Wales, Queensland and South Australia were between 19.4% and 29.0%. Some of the apparent variation between surveys (and, hence, states) may be due to differences in the way asthma action plans were described to participants. While the currently accepted term for written instructions on how to recognise and manage worsening asthma is an 'asthma action plan', some authors have used the term 'asthma management plan'.

In Victoria in 2007, 29.4% of people with an asthma action plan reported that they used it frequently while 20.9% reported that they never used it (Victorian Department of Human Services 2008). The majority of people in Victoria with an asthma action plan found it helpful for managing an acute attack (78.9%), helpful for knowing when to seek medical advice (92.5%) or helpful with day-to-day management of their asthma (93.2%).

Table 6.1: Possession of asthma action plans by people with current asthma, 2003–2009

Population/study	Age (people with current asthma)	Year	Rate (%)	95% CI
ALL AGES				
Possession of a written asthma action plan				
Australia (1)	All ages (*n*=2,181)	2007–08	21.3	18.9–23.7
ADULTS				
Possession of a written asthma action plan				
Australia (1)	15 years and over (*n*=1,766)	2007–08	14.4	12.0–16.9
Possession of an asthma action plan, written instructions of what to do if your asthma is worse or out of control				
New South Wales (2)	16 years and over (*n*=1128)	2009	29.0	25.4–32.6
Possession of written instructions or an asthma action plan from doctor				
Victoria (7)	18 years and over (*n*=819)	2007	55.9	51.1–60.5
Possession of written instructions from their doctor about how to manage worsening asthma				
Australia (3)	16 years and over (*n*=1,006)	2003–04	21.6	19.1–24.1
As far as you are aware, do you have a treatment plan for your asthma?				
Queensland (4)	18 years and over (*n*=382)	2006	19.4	15.5–24.0
CHILDREN				
Possession of a written asthma action plan				
Australia (1)	0–14 years (*n*=415)	2007–08	47.9	40.9–54.8
Possession of a written asthma management plan from a doctor on how to treat asthma				
New South Wales (5)	2–15 years (*n*=622)	2007–08	54.1	49.6–58.7
Possession of an asthma action plan, written instructions of what to do if child's asthma is worse or out of control				
Victoria (6)	1–12 years (*n*≈5,000)	2009	67.0	62.2–71.7

Note: While the currently accepted term for written instructions on how to recognise and manage worsening asthma is an 'asthma action plan', these are sometimes referred to as an 'asthma management plan'. As a result, the questions used in some surveys reported in the table refer to an 'asthma management plan' while others refer to an 'asthma action plan'.

Sources:

Asthma defined as doctor diagnosed asthma plus treatment or symptoms of asthma in the last 12 months:

(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) 2009 Report on Adult Health from the New South Wales Population Health Survey (Centre for Epidemiology and Research 2009).
(3) Australian Asthma Survey (Marks et al. 2007).
(4) Queensland Chronic Disease Survey.
(5) Centre for Epidemiology and Research 2010a.
(6) Victorian Child Health and Wellbeing Survey 2009.

Asthma defined as doctor diagnosed asthma plus symptoms in the last 12 months:

(7) Department of Human Services, Victorian Population Health Survey 2007.

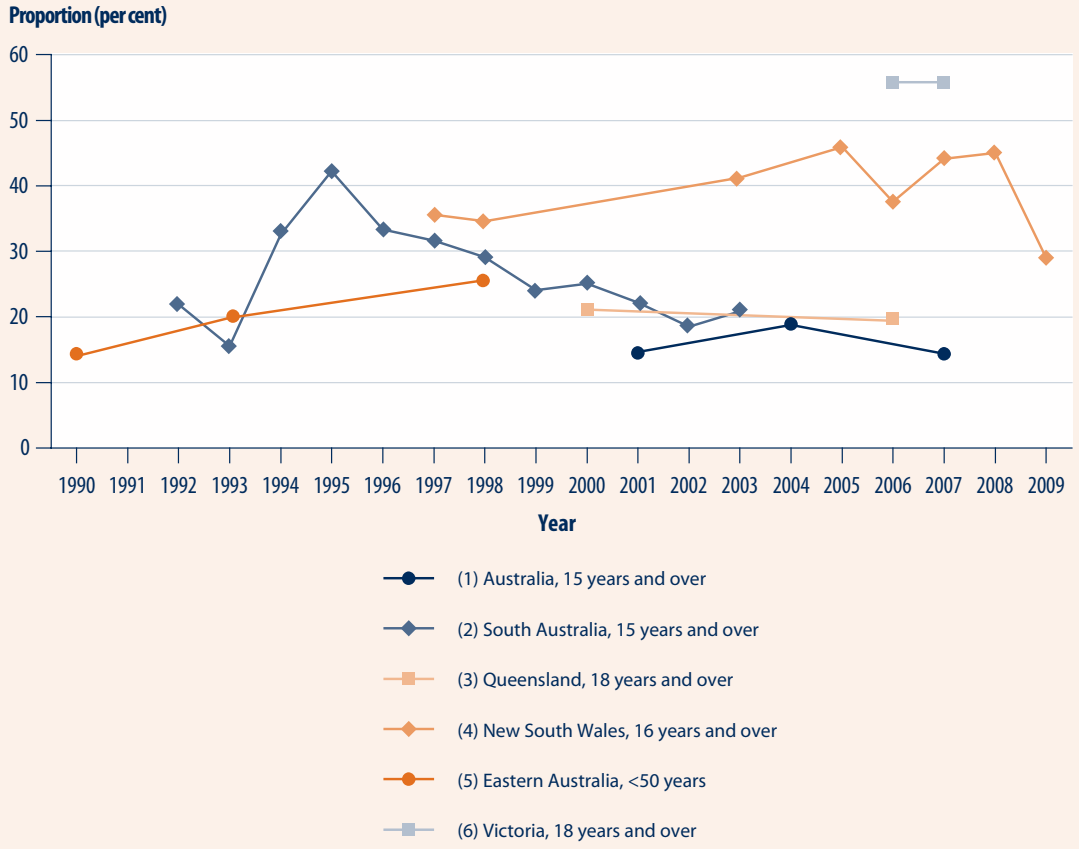
6.1.2 Time trends

There was a rise in the proportion of adults with asthma who reported they had asthma action plans between 1990 and 1995 (Figure 6.1). Since that time, the rate of ownership among adults declined in South Australia after a very large increase between 1993 and 1995 but it continued to increase in New South Wales and nationally. Queensland reported a stable proportion of adults possessing an asthma action plan (Figure 6.1).

In New South Wales, between 2003–04 and 2007–08 there was a significant increase in the proportion of children aged 9–15 years with current asthma who possessed a written asthma management plan (43.0% to 55.7%) (Centre for Epidemiology and Research 2010a).

Between 2006 and 2007, more than half (56%) of people aged 18 years and over with asthma in Victoria possessed an asthma action plan. Similarly, in 2008, 45% of people aged 16 years and over with asthma in New South Wales reported possessing an asthma action plan (Figure 6.1). In 2009, this proportion of ownership decreased to just over a quarter (29%), which may be partly due to a change in wording of the question in the most recent New South Wales survey.

Data from the NHS show that, overall, significantly fewer people aged 15 years and over with asthma had a written asthma action plan in 2007–08 (14%) compared to 2004–05 (19%). However the proportion in 2007–08 was similar to that in 2001 (15%).



Note: Only people with current asthma were asked about the possession of asthma action plans. Definitions used to identify asthma action plans are given with the source of data.

Sources:

Asthma defined as doctor diagnosed asthma plus treatment or symptoms of asthma in the last 12 months and 'Do you have an asthma action plan (written instructions of what to do if your asthma is out of control)?'

(1) ABS National Health Survey.

(2) South Australian Omnibus Survey (Wilson et al. 2003; Wilson et al. 2002).

(3) Queensland Chronic Disease Survey.

Asthma defined as doctor diagnosed asthma plus treatment or symptoms of asthma in the last 12 months, previous to 2009 'Do you have a written asthma action plan?', in 2009 'Do you have an asthma action plan, written instructions or what to do if your asthma is worse or out of control?'

(4) New South Wales Population Health Survey.

Asthma defined as self-reported diagnosis of asthma and 'Do you have a written asthma action plan?'

(5) Eastern Australia (Public Health Division 2001; Gibson et al. 2000; Comino et al. 1996).

Asthma defined as doctor diagnosed asthma plus symptoms in the last 12 months and 'Has your doctor given you written instructions or an asthma action plan, telling you what to do when you have asthma symptoms?

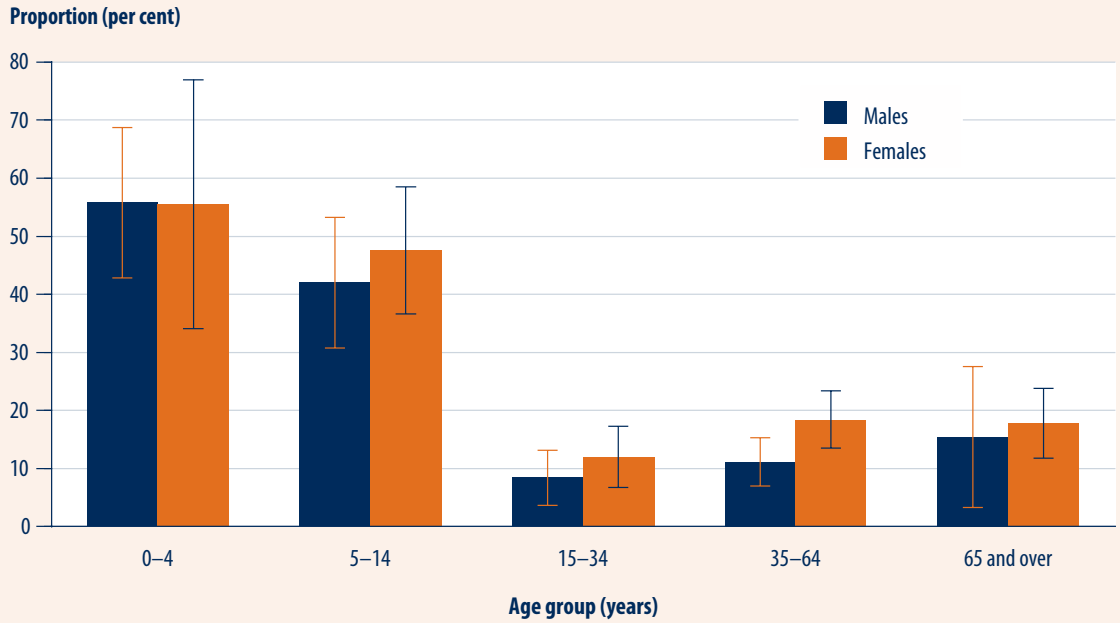
(6) Victorian Population Health Survey.

Figure 6.1: Possession of asthma action plans by adults with current asthma, Australia, 1990–2009

6.1.3 Population subgroups

Age and sex

In the 2007–08 National Health Survey, children aged 0–14 years with current asthma were significantly more likely to have a written asthma action plan than people aged 15 years and over (p<0.0001) (Figure 6.2). Among those aged 15–64 years, more females than males had a written asthma action plan (p=0.001).



Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 6.2: Possession of a written asthma action plan by people with current asthma, by age and sex, 2007–08

States and territories

In 2007–08, the proportion of people with current asthma who reported having a written asthma action plan did not differ significantly by state or territory compared with the national average (21.3%) (p=0.6).

Cities, regions and remote areas

Data from the two most recent National Health Surveys conducted in 2004–05 and 2007–08 show that, overall, possession of a written asthma action plan did not differ significantly between those living in *Major cities*, *Inner regional* areas or *Other* areas of Australia (p=0.7). *Other* areas include *Outer regional* and *Remote* categories of remoteness. In New South Wales in 2008, there was also no difference in possession of asthma action plans among people living in urban versus rural areas (Centre for Epidemiology and Research 2009).

Socioeconomic status

Australian data show that possession of written asthma action plans did not differ significantly by level of socioeconomic status in 2007–08 (p=0.1). This finding is supported by two state-based surveys. The New South Wales Health Survey showed no evidence of significant variation according to socioeconomic status of locality in 2008 (Centre for Epidemiology and Research 2009). A study of children in Victoria also found no evidence of such a trend (Vuillermin et al. 2007), with children residing in areas of lower socioeconomic status just as likely to have been provided with a written asthma plan as children residing in areas of higher socioeconomic status (p=0.8).

Summary

Although written asthma action plans have been recommended in national guidelines for the management of asthma for over 20 years, the majority of people with asthma do not have one. In 2007–08, young adults, particularly men, were least likely to possess a written asthma action plan.

Data on possession of written asthma action plans are not consistently collected in all states and territories of Australia and requires improved data collection for better monitoring.

6.2 Medications used to treat asthma

In this section, we review data on the dispensing of medications for the treatment of asthma in Australia, focusing in particular on medications used to control the disease, principally inhaled corticosteroids. Data on other principal classes of medications are also presented. Various sources of data have been used for this purpose. Section 6.2.2 outlines the sources of data used in the analysis.

Drug therapy is the mainstay of asthma management. Broadly speaking, medications are used in the treatment of asthma in three ways, to:

1. relieve symptoms when they occur ('relievers')
2. control the disease in order to minimise symptoms and exacerbations ('preventers')
3. treat exacerbations of the disease.

The most commonly used class of medications for relief of symptoms are short-acting beta-agonists (salbutamol and terbutaline). These short-acting and long-acting beta-agonist drugs are also used for short-term prevention of exercise-induced asthma (Anderson et al. 1991; Johnson et al. 1986). Rapid-onset, long-acting beta-agonist medications, when used in combination with inhaled corticosteroids (budesonide/formoterol) (O'Byrne et al. 2005), can also be recommended for this purpose in some treatment regimens, and short-acting anti-cholinergic drugs (ipratropium) are sometimes used as reliever medication, usually in the context of an exacerbation. See Appendix 1, Table A1.11 for more details on the classification of respiratory medications and the Glossary for medication definitions.

There is evidence from systematic reviews that inhaled corticosteroids (beclomethasone, budesonide, fluticasone and ciclesonide) are highly effective in reducing symptoms and preventing exacerbations in patients with asthma (Adams et al. 2005, 2004a, 2003). Analyses of data from clinical trials have demonstrated that, in most people, asthma is well controlled with relatively low doses of inhaled corticosteroids, resulting in a lower risk of adverse effects (Powell & Gibson 2003).

The addition of long-acting beta-agonists to inhaled corticosteroids, available in combined formulations (salmeterol/fluticasone and formoterol/budesonide), allows equivalent or greater effectiveness in asthma control with lower doses of inhaled corticosteroids (Kuna et al. 2007; Greening et al. 1994). There is no role for long-acting beta-agonists without concurrent inhaled corticosteroids in the management of people with asthma.

Leukotriene receptor antagonists (montelukast and zafirlukast) are also used as preventer medications, though they are less effective than inhaled corticosteroids (Ducharme & di Salvio 2009). Cromones (cromoglycate and nedocromil) were used in the past for asthma treatment in children but they are less effective than low-dose inhaled corticosteroids (The Childhood Asthma Management Program Research Group 2000), and their current formulations require daily inhaler care.

In Australia, inhaled corticosteroids, leukotriene receptor antagonists and cromones are referred to as 'preventer' medications while in most other countries the term used to refer to these medications is 'controller'.

An anti-IgE monoclonal antibody (omalizumab) is the first biologic immunoregulatory agent for asthma that is registered for use in patients with asthma in Australia. It is an effective adjunctive therapy in allergic patients whose asthma is not adequately controlled by maximal conventional therapy (Walker et al. 2009; Humbert et al. 2005). The high cost of this medication limits its widespread use in Australia.

Oral corticosteroids have long been the mainstay of treatment for severe exacerbations of asthma. The role of intermittent use of inhaled corticosteroids or short-term increases in the maintenance or usual dose of inhaled corticosteroids in the short-term treatment of asthma exacerbations remains uncertain, but there is some evidence to support the short-term use of high-dose inhaled corticosteroids in this context.

Guidelines for the management of asthma (GINA 2009a; NAC 2006) generally recommend a stepwise approach to management, aiming to optimise asthma control with:

- intermittent use of medications to relieve symptoms when they occur
- regular (daily or twice daily) use of medications to control the disease and prevent symptoms and exacerbations
- occasional short courses of oral corticosteroids to treat disease exacerbations.

Different classes of medications are used for each of these purposes, as outlined above.

More recent evidence has demonstrated that an alternative regimen, budesonide/formoterol maintenance and reliever therapy (SMART), achieves similar levels of asthma control (Bateman et al. 2010) with similar or fewer exacerbations at a lower overall steroid dose (Welsh & Cates 2010; Kuna et al. 2007; O'Byrne et al. 2005). SMART uses a low dose of combined rapid-onset long-acting bronchodilator and inhaled corticosteroid (budesonide/formoterol) regularly once or twice daily and also as-needed for relief of symptoms. This regimen is not currently approved in Australia for use in children less than 12 years. See Appendix 1, Table A1.11 for more details on the classification of respiratory medications.

6.2.1 Monitoring medication use

Since appropriate use of medications for asthma improves disease outcomes, disparities in the use of medication are almost certainly relevant to disparities in outcomes of asthma. Monitoring medication use helps to recognise over-use and under-use of medication classes, and trend data are useful in identifying concordance of asthma treatment with evidence-based guidelines.

Under-use of medication is a common problem in chronic diseases such as asthma. Adherence to use of various types of medication, including inhaled corticosteroids, is lower among those with lower socioeconomic status (Wamala et al. 2007; Apter et al. 1998) and African Americans and Hispanics compared to others in the USA (Crocker et al. 2009; Bosworth et al. 2006; Charles et al. 2003a).

Over-use of asthma medication was reported among children in the Netherlands. A large proportion of children used asthma medication even though they did not have a diagnosis of asthma and a large majority received their first prescription for asthma medication before the age of 8 years (Zuidgeest et al. 2010).

A central issue in determining the appropriateness of use of medications for asthma is the underlying severity of asthma and the level of asthma control at the time the medications were prescribed. However, it is usually not possible to determine from survey data or prescription data whether the level of treatment that was prescribed or dispensed is appropriate for the patient's level of disease severity or control (Khan et al. 2003). In the absence of information on disease severity and control, information on the use of medications must be interpreted with caution.

6.2.2 Sources of data

Pharmaceutical Benefits Scheme (PBS) data

Information on reimbursements for the purchase of prescription medications is available from the PBS and the Repatriation Pharmaceutical Benefits Scheme (RPBS) databases. An important limitation of these data is that the databases only include records for prescriptions that were subsidised by the PBS and RPBS.

The PBS currently subsidises the cost of approximately 80% of prescription medications dispensed in Australia (DoHA 2010). However, even for these items that are covered by the PBS or RPBS, subsidies are only paid, and hence recorded in the database, where the cost of the medication is more than the copayment amount (see Box 6.1 for details on the PBS copayment).

Box 6.1: PBS copayment

The copayment amount is the amount the consumer pays. The government subsidises any additional amount above the copayment. The copayment amount differs substantially between general patients and those who hold government health-care concession cards. For general patients, the copayment amount ranged from $22.40 in 2002 to $32.90 in 2009, whereas for people holding government health-care concession cards, the copayment amount ranged from $3.60 in 2002 to $5.30 in 2009.

General patients and concession cardholders are entitled to cheaper medications through the PBS once they reach the PBS Safety Net threshold ($1,264.90 for general patients and $318.00 for concession cardholders in 2009) within a calendar year.

Approximately 64% of people receiving asthma medications subsidised by the PBS, hold a card that entitles them to the concessional rate. The implications of this limitation are described below:

- All combined long-acting beta-agonist and inhaled corticosteroid preparations, and most long-acting beta-agonist preparations (except Serevent 25 pressurised metered dose inhaler in 2008 and 2009, and Oxis 6 Turbuhaler; see Appendix 1, Table A1.10) are dispensed at a price that is higher than the PBS copayment amount for general patients. Hence, the PBS database contains a complete record of prescriptions in Australia for these medication classes.
- Approximately half the preparations of inhaled corticosteroids cost more than the PBS copayment amount for those without a concession card but the remaining formulations cost less and, hence, were not captured on the PBS database (see Appendix 1, Table A1.10). Formulations that cost less than the copayment which are purchased by concession cardholders are captured in the PBS database, and for this reason, the PBS analysis of inhaled corticosteroid prescriptions was limited to those dispensed to concession cardholders.
- Since the PBS schedule changes four times each year, the prescriptions covered by the scheme can vary within a year and from year to year.
- Short-acting beta-agonists and oral corticosteroids cost less than the PBS copayment amount and are only subsidised by the PBS when the patient is a concession cardholder. For this reason, our PBS analysis of short-acting beta-agonist and oral corticosteroid prescriptions is limited to those dispensed to concession cardholders.
- Short-acting beta-agonists are also available 'over the counter' in Australia, that is, without a prescription. However, the over-the-counter cost is greater than the copayment for a concession cardholder who uses a prescription, which means there is a financial incentive for concession cardholders to purchase short-acting beta-agonists with a doctor's prescription. Therefore, it is assumed that most, though not all, short-acting beta-agonists dispensed to people with a concession card are supplied with a prescription and recorded on the PBS database.

The PBS database, which was designed for administrative purposes, has included patient Medicare numbers with all prescription details since 2002. Use of the Medicare number has allowed us to anonymously identify prescriptions for the same individuals within the PBS data and also to link information on age, sex and home postcode using an encrypted Medicare patient identification number. In this way, it is ensured that patient confidentiality is protected.

Data from the PBS do not provide information on the number of prescriptions not filled by the patient and do not contain information on the reason for which the drug was prescribed.

The medications that are used for asthma are also used for the treatment of some other respiratory illnesses; in particular, chronic obstructive pulmonary disease (COPD) among older people and viral and other wheezing illnesses in young children. For this reason, medication dispensing within the subgroup of people aged 5–34 years is described separately in this chapter. In this age group, COPD is very uncommon and non-asthma wheezing illness of young children is relatively uncommon and, therefore, the medications were more likely to have been used for asthma. Information on medications dispensed for COPD among people aged 55 years and over is discussed in Chapter 8.

IMS Health data

Information on the wholesale supply of medications in the community is available from IMS Health, a commercial market information company. IMS Health collects data from all pharmaceutical wholesalers about the sale of both prescription and non-prescription medications to the hospital and community sectors. Since these are wholesale supply data, they do not include any information about the individuals who purchased the medications or whether the medication (specifically short-acting beta-agonists) was purchased over the counter, that is, without a prescription.

BEACH (Bettering the Evaluation and Care of Health) survey data

Information on the reason for which medications are prescribed is available from the Bettering the Evaluation and Care of Health (BEACH) survey (AIHW: Britt et al. 2009), which is derived from a set of encounters reported by a rolling random sample of GPs in Australia.

BEACH data include those medications prescribed, those supplied to the patient directly by the GP, and those advised for over-the-counter purchase. Each prescription recorded reflects the GP's intent that the patient receives the prescribed medication and the specified number of repeats. The prescription is counted only once, irrespective of the number of repeats ordered. Hence, the medication is directly linked to the problem being managed by the GP.

However, BEACH survey data do not provide information on the number of prescriptions not filled by the patient (which also applies to the PBS and IMS Health data). Furthermore, BEACH data do not record the frequency of GP visits by an individual and may reflect visits by patients for acute care rather than routine follow-up. A study conducted in the United States reported that asthma visits for exacerbations were 2.5 times more frequent than visits for evaluation or follow-up (Yawn et al. 2007).

Other sources

Health surveys, including the Australian Bureau of Statistics (ABS) National Health Survey (NHS), are the best source of information about *self-reported use* of medication by people with asthma and we have included some information from the 2007–08 NHS. However, self-report is known to overestimate actual usage of preventer medications in asthma (Rand & Wise 1994).

The Longitudinal Study of Australian Children (LSAC) provides information on parent-reported asthma medication use among children in each of two selected age cohorts: children born between March 2003 and February 2004 and children born between March 1999 and February 2000. This study also enables information on the prescription of medications for each child through the LSAC cohort linkage to the PBS and MBS databases. See Appendix 1, Section A1.6 & A1.7, for more details about these data sources described above.

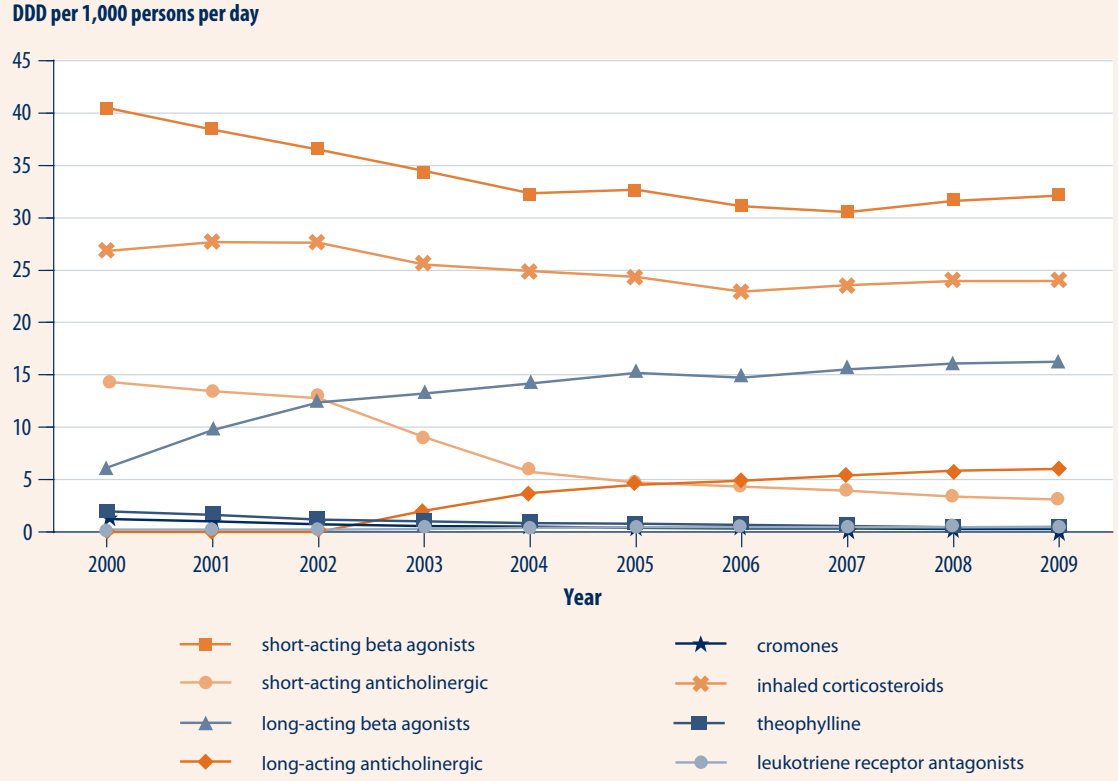
It is important to note that from available data sources, there is no way of distinguishing medications dispensed for asthma from other obstructive lung diseases, such as COPD.

In the following sections, we describe the rate of medication prescribing and dispensing for asthma and other respiratory conditions in the community as a whole and assess variation by age group, sex, socioeconomic status and remoteness of residence.

6.2.3 Time trends in the supply of medications for asthma and other respiratory disorders

Figure 6.3 shows the time trend in the supply of various medications commonly used to treat asthma, and other respiratory diseases, since 2000. The data are expressed in units of defined daily doses (DDDs) per 1,000 population per day. This unit of measurement represents a standardised measure of medication dosage, allowing data for different members of the same class to be combined and various classes to be compared, using a common currency. See Appendix 1, Section A1.9.3, for more details of these calculations and their interpretation.

- Short-acting beta-agonists, mainly salbutamol and terbutaline, remain the most commonly supplied class of medications among those used to treat respiratory disorders in Australia (Figure 6.3).
- The supply of short-acting beta-agonists decreased substantially between 2000 and 2004 but has since stabilised (Figure 6.3).
- There was a progressive decline in the supply of short-acting anti-cholinergic ipratropium bromide. This trend has probably been accelerated by the introduction of tiotropium bromide, a long-acting anti-cholinergic medication that is approved for use by patients with COPD (Figure 6.3).
- The annual total supply of inhaled corticosteroids was relatively stable since 2000, with a slight decrease in supply between 2002 and 2006 (Figure 6.3).
- Long-acting beta-agonists first became eligible for reimbursement under the PBS in 2000. There was a rapid increase in the supply of this class of medications until 2005 but this has plateaued since that time (Figure 6.3).
- The supply of cromones (cromoglycate and nedocromil) and theophylline was low and decreased during 2000–2009 (Figure 6.3).
- Reimbursement for prescriptions for leukotriene receptor antagonists was introduced in 2005 and only children are eligible. The overall supply of this class of medications remains low relative to other respiratory medications (Figure 6.3).



Note: Respiratory medications classified according to the Anatomical Therapeutic Chemical classification system (ATC).
Source: IMS Health data.

Figure 6.3: Respiratory medications supplied by wholesalers and manufacturers, by defined daily dose (DDD) per 1,000 people per day, 2000–2009

6.2.4 Current use of medications for asthma

In the 2007–08 National Health Survey, almost 54% of people with asthma reported using medication for their condition in the last 2 weeks. The proportion of people with asthma who reported using medication increased with age ($p<0.0001$). The lowest reported use was among children aged 0–4 years (39%) and the highest was among those aged 65 years and over (75%).

Among school-entry children aged 5 years in the Australian Capital Territory, 94% of those with parent-reported asthma had used at least one asthma medication in the preceding year (Phillips et al. 2007). However, 32% of children in the Australian Capital Territory taking preventer medication for asthma were taking doses that were not in accordance (higher than the recommended daily dose or using two preventer medications concurrently) with National Asthma Council (NAC) Australia guidelines (Brown et al. 2010).

A Victorian survey reported that among children aged 1–12 years with asthma, 63% had taken medication for asthma in the last 12 months (Victorian Child Health and Wellbeing Survey 2009).

In the Tasmanian Longitudinal Health Study, 85% of people aged 44 years with current asthma used some form of asthma medication within the last 12 months. While overall medication increased as the disease severity increased, large proportions of participants classified as having moderate persistent (55.4%) or severe persistent (39.7%) asthma were not using any inhaled corticosteroid preventer medication (Kandane-Rathnayake et al. 2009). This implies inconsistencies in the appropriate use of asthma medication, particularly inhaled corticosteroids.

In children, intermittent asthma is much more common than persistent asthma. Hence, inhaled corticosteroids are generally not required for the treatment of asthma in children, particularly in young children. For this reason, we describe the dispensing of this class of medications separately for adults and children.

Provision of prescriptions in general practice

GPs play a central role in the provision of medication for asthma in the community. Data on prescribing patterns of GPs are obtained from the Bettering the Evaluation and Care of Health (BEACH) survey (AIHW: Britt et al. 2009).

Prescribing patterns

Between April 2007 and March 2010, the most frequently prescribed medication during GP encounters for the management of asthma was inhaled corticosteroids (either alone or in combination with long-acting beta-agonists). During this time, inhaled corticosteroids were prescribed for the management of asthma at 54.0% (CI: 52.3–55.7%) of GP encounters where asthma was managed. In comparison, leukotriene receptor antagonists (2.0%) and cromones (0.7%) were rarely prescribed. Oral corticosteroids were prescribed for asthma at 13.5% (CI: 12.4–14.7%) of encounters where asthma was managed; these would be expected to mostly reflect visits for asthma exacerbations.

Prescribing patterns among adults

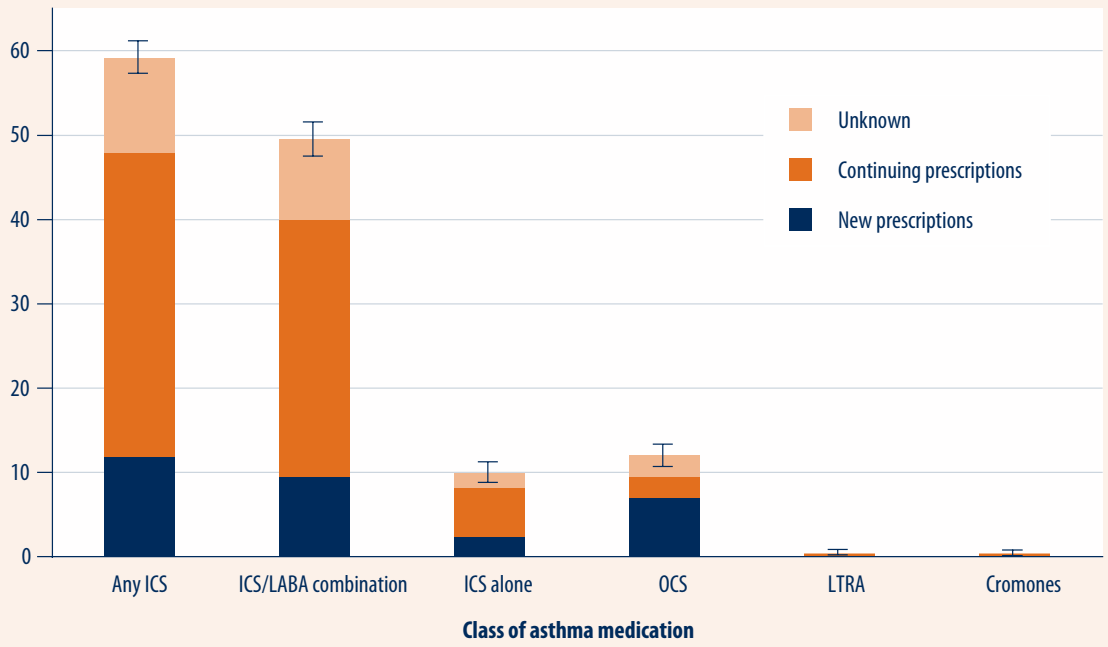
The overall proportion of asthma consultations in which any inhaled corticosteroids were prescribed was higher in adults (59.2%) than it was in children (39.8%).

Among adults aged 15 years and over, the proportion of GP encounters for asthma at which inhaled corticosteroids in combination with long-acting beta-agonists were prescribed (49.5%) was nearly 5 times the proportion of encounters for asthma at which inhaled corticosteroids alone were prescribed (10.0%) (Figure 6.4).

Sixty-two per cent of all inhaled corticosteroid prescriptions for asthma were 'continuing' while 18.9% were first-time prescriptions (that is, 'new' prescriptions) for this class of medication.

Leukotriene receptor antagonists (0.5%) and cromones (0.4%) were very rarely prescribed.

Oral corticosteroids were prescribed at 11.9% of consultations for asthma among adults. The majority of oral corticosteroid prescriptions were 'new' (58.3%). Presumably most of these encounters would have been visits for acute care. However, in some instances, oral corticosteroids may have been prescribed for use in the event of a subsequent exacerbation, for example, to accompany provision of an asthma action plan.



Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96. ICS = inhaled corticosteroids, LABA = long-acting beta-agonists, OCS = oral corticosteroids, LTRA = leukotriene receptor antagonists.
2. 'Continuing prescriptions' refer to the continuation or repeat of previous asthma therapy and 'New prescriptions' refer to the medication being used for the first time to manage asthma.

Source: Bettering the Evaluation and Care of Health (BEACH) survey.

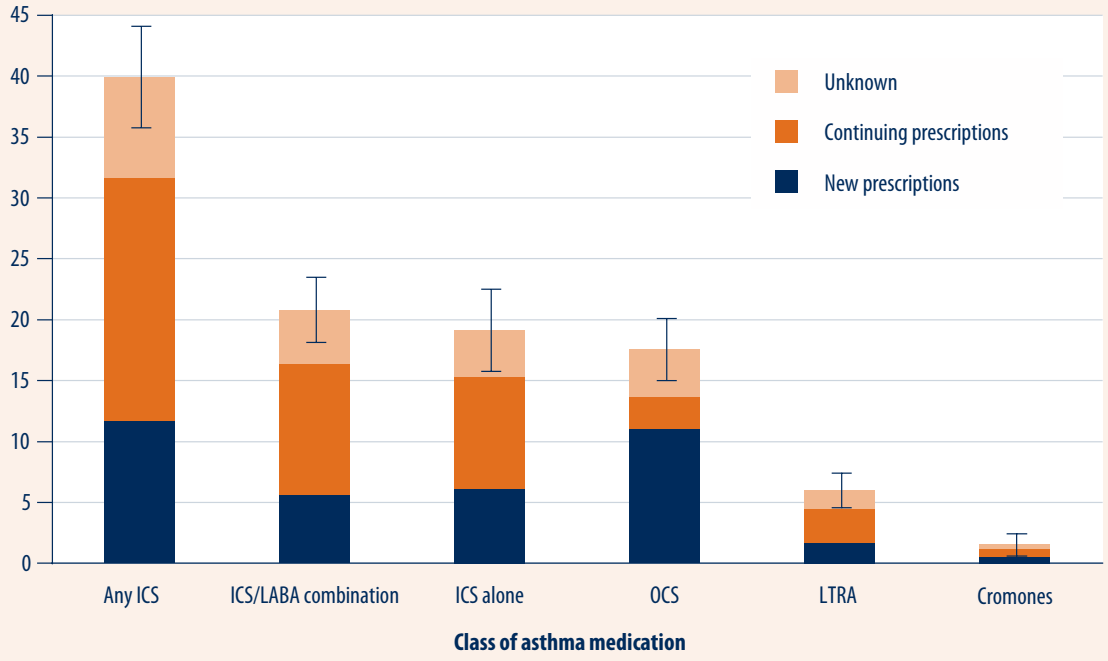
Figure 6.4: Medications prescribed for the treatment of asthma in general practice, by class of medication and prescription status, people aged 15 years and over, April 2007 to March 2010

Prescribing patterns among children

Among children aged 0–14 years who visited a GP for their asthma, 39.8% were prescribed inhaled corticosteroids either alone or in combination with long-acting beta-agonists (Figure 6.5). More than half (52.7%) of these prescriptions were 'continuing' prescriptions and 28.3% were prescribed for the first time. Furthermore, a large proportion of these prescriptions were for inhaled corticosteroids in combination with long-acting beta-agonists (52.1%). This pattern of prescribing combination asthma therapy does not reflect the recommended guidelines of minimal use among children.

Very few children were prescribed leukotriene receptor antagonists (6.0%) or cromones (1.5%) for their asthma. Among children prescribed leukotriene receptor antagonists, 47.2% of prescriptions were continuing and 25.9% were new. Among children prescribed cromones, 45.6% of prescriptions were continuing and 36.6% were new.

Oral corticosteroids were prescribed for 17.5% of children attending GPs for asthma between April 2007 and March 2010. The majority of oral corticosteroid prescriptions were 'new' (64.1%). Presumably most of these encounters were visits for acute care. However, in some instances, oral corticosteroids may have been prescribed for use in the event of a subsequent exacerbation, for example, to accompany provision of an asthma action plan.



Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96. ICS = inhaled corticosteroids, LABA = long-acting beta-agonists, OCS = oral corticosteroids, LTRA = leukotriene receptor antagonists.
2. 'Continuing' prescriptions refer to the continuation or repeat of previous asthma therapy and 'New' prescriptions refer to the medication being used for the first time to manage asthma.

Source: Bettering the Evaluation and Care of Health (BEACH) survey.

Figure 6.5: Medications prescribed for the treatment of asthma in general practice, by class of medication and prescription status, children aged 0–14 years, April 2007 to March 2010

Asthma medication use among children

Analysis of data between 2006 and 2008 from the Longitudinal Study of Australian Children (LSAC) showed that among children aged 4–5 years with parent-reported wheeze or ever diagnosed asthma, 35.4% had reportedly used asthma medications in the last 12 months (Table 6.2). Among these children, 15.7% had a PBS record of preventer medications (inhaled corticosteroids, cromones and/or leukotriene receptor antagonists) having been dispensed at least once during the previous 2-year period.

Between 2004 and 2008 among children aged 8–9 years with parent-reported wheeze or ever diagnosed asthma, 37.2% had reportedly used medication for asthma in the last 12 months (Table 6.2). Fifteen per cent of these older children with wheeze or asthma had preventer medications dispensed at least once during the previous 2-year period.

Table 6.2: Prevalence of asthma medication use among children from the Longitudinal Study of Australian Children (LSAC), with parent-reported wheezing or ever diagnosed asthma[a], 2004–2008

	Age 4–5 years			Age 8–9 years		
Type of asthma medication dispensed	Number of children	Prevalence per 100 children with wheezing or ever diagnosed asthma[c] (95% CI)		Number of children	Prevalence per 100 children with wheezing or ever diagnosed asthma[d] (95% CI)	
Total number of children in cohort	1,666			1,723		
Data for medication from PBS[b]						
Any ICS	199	12.7	(10.8–14.5)	222	13.0	(11.2–14.9)
ICS alone	87	6.3	(4.8–7.8)	49	3.3	(2.3–4.3)
ICS in combination with long-acting beta agonists (LABA)	129	7.8	(6.4–9.3)	177	10.0	(8.5–11.6)
Cromones	5	0.3	(0.02–0.5)	3	0.1	(0.0–0.3)
Leukotriene Receptor Antagonists	75	4.2	(3.1–5.2)	52	2.9	(2.0–3.8)
Any of the above medications	256	15.7	(13.7–17.7)	256	15.0	(13.0–17.0)
Data from parental report						
Parent-reported use of medication for child with asthma in last 12 months[e]	589	35.4	(33.0–37.8)	651	37.2	(34.7–39.8)

(a) Cumulative count of parent-reported wheezing or ever diagnosed asthma from 2006 to 2008 for children aged 4–5 years and from 2004 to 2008 for children aged 8–9 years.
(b) Information collected from PBS linked data for medications dispensed between Wave 1 and 3 of the Longitudinal Study of Australian Children. Does not include over-the-counter items and items that cost less than the general patient copayment, in particular short-acting beta agonists (such as Ventolin) and Prednisone.
(c) Weighted to the Australian population aged 4–5 years at March 2008.
(d) Weighted to the Australian population aged 8–9 years at March 2008.
(e) Information collected at 4 year follow-up (2008/Wave 3).
Source: Longitudinal Study of Australian Children (LSAC).

Inhaled corticosteroids

Inhaled corticosteroids are used to reduce airway inflammation; a key feature of asthma. For people with asthma, this results in better control of symptoms and disease exacerbations. Inhaled corticosteroids are most effective when used on a regular basis, either daily or twice daily. Regular use of inhaled corticosteroids is the recommended treatment in people with persistent asthma.

In 2009, there were 24 defined daily doses (DDDs) of inhaled corticosteroids supplied per 1,000 persons per day. This measure of utilisation has remained relatively stable over the last few years following a slight decline between 2002 (28 DDDs per 1,000) and 2006 (23 DDDs per 1,000) (Figure 6.3). See Appendix 1, Section A1.9.3, for more details of these calculations and their interpretation.

A number of studies have shown that use of inhaled corticosteroids for control of symptomatic asthma is sub-optimal in the community. Among people with current asthma aged 5 years and over in 2004–05, 18.5% reported having used inhaled corticosteroids in the previous 2 weeks (ACAM 2007a). In the subgroup that reported using short-acting beta-agonists in the previous 2 weeks, indicating that they were likely to have experienced symptoms of asthma during that time, only 28% had also used inhaled corticosteroids during this period.

The frequency of parent-reported medication use among children with asthma had remained stable between 2000 and 2005 in the Australian Capital Territory and 53% of all children with asthma who were taking inhaled corticosteroids, cromones or montelukast reported using them at least 4 days per week during this time (Phillips et al. 2007). A further study in the Australian Capital Territory reported that 80% of children were taking their medications for asthma at frequencies, or with delivery devices, not in accordance with the National Asthma Council Australia guidelines (Brown et al. 2010).

Government health-care concession cardholders are more likely to be dispensed inhaled corticosteroids than those without a concession card (ACAM 2008a). Between 2003 and 2006, Australian concession cardholders were dispensed inhaled corticosteroid prescriptions at a higher rate than general beneficiaries (43.7 compared with 9.1 inhaled corticosteroid prescriptions per 100 person-years) (Ampon et al. 2009). The cost of inhaled corticosteroids is approximately 6 times greater for individuals who do not have a concession card. Therefore, cost is an important barrier in the use of inhaled corticosteroids.

In 2009, dispensing of inhaled corticosteroids among all adults with a government health-concession card increased with increasing age (Table 6.3). This is consistent with the trends seen in the dispensing of other classes of medication used in the treatment of asthma and may reflect the changing nature of obstructive lung disease from childhood to older adult life or willingness to take medications in general. The rates of dispensing of this class of medication among concession cardholders were higher among females compared with males and those residing in areas of higher socioeconomic status compared with those residing in areas of lower socioeconomic status.

Table 6.3: Proportion of concession cardholders dispensed inhaled corticosteroids (alone or in combination with long-acting beta-agonists), by demographic characteristics, 2009

Demographic characteristics	Age 15 years and over		Age 15–34 years	
	Number	Per cent	Number	Per cent
Sex				
Male	244,767	10.9	27,246	5.7
Female	374,658	12.8	46,936	7.5
Age group				
15–34 years	74,182	6.7	74,182	6.7
35–64 years	197,106	11.2	..	..
65 years and over	348,137	15.1	..	..
Socioeconomic status				
SES 1 (Lowest)	129,496	8.6	17,527	4.6
2	135,014	11.3	16,322	6.4
3	130,741	12.4	15,625	7.7
4	114,501	14.8	13,690	8.1
SES 5 (Highest)	106,207	17.5	10,570	10.9
Remoteness category				
Major cities	404,353	12.9	48,963	7.1
Inner regional	140,268	10.0	16,779	6.2
Other areas[(a)]	71,151	11.1	8,084	5.5
All concession cardholders	**619,425**	**12.0**	**74,182**	**6.7**

SES = Socioeconomic status, see Appendix 1, Section A1.13.3
.. = Not applicable.
(a) Other areas include Outer regional, Remote and Very remote (calculated from the Pharmaceutical Benefits Scheme and the National Health Survey 2007–08 data sources).
Note: The National Health Survey 2007–08 was used to estimate the total number of Australians with a government concession card.
Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

Combined long-acting beta-agonist and inhaled corticosteroid formulations

Inhalation devices that combine long-acting beta-agonists and corticosteroids in the same unit were introduced onto the Australian market in 2000. In subsequent years, the proportion of all inhaled corticosteroids that were supplied in combination with long-acting beta-agonists steadily increased. Two years after their introduction onto the Australian market, this combined therapy represented 47% of all supplied inhaled corticosteroid therapy. By 2009, the market share had risen to 80% despite guidelines recommending that they should only be used in patients whose asthma was not well-controlled with inhaled corticosteroids alone.

A similar trend was observed in the United Kingdom between 2000 and 2006. The percentage of prescribed combination inhalers (inhaled corticosteroids and long-acting beta-agonists) dramatically increased among children from 2.6% in 2000 to 20.6% in 2006, despite recommendations by the British Thoracic Society that they should rarely be used among children (Cohen et al. 2007).

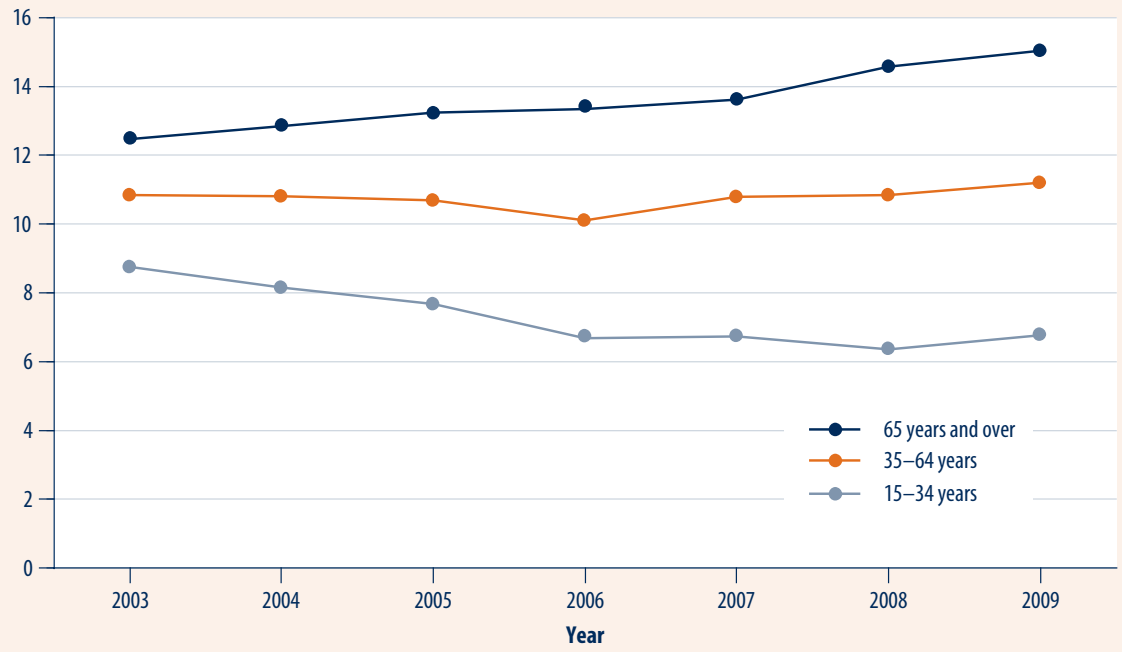
In the Australian population who held a concession card in 2009, dispensing of inhaled corticosteroids and long-acting beta-agonists in combination formulations increased with age ($p<0.0001$). Among those aged 15–34 years, only 5.6% were dispensed this type of combined therapy while 12.8% of those aged 65 years and over were dispensed this class of medication.

In the population of concession cardholders aged 15 years and over, there were lower rates of dispensing among people living in areas of lower socioeconomic status ($p<0.0001$). This was also observed when the analysis was limited to people aged 15–34 years ($p<0.0001$). Furthermore, people aged 15 years and over living in more remote areas had lower rates of dispensing than those living in major cities ($p<0.0001$).

Number of inhaled corticosteroid prescriptions

Between 2003 and 2009, the dispensing of any inhaled corticosteroids decreased among people aged 15–34 years with a concession card, particularly between 2005 and 2006 (Figure 6.6). This may be partly attributed to the large (24%) increase in the copayment amount in January 2005. A study from Western Australia has shown that dispensing of combined ICS-LABA medications decreased by approximately 8% following the rise in copayment amount at that time (Hynd et al. 2009).

This decrease in prescriptions for ICS-LABA combination may also reflect a change in prescribing habits over this time. In contrast to the overall trend, the dispensing of any inhaled corticosteroids has increased among people aged 65 years and over between 2003 and 2009 while the trend remained stable among people aged 35–64 years, with the exception of a decrease in 2006 (Figure 6.6).



Note: Includes prescriptions for inhaled corticosteroids alone or in combination with long-acting beta-agonists.

Sources: Pharmaceutical Benefits Scheme; Australian Bureau of Statistics (ABS) National Health Survey 2004–05 and 2007–08 for the population estimate for government concession cardholders 2003–2006 and 2007–2009, respectively.

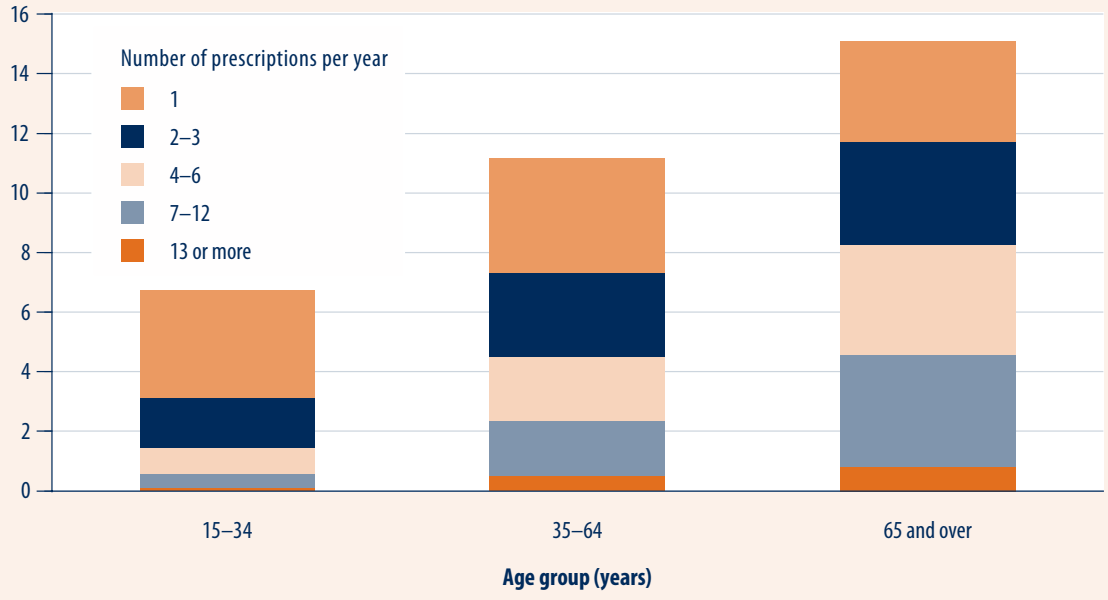
Figure 6.6: Proportion of concession cardholders dispensed inhaled corticosteroids (alone or in combination with long-acting beta-agonists) by year of supply and age group, 2003–2009

In 2009, 12.0% of people with a concession card aged 15 years and over were dispensed at least one prescription for inhaled corticosteroids. The dispensing of inhaled corticosteroids increased with age: 6.7% of those aged 15–34 years, 11.2% of those aged 35–64 years and 15.1% of those aged 65 years and over were dispensed at least one prescription for inhaled corticosteroids.

Among people aged 15 years and over who were dispensed any inhaled corticosteroids, 30.0% were dispensed only one prescription of this class of medication during 2009. Among people aged 15–34 years, more than half of those dispensed any inhaled corticosteroids were dispensed only one prescription of inhaled corticosteroids, compared with 35.0% of those aged 35–64 years (Figure 6.7).

In 2009, people aged 65 years and over had the highest prevalence of inhaled corticosteroids dispensed and the highest proportion of multiple prescriptions for this medication dispensed. In this age group, approximately 30% of people who had at least one prescription dispensed, had seven or more prescriptions for inhaled corticosteroids. Furthermore, 5.4% had 13 or more prescriptions dispensed over the course of the year (that is, more than one prescription per month). In contrast, only 8.6% of people aged 15–34 years and 21.2% of those aged 35–64 years had seven or more inhaled corticosteroid prescriptions dispensed. This is the minimum rate of dispensing consistent with regular use.

Overall, among people with a concession card, both the prevalence and the frequency of inhaled corticosteroids dispensed were much greater in people aged 65 years and over than in younger adults. Many of the people aged 65 years and over would have been dispensed inhaled corticosteroids for COPD, rather than typical asthma.



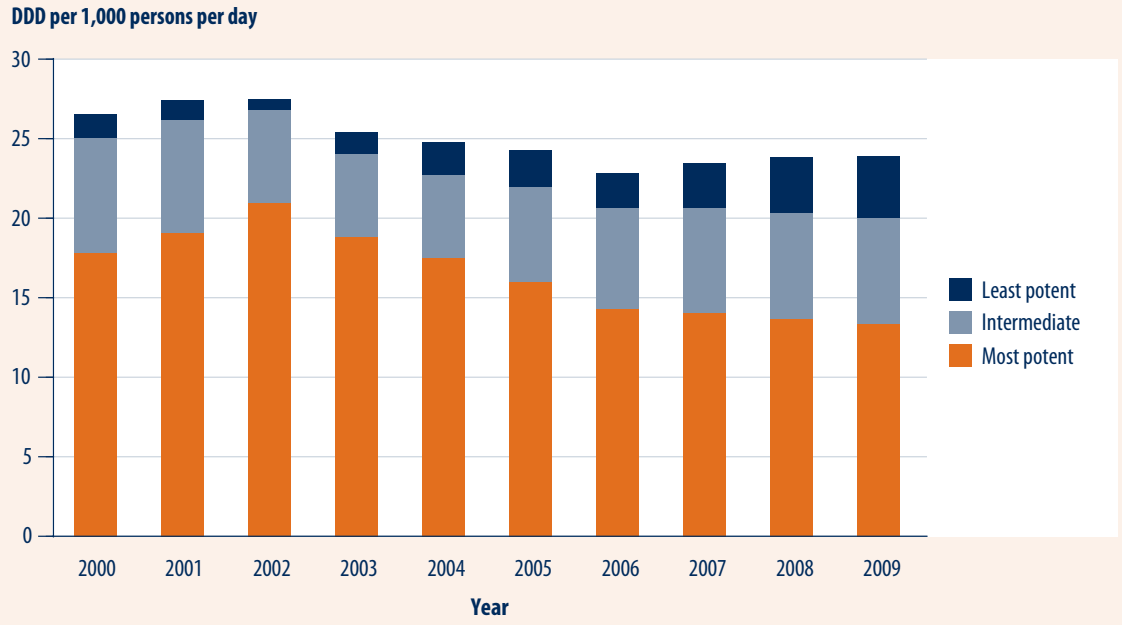
Note: Includes prescriptions for inhaled corticosteroids alone or in combination with long-acting beta-agonists.
Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

Figure 6.7: Proportion of concession cardholders over 15 years of age dispensed inhaled corticosteroids (alone or in combination with long-acting beta-agonists), by age group and number of prescriptions, 2009

Potency of inhaled corticosteroids

Data on the supply of pharmaceuticals demonstrate that the total number of doses of inhaled corticosteroids declined to 2006 and has remained relatively constant since then. The proportion of doses that are the highest potency formulation of inhaled corticosteroids have declined since 2002 (Figure 6.8).

Over the past 10 years, there was considerable educational activity for medical practitioners about the importance of avoiding prescribing excessive doses of inhaled corticosteroids to people with asthma, especially children with asthma. Higher doses of inhaled corticosteroids among children have been associated with detectable systemic effects on both growth and the hypothalamic-pituitary-adrenal axis (Van Asperen et al. 2010; GINA 2009b).



DDD = defined daily dose.

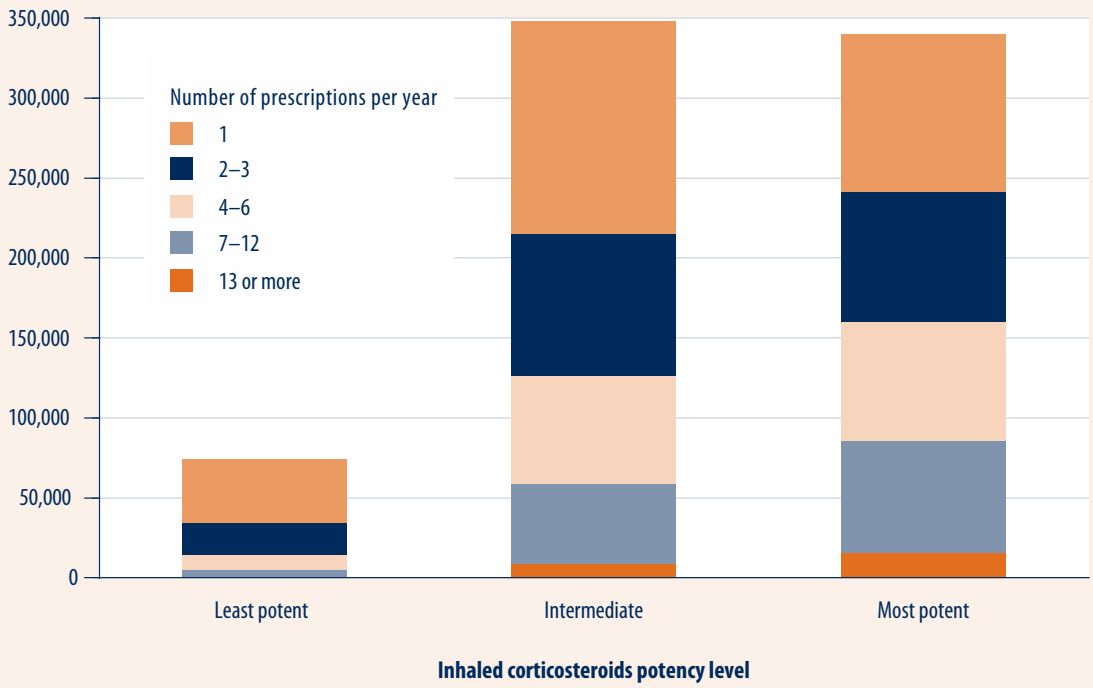
Notes

1. Least potent includes Becotide 100, Becotide MDI 100, Qvar 50, Qvar 50 Autohaler, Pulmicort Meter Aero MDI 100 (discontinued November 2002), Pulmicort Turbuhaler 100, Alvesco 80, Flixotide Jnr Accuhaler 100, Flixotide Jnr Oral pressurised inhalation 50 micrograms per dose (120 doses) CFC-free formulation, Seretide Accuhaler 100/50, Seretide MDI 50/25, Symbicort Turbuhaler 100/6.
2. Intermediate level includes Respocort Inhaler, Becloforte MDI 250, Respocort Autohaler 250, Qvar 100, Qvar 100 Autohaler, Pulmicort Respules 500 mcg, Pulmicort Meter Aero MDI 200 (discontinued November 2002), Pulmicort Turbuhaler 200, Alvesco 160, Flixotide Accuhaler 250, Flixotide 125, Seretide Accuhaler 250/50, Seretide MDI 125/25, Symbicort Turbuhaler 200/6.
3. Most potent includes Pulmicort Respules 1 g, Pulmicort Turbuhaler 400, Flixotide Accuhaler 500, Flixotide MDI 250, Seretide Accuhaler 500/50, Seretide MDI 250/25, Symbicort Turbuhaler 400/12.

Source: IMS Health.

Figure 6.8: Relative potency of inhaled corticosteroids supplied by wholesalers separately or as part of combined therapy, by defined daily dose per 1,000 persons per day, 2000–2009

High potency formulations represented 66% of supply of inhaled corticosteroids in 2005, reducing to 26% in 2009. Less potent formulations have increased in supply from 10% of the total proportion supplied in 2005 to 23% in 2009. A similar trend is observed when examining dispensed prescriptions. The majority of prescriptions for inhaled corticosteroids were for those with intermediate potency formulations of this class of medication (Figure 6.9).



Notes

1. Least potent includes Qvar 50, Qvar 50 Autohaler, Pulmicort Turbuhaler 100, Alvesco 80, Flixotide Jnr Accuhaler 100, Flixotide Jnr 50 , Seretide Accuhaler 100/50, Seretide 50/25, Symbicort Turbuhaler 100/6.
2. Intermediate level includes Qvar 100, Qvar 100 Autohaler, Pulmicort Respules 500 mcg, Pulmicort Turbuhaler 200, Alvesco 160, Flixotide Accuhaler 250, Flixotide 125, Seretide Accuhaler 250/50, Seretide 125/25, Symbicort Turbuhaler 200/6.
3. Most potent includes Pulmicort Respules 1 g, Pulmicort Turbuhaler 400, Flixotide Accuhaler 500, Flixotide 250, Seretide Accuhaler 500/50, Seretide 250/25, Symbicort Turbuhaler 400/12.
4. Unless otherwise indicated, medications are pressurised metered dose inhalers.

Source: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

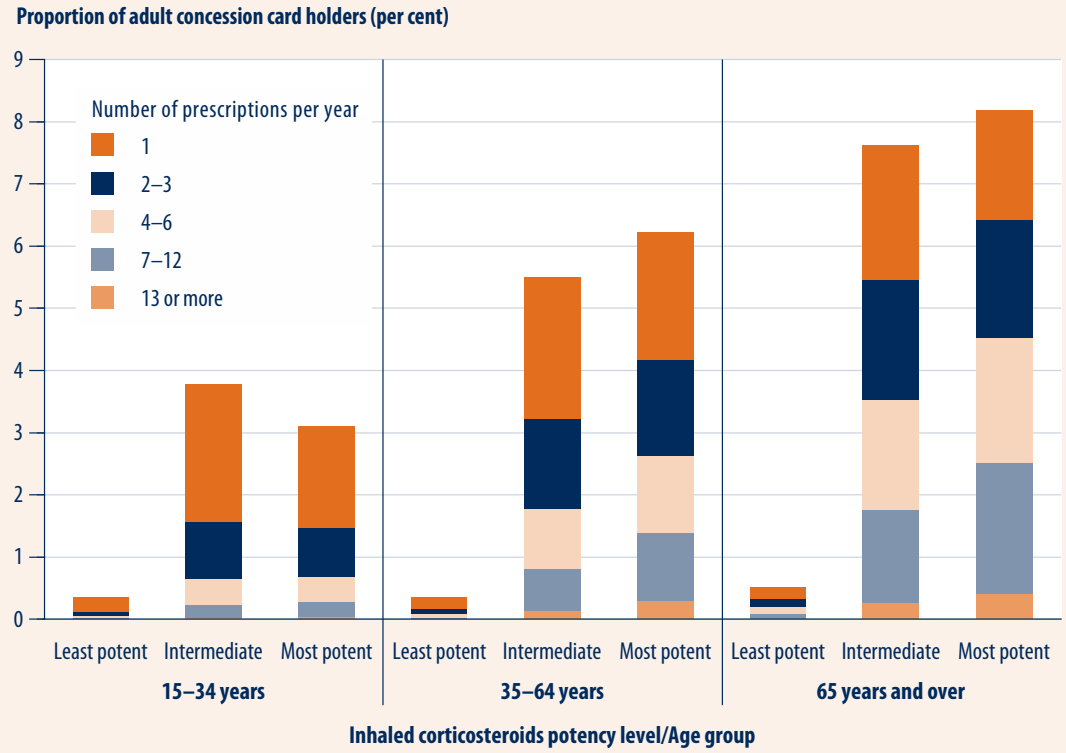
Figure 6.9: Proportion of concession cardholders dispensed inhaled corticosteroids (alone or in combination with long-acting beta-agonists), by potency class and number of prescriptions, all ages, 2009

Use of inhaled corticosteroids by adults

Overall, among people who hold a concession card aged 15 years and over, 49.8% of prescriptions dispensed for inhaled corticosteroids were in the most potent category, 47.0% were of intermediate potency and only 3.2% were classified as being in the least potent category.

A higher proportion of older Australians (65 years and over) were dispensed inhaled corticosteroids of the most potent formulations compared with young adults (15–34 years) and those aged 35–64 years (Figure 6.10).

Those aged 65 years and over were also more likely to have 13 or more prescriptions dispensed for the intermediate and most potent formulations of this class of medication in 2009 than younger adults.



Notes

1. Least potent includes Qvar 50, Qvar 50 Autohaler, Pulmicort Turbuhaler 100, Alvesco 80, Flixotide Jnr Accuhaler 100, Flixotide Jnr 50 , Seretide Accuhaler 100/50, Seretide 50/25, Symbicort Turbuhaler 100/6.
2. Intermediate level includes Qvar 100, Qvar 100 Autohaler, Pulmicort Respules 500 mcg, Pulmicort Turbuhaler 200, Alvesco 160, Flixotide Accuhaler 250, Flixotide 125, Seretide Accuhaler 250/50, Seretide 125/25, Symbicort Turbuhaler 200/6.
3. Most potent includes Pulmicort Respules 1 g, Pulmicort Turbuhaler 400, Flixotide Accuhaler 500, Flixotide 250, Seretide Accuhaler 500/50, Seretide 250/25, Symbicort Turbuhaler 400/12.
4. Unless otherwise indicated, medications are pressurised metered dose inhalers.
5. Adults have been classified according to the most potent formulation of inhaled corticosteroid prescription they received in 2009.

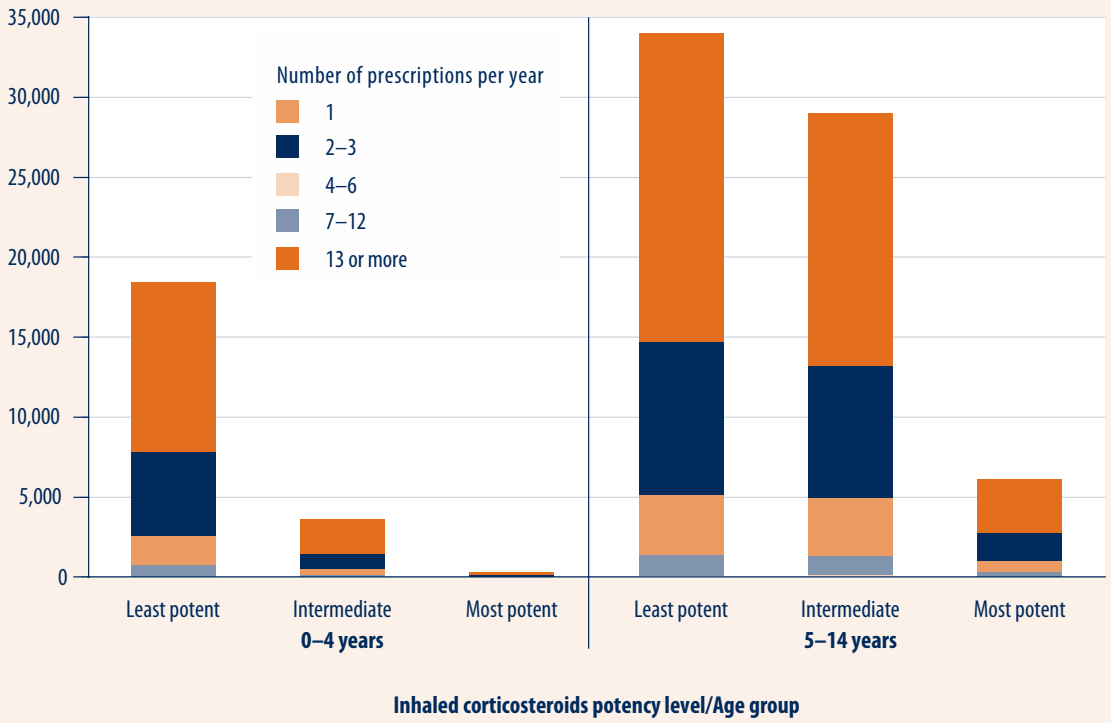
Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

Figure 6.10: Proportion of concession cardholders dispensed inhaled corticosteroids (alone or in combination with long-acting beta-agonists), by potency class, age group and number of prescriptions, 2009

Use of inhaled corticosteroids by children

Among children (those aged less than 15 years whose parent held a concession card on behalf of the child), 57.3% of prescriptions for inhaled corticosteroids were in the least potent category, 35.7% were of intermediate potency and only 7.0% were classified as being in the most potent category.

There were much higher proportions of children aged 5–14 years who were dispensed prescriptions for the intermediate and most potent formulations of inhaled corticosteroids compared to children aged 0–4 years (Figure 6.11). The frequency of dispensing these more potent formulations was also higher in older children compared with younger children.



Notes

1. Least potent includes Qvar 50, Qvar 50 Autohaler, Pulmicort Turbuhaler 100, Alvesco 80, Flixotide Jnr Accuhaler 100, Flixotide Jnr 50, Seretide Accuhaler 100/50, Seretide 50/25, Symbicort Turbuhaler 100/6.
2. Intermediate level includes Qvar 100, Qvar 100 Autohaler, Pulmicort respules 500 mcg, Pulmicort turbuhaler 200, Alvesco 160, Flixotide Accuhaler 250, Flixotide 125, Seretide Accuhaler 250/50, Seretide 125/25, Symbicort Turbuhaler 200/6.
3. Most potent includes Pulmicort Respules 1 g, Pulmicort Turbuhaler 400, Flixotide Accuhaler 500, Flixotide 250, Seretide Accuhaler 500/50, Seretide 250/25, Symbicort Turbuhaler 400/12.
4. Unless otherwise indicated, medications are pressurised metered dose inhalers
5. Children have been classified according to the most potent formulation of inhaled corticosteroid prescription they received in 2009.

Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

Figure 6.11: Proportion of children concession cardholders dispensed inhaled corticosteroids, by potency class, age group and number of prescriptions, 2009

Long-acting beta-agonists

Long-acting beta-agonists (salmeterol and formoterol), which were introduced into clinical use in Australia in 1999, provide approximately 12–24 hours bronchodilatation (Lotvall 2002).

Current national (NAC 2006) and international (GINA 2009a) guidelines for the management of asthma recommend that adults with asthma that is not adequately controlled on low or moderate doses of inhaled corticosteroids alone should be prescribed long-acting beta-agonists in conjunction with inhaled corticosteroids on a regular basis. Long-acting beta-agonists are not recommended for use in adults or children without concomitant inhaled corticosteroids.

More recently, a regimen was approved for use in Australia which combines regular maintenance use of a combination rapid-onset long-acting beta-agonist (formoterol) and low-dose inhaled corticosteroid (budesonide) medication with as-needed use of the same medication 'budesonide/formoterol maintenance and reliever therapy' (SMART) based on evidence of similar or better asthma control and fewer exacerbations with lower average inhaled corticosteroid doses. Prescription and dispensing data specific for the maintenance and reliever therapy regimen, SMART, is not available to us and hence is not presented in this report.

Overall, 5.0% of the population were dispensed long-acting beta-agonist medication in 2009. Dispensing was greater among females (5.6%) and those aged 65 years and over (11.2%) (Table 6.4). Of the 1,103,451 people dispensed any long-acting beta-agonists in 2009, only 20,464 (1.9%) received the medication as a separate inhaler rather than in combination with inhaled corticosteroids. Among these people, only 7,043 (0.64%) did not receive a prescription for inhaled corticosteroids within 2009. Those receiving long-acting beta-agonist medication without inhaled corticosteroids were mostly aged 55 years and over (0–14: 3.7%; 15–34: 10.7%; 35–64: 21.4%; 55 or older: 64.1%). The potential for use of long-acting beta-agonist medication alone in patients with asthma is therefore low in the Australian population.

There was little variation in the proportion of long-acting beta-agonist users according to remoteness of residence. However, a slightly higher proportion of people residing in areas of highest socioeconomic status were dispensed this class of medication compared with those living in areas of lowest socioeconomic status. Furthermore, the rates of dispensing were higher among government health concession cardholders compared with those without concession cards. The same trends were seen among people aged 5–34 years (Table 6.4).

Table 6.4: Proportion of population dispensed long-acting beta-agonists, by demographic characteristics, 2009

Demographic characteristics	All ages		Age 5–34 years	
	Number	Per cent	Number	Per cent
Sex				
Male	489,876	4.5	147,239	3.2
Female	613,024	5.6	154,087	3.5
Age group				
0–4 years	14,977	1.1	..	..
5–14 years	94,319	3.4	94,319	3.4
15–34 years	207,007	3.4	207,007	3.4
35–64 years	460,193	5.3	..	..
65 years and over	326,403	11.2	..	..
Socioeconomic status				
SES 1 (Lowest)	178,647	4.3	46,439	2.8
2	206,343	5.1	52,568	3.2
3	222,574	5.3	60,284	3.4
4	222,151	5.4	62,933	3.6
SES 5 (Highest)	265,337	6.4	76,946	4.5
Remoteness category				
Major cities	760,995	5.4	214,340	3.6
Inner regional	219,161	5.4	55,697	3.6
Other areas[(a)]	117,549	4.8	29,942	3.1
Concessional status[(b)]				
Government health concession cardholders	536,240	10.4	62,016	5.5
No government health concession card	457,363	4.7	144,991	3.6
All persons	**1,103,451**	**5.0**	**301,326**	**3.4**

SES = socioeconomic status, see Appendix 1, Section A1.13.3

.. = Not applicable.

(a) Other areas include Outer regional, Remote and very remote areas.

(b) Limited to persons aged 15 years and over.

Note: The National Health Survey 2007–08 was used to estimate the total number of Australians with a government concession card.

Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

Number of long-acting beta-agonist prescriptions

There is evidence that long-acting beta-agonists are less effective in children than in adults and their use is not recommended in children with asthma except if their asthma is poorly controlled despite other therapy (Ducharme et al. 2010; Van Asperen et al. 2010; GINA 2009b; Sorkness et al. 2007; Bisgaard & Szefler 2006). Hence, the utilisation of this class of medications is described here separately for adults and children.

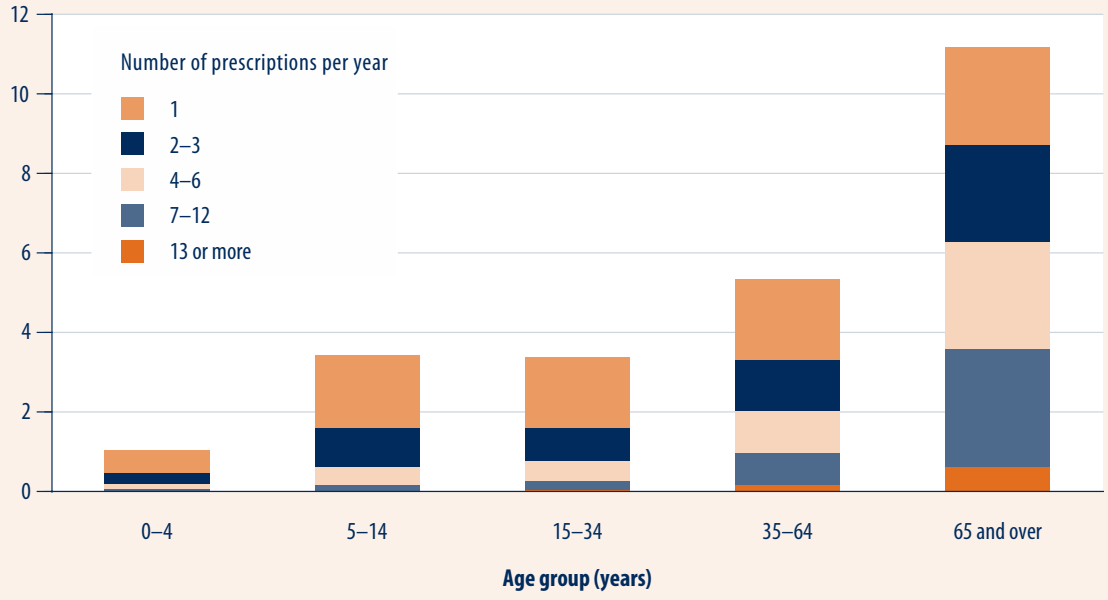
Adults

In 2009, 5.6% of all people aged 15 years and over were dispensed at least one prescription for long-acting beta-agonists.

The proportion of adults dispensed four or more prescriptions increased with age (Figure 6.12). In 2009, 0.8% of adults aged 15–34 years were dispensed four or more prescriptions for this class of asthma medication compared with 2.0% of adults aged 35–64 years and 6.3% of those aged 65 years and over. Furthermore, during the same year, 0.3% of people aged 15–34 years had seven or more prescriptions for long-acting beta-agonists dispensed compared with 1.0% of adults aged 35–64 years and 3.6% of those aged 65 years and over.

Children

In 2009, 2.6% of all children aged 0–14 years were dispensed at least one prescription for long-acting beta-agonists. Dispensing was much lower in younger children aged 0–4 years (1.1%) compared with those aged 5–14 years (3.4%) (Figure 6.12). In contrast to adults, more than half the children dispensed long-acting beta-agonists were dispensed only one prescription in 2009. Very few children averaged one or more prescriptions for long-acting beta-agonists per month.



Note: Includes all those using long-acting beta-agonists alone and in combined formulation with inhaled corticosteroids.
Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

Figure 6.12: Proportion of population dispensed long-acting beta-agonists (alone or in combination with inhaled corticosteroids), by age group, number of prescriptions, 2009

Short-acting bronchodilators

Short-acting bronchodilators are commonly referred to as 'relievers' due to their mode of use by patients with asthma. Short-acting beta-agonists (salbutamol and terbutaline) are the most commonly used class of short-acting bronchodilators. They are very effective in providing rapid relief of acute asthma symptoms and, since they can be purchased without a prescription, are readily accessible in Australia (ACAM 2008a). Use of short-acting bronchodilators is very common among people with asthma and related conditions.

The duration of action of short-acting beta-agonists is typically 4–6 hours (Lotvall 2002). It is recommended that short-acting beta-agonists should be used on an as-needed basis for short-term relief of symptoms (NAC 2006), since their regular or excessive use may contribute to poorly-controlled asthma (Taylor 2009; Paris et al. 2008). Further data on short-acting beta-agonist use as a marker for poorly-controlled asthma are found in Section 3.1.1. Short-acting anticholinergics (ipratropium) and rapid-onset, long-acting beta-agonists in combination with inhaled corticosteroids may also be used as 'relievers'.

Overall, 12.3% of all adults holding a government health-care concession card had at least one PBS-subsidised prescription for short-acting beta-agonists dispensed during 2009.

In the 2007–08 NHS, 42.9% of surveyed people with current asthma who were aged 5 years and over reported using short-acting beta-agonists in the last 2 weeks.

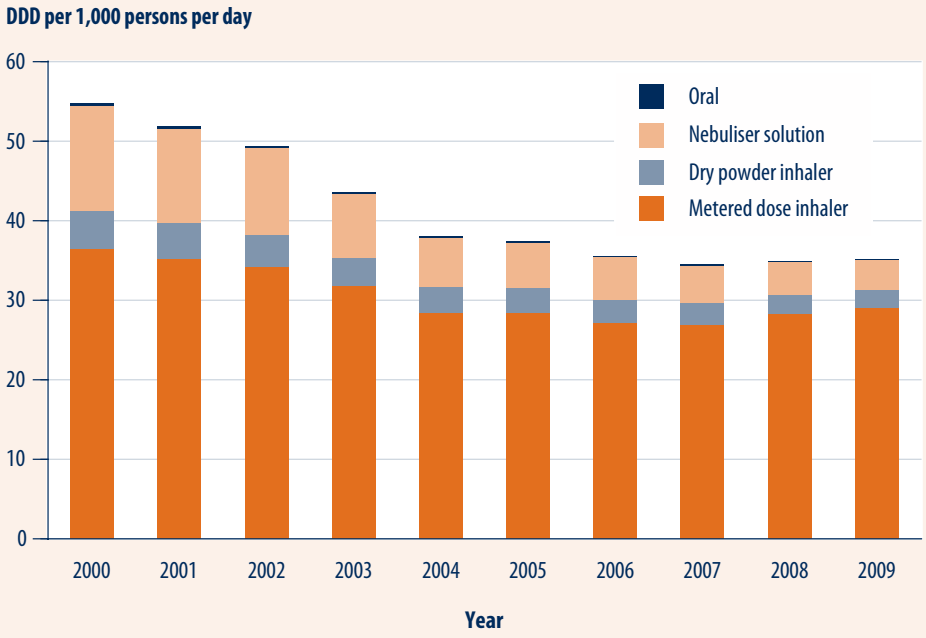
Among people attending their GP for management of asthma, short-acting beta-agonists accounted for half of all medications (50.3%) prescribed for asthma (AIHW: Britt et al. 2009). Furthermore, 94% of patients were reported to use a short-acting beta-agonist in the previous 12 months including 14% who were reported using this medication twice daily (13.8%) (AIHW: Britt et al. 2007b).

Some children who use salbutamol do not have a diagnosis of asthma. Among children aged 5 years beginning school in the Australian Capital Territory who were taking salbutamol, 19% did not report having a diagnosis of asthma in 2000 and this proportion had increased to 35% in 2005 (Phillips et al. 2007). It is possible that this increase reflects changes in diagnostic labelling.

Route of administration and mode of delivery of bronchodilators

Short-acting bronchodilators are available in oral formulations as well as inhaled formulation. Oral formulations are less effective and cause more side effects and are not recommended for use in patients with asthma. In fact, nearly all short-acting beta-agonist and anti-cholinergic bronchodilator medication is administered by inhalation. The most popular devices supplied were metered dose inhalers, or 'puffers'. Between 2000 and 2009, the proportion of supply of this class of medication in the form delivered by metered dose inhalers increased from 66% to 83%, even though the overall supply decreased over this period (Figure 6.13).

In 2000, approximately one-quarter of the supply of this class of medication was in the form used for nebulised delivery. This proportion has gradually declined with changes in asthma guidelines that encourage their delivery by pressurised metered dose inhaler and large volume spacer even in emergency departments, and in 2009 only 11% was supplied in the form of a nebuliser solution.



DDD = defined daily dose.
Source: IMS Health.

Figure 6.13: Delivery devices supplied by wholesalers for the administration of short-acting beta-agonist and anticholinergic medication, by defined daily dose per 1,000 persons per day, 2000–2009

Sociodemographic distribution of use

The prevalence of reported use of short-acting beta-agonists by people with current asthma in the 2007–08 NHS was highest among adults aged 35 years and over (45.8% reported using this medication class in the previous 2 weeks) but was also common among children (35.8%).

Dispensing of short-acting beta-agonists was slightly more common in females (13.5%) than males (11%) (PBS data for concession cardholders, Table 6.5), reflecting the higher prevalence of asthma in females. Dispensing of this class of medications increased with age. Among those aged 65 years and over, 13.4% were dispensed this class of medication compared with only 9.3% among those aged 15–34 years. Among people aged 15 years and over, those residing in *Major cities* or *Remote* areas of Australia had a higher proportion of short-acting beta-agonist prescriptions dispensed than those living in *Inner regional* areas of Australia ($p<0.0001$).

Table 6.5: Proportion of people with government health-care concession cards dispensed short-acting beta-agonists, by demographic characteristics, 2009

Demographic characteristics	Age 15 years and over		Age 15–34 years	
	Number	Per cent	Number	Per cent
Sex				
Male	238,356	11.0	36,693	7.6
Female	395,386	13.5	65,580	10.5
Age group				
15–34 years	102,273	9.3	102,273	9.3
35–64 years	221,700	12.6	..	..
65 years and over	309,769	13.4	..	..
Remoteness category				
Major cities	404,892	12.9	65,788	9.6
Inner regional	147,437	10.6	23,878	8.8
Other areas[(a)]	77,637	12.1	12,112	8.3
All concession cardholders	**633,742**	**12.2**	**102,273**	**9.3**

.. = Not applicable.

(a) Other areas include Outer regional, Remote and Very remote areas (calculated from the Pharmaceutical Benefits Scheme and the National Health Survey 2007–08 data sources).

Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

The need to limit the analysis of short-acting beta-agonist prescriptions data to concession cardholders meant it was not possible to judge the impact of socioeconomic status, since concession cardholders already represent a lower socioeconomic status subgroup. Studies elsewhere have explored this. In Canada, Lynd and colleagues (Lynd et al. 2004) found that greater levels of socioeconomic disadvantage were associated with higher levels of use of short-acting beta-agonists, even when controlling for level of severity of asthma.

Generally, high rates of use of short-acting beta-agonists are an indicator of poor asthma control. Campaigns that focus on the subgroup of people with asthma who are high users of short-acting beta-agonists may lead to gains in a range of asthma outcomes.

Oral corticosteroids

During episodes of severe worsening of asthma symptoms (known as 'exacerbations'), oral corticosteroids are often used for short-term treatment. A very small number of people with very severe asthma not controlled with maximal inhaled therapy need long-term treatment with oral corticosteroids to control their disease.

Among concession cardholders who had a prescription for any asthma medication in 2009, 4.0% were dispensed oral corticosteroids (Table 6.6). The use of oral corticosteroids increased with age, with 1.8% of those aged 15–34 years compared with 5.2% of those aged 65 years and over being dispensed oral corticosteroids in 2009 (Table 6.6 and Figure 6.14).

Table 6.6: Proportion of concession cardholders dispensed oral corticosteroids, by demographic characteristics, 2009

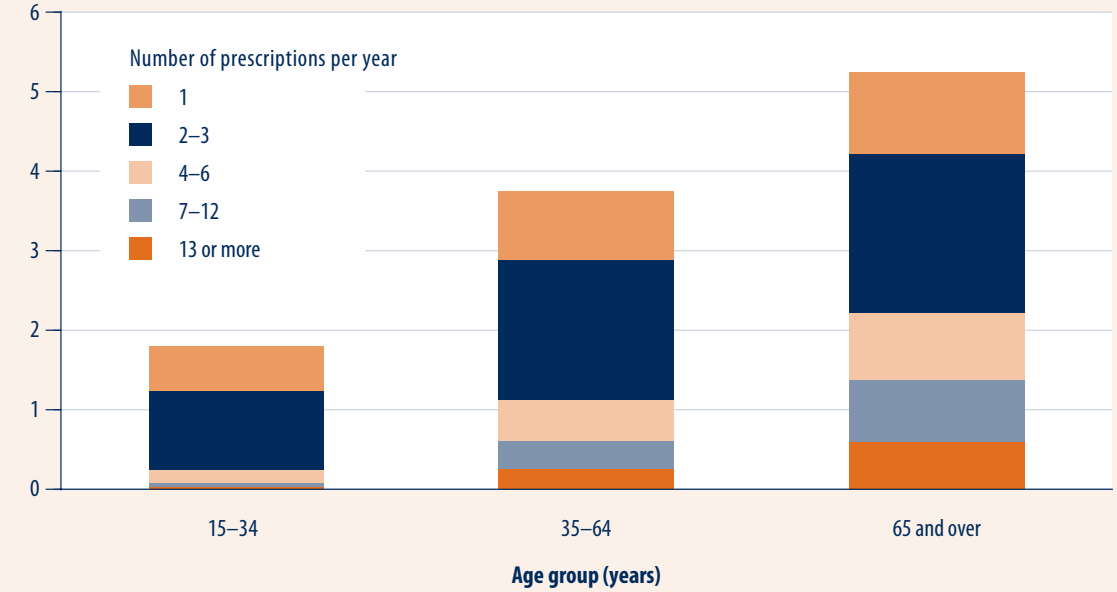
	Age 15 years and over		Age 15–34 years	
Demographic characteristics	Number	Per cent	Number	Per cent
Sex				
Male	78,402	3.5	6,170	1.3
Female	128,716	4.4	13,683	2.2
Age group				
15–34 years	19,853	1.8	19,853	1.8
35–64 years	66,195	3.7	..	..
65 years and over	121,070	5.2	..	..
Remoteness category				
Major cities	131,714	4.2	12,736	1.9
Inner regional	49,085	3.5	4,658	1.7
Other areas[(a)]	25,002	3.9	2,356	1.6
All concession cardholders	**207,118**	**4.0**	**19,853**	**1.8**

.. = Not applicable.

(a) Other areas include Outer regional, Remote and Very remote areas (calculated from the Pharmaceutical Benefits Scheme and the National Health Survey 2007–08 data sources).

Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

In 2009, 1.8%, 3.7% and 5.2% of people with a concession card aged 15–34 years, 35–64 years and 65 years and over, respectively, were dispensed one or more prescriptions for oral corticosteroids (Figure 6.14). Most adults who were dispensed oral corticosteroids filled 2–3 prescriptions for this class of medication in 2009. The proportion of adults with multiple prescriptions for oral corticosteroids increased with age.



Note: Data restricted to patients with government health concession card who had taken any asthma or COPD medication in 2009.
Sources: Pharmaceutical Benefits Scheme; ABS National Health Survey 2007–08 for the population estimate for government health concession cardholders.

Figure 6.14: Proportion of oral corticosteroids dispensed among adults with a government health concession card, by age group and number of prescriptions, 2009

Summary

The most important change in the nature of the pharmacological treatment for asthma over the last 10 years was the gradual increase in use of long-acting beta-agonists in combination with inhaled corticosteroids. This was accompanied by a reduction in the use of short-acting beta-agonists over this period, suggesting a trend to improved levels of control of the disease. However, this trend has plateaued over the last 5 years and data on the supply of most medications for asthma and other respiratory disorders have also remained relatively stable in recent years.

There are important age-related differences in treatment for asthma. The dispensing of almost all medications for asthma increases with age.

The pattern of dispensing of asthma therapies is quite different in children compared with adults, as should be expected given the differences in clinical practice guidelines for adults and children.

Dispensing of inhaled corticosteroids is less common in children than in adults with asthma, and the dispensing of inhaled corticosteroids for children has declined over the last 6 years. Most children using inhaled corticosteroids are only dispensed one prescription per year and the majority dispensed to children are among the less potent formulations.

Over 80% of inhaled corticosteroids are supplied in combination with long-acting beta-agonists, despite guidelines recommending that these medications should only be used in patients whose asthma was not well-controlled with inhaled corticosteroids alone.

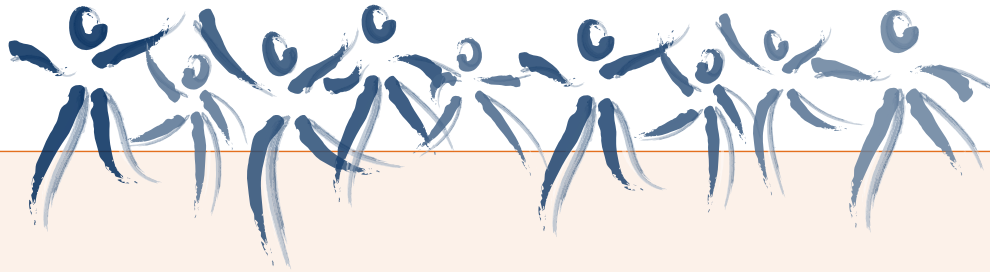
Dispensing of combined inhaled corticosteroids with long-acting beta-agonists for children, while substantially less than for adults, is relatively common compared with other medications prescribed for children with asthma. The dispensing of combination therapy among children occurs more often than would be expected considering asthma guidelines.

Among adults, dispensing data indicate that the majority of inhaled corticosteroid-containing medications are not prescribed or used in accordance with current asthma guidelines. The majority of inhaled corticosteroids are prescribed in combination with long-acting beta-agonists, despite guidelines recommending the use of the combination medication only for patients whose asthma is not well-controlled on inhaled corticosteroids alone.

A large number of prescriptions for inhaled corticosteroids are for the high potency formulations, despite evidence that, for most patients, most of the benefit is obtained at the lowest potency. However, there is some evidence that, in the most recent year of data (2009), there was a reduction in the proportion of prescriptions for the most potent formulations of inhaled corticosteroids.

It is clear that intermittent use of inhaled corticosteroids is the most common mode of use in adults, as well as children, despite treatment guidelines recommending their regular use in people with persistent asthma in order to improve asthma control and reduce the risk of exacerbations.

7. Smoking and occupational exposures as risk factors for asthma



Key points

- People with asthma smoke at least as much as people without asthma, despite the known adverse effects.
- In 2007–08 the prevalence of smoking was higher in females with asthma than in those without asthma. This was not observed in males.
- Socioeconomic status is a strong determinant of the risk of smoking among people with asthma, with smoking rates higher in areas of lower socioeconomic status.
- An estimated 7.8% of children with asthma reside where smoking occurs inside the home.
- Nearly 10% of adult-onset asthma is caused by occupational exposures and, hence, could be avoided if exposure to triggering agents in the workplace were removed.
- Occupational asthma is the one truly preventable form of the disease.

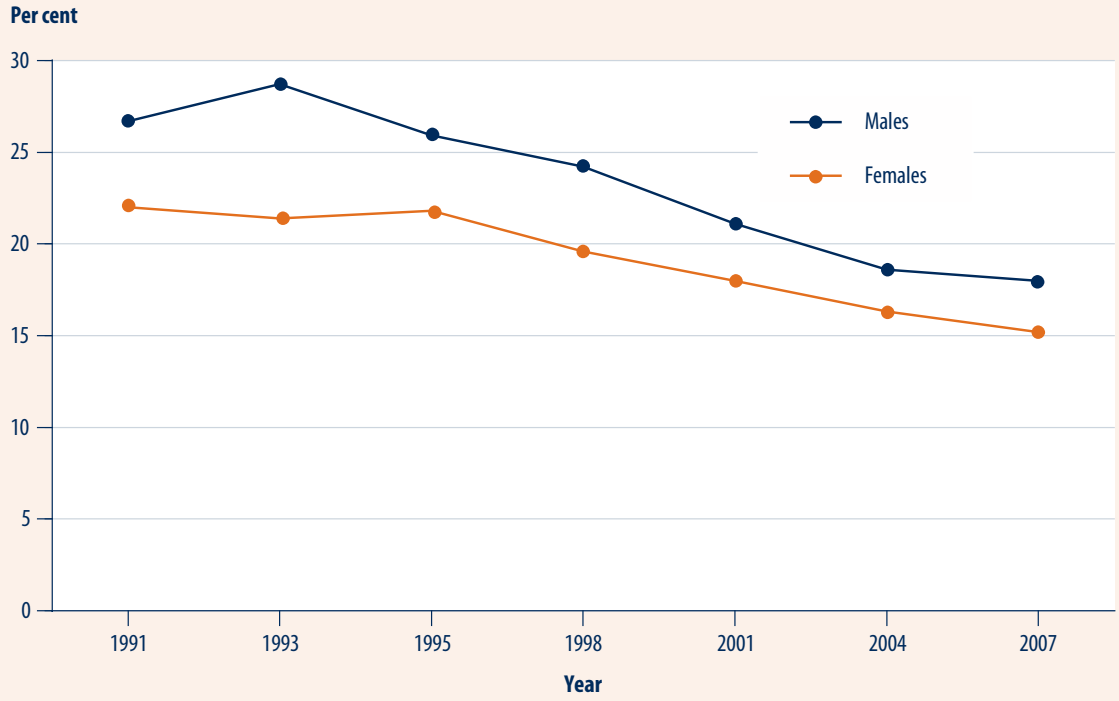
Introduction

In this chapter, we present data on trends in smoking prevalence, smoking among people with asthma and exposure to environmental tobacco smoke among children with asthma. We also discuss occupational exposure as a risk factor for the development of asthma in adulthood.

Exposure to occupational allergens and other agents was conclusively linked both to the development of asthma and the progression of the disease. Since this is a potentially avoidable cause of asthma, exposure to occupational allergens and the occurrence of occupational asthma are important targets for surveillance.

Trends in smoking prevalence

Smoking rates in Australia have been declining for decades. Between 1991 and 2007, the prevalence of smoking daily declined by 32% among males and females aged 14 years and over (Figure 7.1). In 2007, the prevalence of smoking in this age group was 16.6%, including 18.0% in males and 15.2% in females.



Sources: National Campaign Against Drug Abuse Household Survey 1991, 1993; National Drug Strategy Household Survey 1995, 1998, 2001, 2004; AIHW 2005, 2008a.

Figure 7.1: Prevalence of daily smoking among people aged 14 years and over, 1991–2007

7.1 People with asthma who smoke

The harmful effects of both active and passive smoking are well known. People with asthma who smoke have particular problems (Siroux et al. 2000) and find their asthma more difficult to control than non-smokers. In part, this may be because smoking impairs the effectiveness of inhaled corticosteroids (Chalmers et al. 2002), even at high doses (Pedersen et al. 1996). In addition, both smoking and asthma accelerate the rate of decline in lung function with age (James et al. 2005).

7.1.1 Prevalence

In 2007–08, the prevalence of smoking at least once a week in people aged 18 years and over was 22.9% among those with current asthma and 20.4% among those without current asthma (Table 7.1).

Survey data from the states and territories confirm that the rate of smoking among people with asthma (18.1–35.8%) is the same, if not higher than, the rate among people without asthma (Table 7.1).

The Tasmanian Longitudinal Study reported a high prevalence (35.8%) of current smoking among people with asthma between 2004 and 2008. The proportion of ex-smokers is generally similar among those with and without asthma across the surveys.

A South Australian study incorporating over 10 years of aggregated health survey data found that asthma was associated with ex-smoking status (OR 1.29, CI: 1.15 to 1.44, compared with non-smokers). However, current smoking was only significantly associated with asthma in females (OR 1.27, CI: 1.08 to 1.51) and not in males (OR 0.98, CI: 0.80 to 1.20) (Wilson et al. 2006).

In New South Wales, since 1997 there was a significant decrease in the proportion of adults with current asthma who were current smokers (24.5% to 19.1%), particularly among females (Centre for Epidemiology and Research 2009).

It is clear that many people with asthma continue to smoke. However, it is also possible that the very high rates of smoking (and particularly ex-smoking status) among people with asthma reflect the fact that some people may have asthma-like symptoms or have been diagnosed with asthma due to the adverse effects of smoking.

Table 7.1: Smoking status among people with and without current asthma, most recent survey results, 2004–2009

Study	Year	Age (years)	Smoking status	People with asthma		People without asthma	
				Rate (%)	95% CI	Rate (%)	95% CI
Australia (1)	2007–08	18 and over	Current smoker[a]	22.9	20.3–25.5	20.4	19.5–21.2
			Ex-smoker	31.2	28.4–33.9	29.5	28.5–30.4
			Never smoked	45.9	42.7–49.1	50.2	49.0–51.3
				(*n*=1,658)		(*n*=14,121)	
New South Wales (2)	2009	16 and over	Smoke daily	16.0	13.4–19.1	13.3	12.2–14.3
			Smoke occasionally	2.8	1.6–4.0	3.8	3.2–4.4
			Don't smoke now but used to	23.7	20.6–26.9	24.4	23.2–25.6
			Tried but never smoked	11.4	8.7–14.1	10.6	9.7–11.6
			regularly	45.9	41.9–49.8	47.9	46.5–49.4
			I've never smoked	(*n*=1,257)		(*n*=9,415)	
Victoria (3)	2008	18 and over	Current smoker[b]	18.9	16.9–21.0	19.2	18.4–19.9
			Ex-smoker	23.6	21.7–25.5	23.8	23.1–24.5
			Never-smoker	57.3	54.8–59.8	56.8	56.0–57.7
				(*n*=3,824)		(*n*=30,345)	
Western Australia (4)	2009	16 and over	Current smoker[b]	18.1	14.0–22.1	16.5	15.2–17.7
			Ex-smoker	25.0	20.7–29.2	25.7	24.4–27.0
			Never smoked	57.0	51.8–62.1	57.8	56.2–59.4
				(*n*=881)		(*n*=9,218)	
South Australia (5)	2009	16 and over	Current smoker[b]	15.2	12.8–18.0	15.1	14.2–16.2
			Ex-smoker	34.1	30.7–37.5	38.1	36.8–39.4
			Non-smoker	50.7	47.1–54.3	46.7	45.4–48.1
				(*n*=741)		(*n*=5,135)	
Tasmania (6)	2004–2008	41–44	Current smoker	35.8	32.1–39.7	29.1	27.9–30.4
				(*n*=637)		(*n*=5,059)	

CI = Confidence interval.

(a) Includes people who reported smoking at least once a week.

(b) Includes people who reported smoking daily or occasionally.

Sources:

(1) ACAM analysis of ABS National Health Survey 2007–08. Data excludes people who smoked less than weekly (0.35% of people with asthma and 0.42% of people without asthma).

(2) New South Wales Population Health Survey, Centre for Epidemiology and Research, NSW Health.

(3) Victorian Population Health Survey 2008, Health Intelligence Unit, Department of Health, Health Intelligence Unit, Department of Health (unpublished data).

(4) WA Health and Wellbeing Surveillance System, Epidemiology Branch, Department of Health, Government of Western Australia.

(5) South Australian Monitoring and Surveillance System (SAMSS), Population Research and Outcome Studies, Health Intelligence, Department of Health, Government of South Australia.

(6) Tasmanian Longitudinal Health Survey (unpublished data).

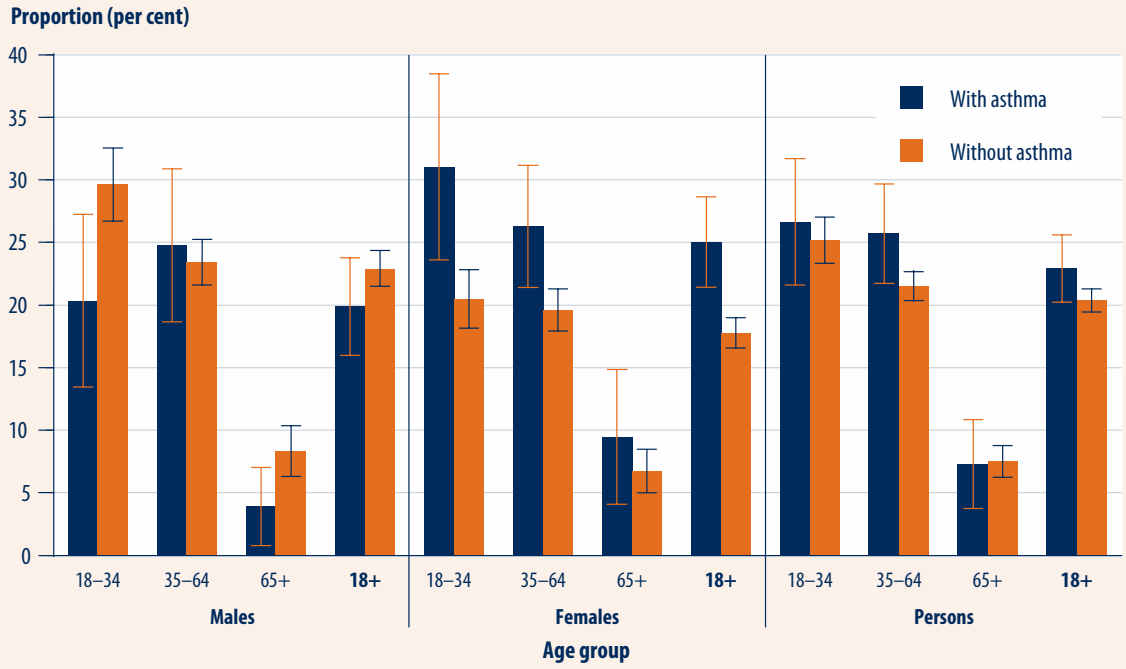
7.1.2 Population subgroups

Age and sex

The prevalence of current smoking in adults decreases with increasing age, but among men the prevalence of ever having smoked increases with age. As a consequence, and as expected, a far higher proportion of older people, particularly men, are ex-smokers (ACAM 2007a).

In the 2007–08 National Health Survey, 31% of young females aged 18–34 years with asthma were current smokers (Figure 7.2). The prevalence of smoking among females in this younger age group was significantly higher than among older females ($p<0.0001$). The prevalence of current smoking among males aged 18–34 years with asthma was 20% in 2007–08, a significant decrease since 2004–05 (38%) ($p<0.0001$) (ACAM 2008a).

The higher prevalence of smoking in people with asthma compared to people without asthma was only observed for females and not for males (Figure 7.2). Among adult females, 25.0% of those with asthma compared to 17.8% of those without asthma reported being current smokers. Among adult males, 19.9% of those with asthma were smokers compared to 22.9% of those without the condition.



Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey 2007–08.

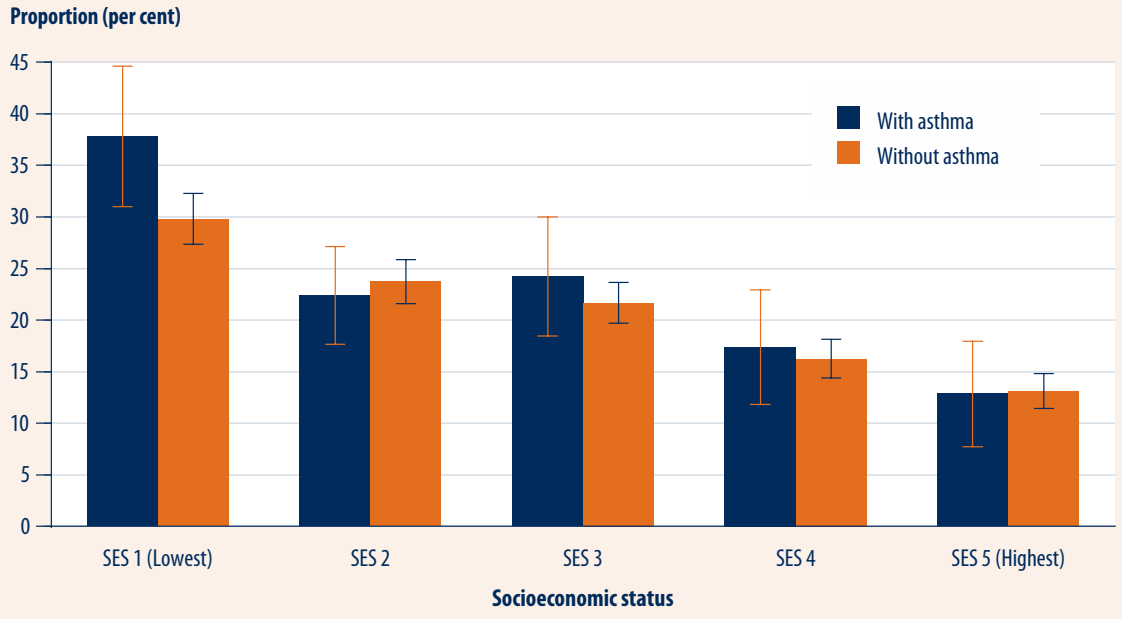
Figure 7.2: Prevalence of current smoking among adults aged 18 years and over, by asthma status, age group and sex, 2007–08

Socioeconomic status

The prevalence of smoking among people with asthma in 2007–08 was almost three times higher (37.8%) among those living in areas of lowest socioeconomic status than among those living in areas of highest socioeconomic status (12.9%) (rate ratio 2.9, CI: 2.0–4.2) (Figure 7.3). This differential was less marked among people without asthma (rate ratio 2.3, CI: 2.0–2.6).

Among those living in areas of lowest socioeconomic status, the prevalence of smoking among people with asthma (37.8%) was substantially higher than that observed among people without the condition (29.8%) (p=0.004). However, there were no differences in the prevalence of smoking among people with and without asthma living in the highest socioeconomic status areas.

The causal direction underlying the three-way association between socioeconomic status, smoking status and asthma cannot be ascertained from these cross-sectional data. Possible explanations include a synergistic adverse effect of smoking and low socioeconomic status of the risk of having asthma or, alternatively, a synergistic association between low socioeconomic status and asthma on the risk of continuing to smoke.



SES = Socioeconomic status, see Appendix 1, Section A1.13.3.
Note: Age-standardised to the Australian population as at June 2001;
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 7.3: Prevalence of current smoking among adults aged 18 years and over, by asthma status and socioeconomic status, 2007–08

7.2 Passive smoke exposure in children with asthma

Exposure to environmental tobacco smoke, commonly referred to as 'passive smoke', in childhood is a risk factor for the development of asthma symptoms and also for the worsening of pre-existing asthma. It was shown that exposure to environmental tobacco smoke increases the risk of wheezing illness in young children (Young et al. 2000; Martinez et al. 1992) and that the association between exposure and childhood wheezing illness is most consistent at high levels of environmental tobacco smoke exposure (NHMRC 1997).

These findings are supported by evidence from international studies which conclude that parental smoking is associated with more severe asthma in children (Pattenden et al. 2006; Strachan & Cook 1998) and that exposure to environmental tobacco smoke after birth is a likely cause of wheezing or other acute respiratory illness in young children (Strachan & Cook 1997).

Cohort studies have shown that children with pre-existing asthma who are exposed to environmental tobacco smoke have increased morbidity and asthma symptoms (Murray & Morrison 1989), more frequent exacerbations (Chilmonczyk et al. 1993), more severe asthma symptoms (Strachan & Cook 1998; Murray & Morrison 1993), impaired lung function (Chilmonczyk et al. 1993; Murray & Morrison 1989) and increased airway reactivity (Oddoze et al. 1999; Murray & Morrison 1989) or peak flow variability (Fielder et al. 1999; Frischer et al. 1993).

There is also evidence that children exposed to environmental tobacco smoke are more likely to attend emergency departments with asthma (Evans et al. 1987). It was shown that maternal smoking is a risk factor for hospital admissions in children with asthma (Gurkan et al. 2000). Recovery after hospitalisation, measured by use of reliever medication and number of symptomatic days, is also impaired in children exposed to passive smoke (Abulhosn et al. 1997).

A Brisbane study conducted between 1981 and 1998 showed that 14-year-old girls, but not boys, had an increased risk of having asthma symptoms (OR 1.96, CI: 1.25–3.08) if their mother reported smoking heavily (defined as 20 or more cigarettes per day) both during pregnancy and 6 months after the birth of their daughter (Alati et al. 2006). Smoking during pregnancy was the most important risk factor.

There is some evidence that early life exposure to tobacco smoke may have long-term consequences. It was reported that as much as 17% of adult-onset asthma is attributable to maternal smoking in childhood (Skorge et al. 2005).

Other international studies have reported associations with passive smoke exposure in childhood and asthma in adulthood:

- A Swedish study showed that the prevalence of adult asthma among people who never smoked was higher among subjects who had been exposed to environmental tobacco smoke as a child (Larsson et al. 2001).
- Findings from the European Community Respiratory Health Survey showed a higher prevalence of respiratory symptoms and poorer lung function among adults whose mother smoked during pregnancy or had childhood exposure to maternal smoking (Svanes et al. 2004)
- Grandmaternal smoking during the mother's fetal period was associated with a 2.1 times higher risk of the grandchild developing asthma (Li et al. 2005). These multi-generational effects are hypothesised to act through epigenetic mechanisms. This means that by altering DNA patterns in the fetal oocyte, tobacco-derived products may affect immune function mechanisms in the offspring, resulting in an increased susceptibility to asthma affecting one generation to the next (Li et al. 2005; Bousquet et al. 2004).

Other studies have reported that subjects who were exposed to passive smoke during their childhood are more likely to take up smoking themselves (Larsson et al. 2001; Cook & Strachan 1999) and this may increase their risk of developing asthma.

The large body of evidence regarding the harmful consequences of passive smoke exposure has resulted in the introduction of smoking bans in many public areas including bars, cafes and restaurants, shopping centres, entertainment venues and the workplace. In January 2008, South Australia introduced anti-smoking laws to prohibit smoking in cars carrying children under the age of 18 years. Since then, these bans have also been introduced in most of the other states and territories of Australia (New South Wales, Victoria, Queensland, Western Australia and Tasmania).

Young children, who are most vulnerable to the effects of passive smoke exposure, are most likely to be exposed to passive smoke in their home, where smoking bans do not apply. There is evidence, though, that the proportion of homes in which smoking was *not permitted* inside the house, as described by owners of the household, increased in Australia from 71.6% in 1999 to 80.1% in 2004 (Valenti et al. 2005).

Changes in legislation around smoking can lead to improvements in asthma outcomes. In Scotland, bans on smoking in public places led to a reduction in hospitalisations for children with asthma (Mackay et al. 2010).

This section provides data on the proportion of children with asthma who are exposed to passive smoke through living with a person who smokes or living with a person who smokes inside the house.

7.2.1 Exposure to passive smoke

Australian children with asthma continue to be exposed to environmental tobacco smoke in the home despite the known adverse effects. In 2007–08, 38.1% of children aged 0–14 years with asthma *lived with one or more daily cigarette smokers*. This proportion was marginally higher than that observed among children without asthma (32.7%) (p=0.03) (Figure 7.2). Among children with asthma, 7.8% were residing in homes where *smoking occurred daily inside the home* (Table 7.3). This rate was similar to that observed for children without asthma (7.1%). Results from health surveys conducted in Victoria, Western Australia and South Australia support these findings (Table 7.2 and Table 7.3).

In South Australia between 2002 and 2007, among children aged 2–15 years, there was a significantly higher proportion of children with asthma living in a home environment where smoking occurred frequently than among those living in a smoke free home (Population Research and Outcomes Studies Unit 2008).

Table 7.2: Exposure to passive smoke among children, 2007–2009

				Children with asthma		Children without asthma	
Study	Year	Age (years)	Household smoking status	Rate (%)	95% CI	Rate (%)	95% CI
Australia (1)	2007–08	0–14	One or more daily smokers in the household	38.1 (*n*=415)	31.1–45.2	32.7 (*n*=3,631)	30.5–34.9
Victoria (2)	2009	1–12	One or more regular smokers	28.1	23.8–32.4	25.2	23.6–26.7
			No smoker	71.9 (*n*=n.a.)	67.6–76.2	74.7 (*n*=n.a.)	73.2–76.2

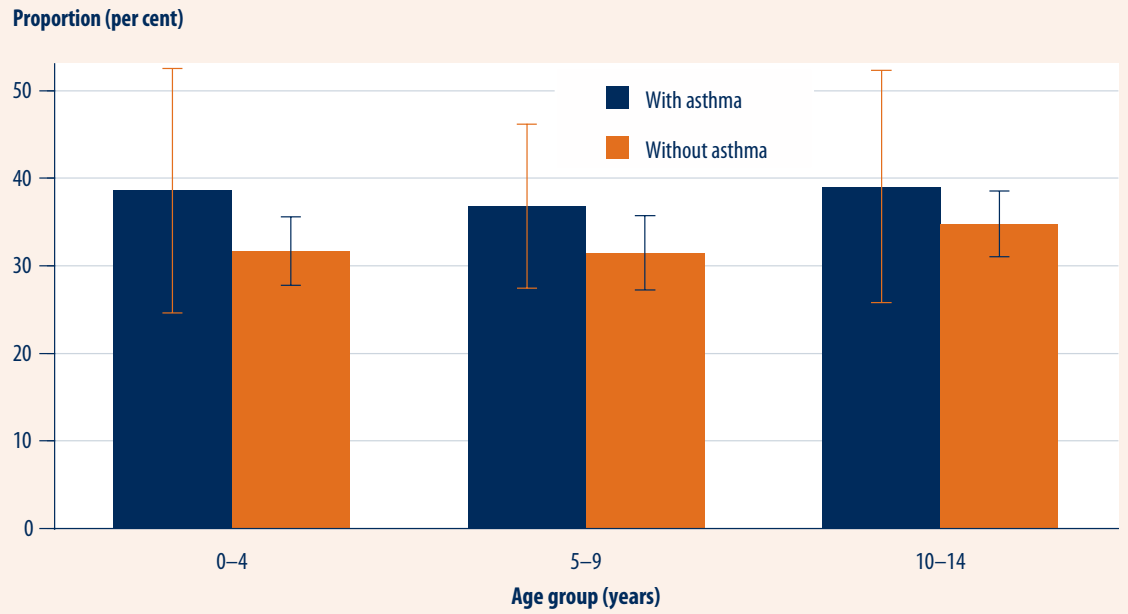
CI = Confidence interval.
n.a. = Not available.
Sources:
(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) Victorian Child Health and Wellbeing Survey, Child Outcomes Monitoring, Statewide Outcomes for Children Branch, Office for Children, Department of Human Services.

Table 7.3: Exposure to passive smoke inside the house among children, 2007–2009

Study	Year	Age (years)	Household smoking status	Children with asthma		Children without asthma	
				Rate (%)	95% CI	Rate (%)	95% CI
Australia (1)	2007–08	0–14	One or more daily smokers smoke inside the house	7.8 (*n*=415)	4.2–11.3	7.1 (*n*=3,631)	5.8–8.4
New South Wales (2)	2007–08	2–15	People occasionally or frequently smoke inside the house	4.2	2.3–6.2	7.0	6.0–8.1
			My home is smoke free	95.8 (*n*=507)	93.8–97.7	93.0 (*n*=3,014)	92.0–94.0
Victoria (3)	2009	1–12	Usually smoke inside	1.7	0.2–3.2	1.4	0.6–2.3
			Sometimes smoke inside and sometimes smoke outside	7.6	2.4–12.8	5.7	4.0–7.5
			Usually smoke outside the house	6.7	1.9–11.5	6.2	4.5–7.9
			Always smoke outside the house	82.8 (*n*=n.a.)	75.8–89.7	85.6 (*n*=n.a.)	83.1–88.1
Western Australia (4)	2009	0–15	People frequently smoke inside the house	1.4	0.1–2.8	1.0	0.6–1.4
			People occasionally smoke inside the house	1.5	0.0–3.3	1.0	0.6–1.3
			My home is smoke free	97.0 (*n*=203)	94.8–99.3	98.0 (*n*=2,217)	97.5–98.6
South Australia (5)	2009	2–17	People frequently smoke inside the house	2.9	1.3–6.2	1.3	0.8–2.0
			People occasionally smoke inside the house	2.3	0.9–5.4	2.2	1.6–3.1
			My home is smoke free	94.8 (*n*=198)	90.8–97.2	96.5 (*n*=1,393)	95.4–97.3

CI = Confidence interval.
n.a. = Not available.
Sources:
(1) ACAM analysis of ABS National Health Survey 2007–08.
(2) New South Wales Population Health Survey, Centre for Epidemiology and Research, NSW Health.
(3) Victorian Child Health and Wellbeing Survey, Child Outcomes Monitoring, Statewide Outcomes for Children Branch, Office for Children, Department of Human Services.
(4) Epidemiology Branch, Analysis and Performance Reporting Directorate, Department of Health, Government of Western Australia.
(5) South Australian Monitoring and Surveillance System (SAMSS), Population Research and Outcome Studies, Health Intelligence, Department of Health, Government of South Australia.

In the 2007–08 NHS, high rates of exposure to environmental tobacco smoke were observed for children of all ages with and without asthma (Figure 7.4).

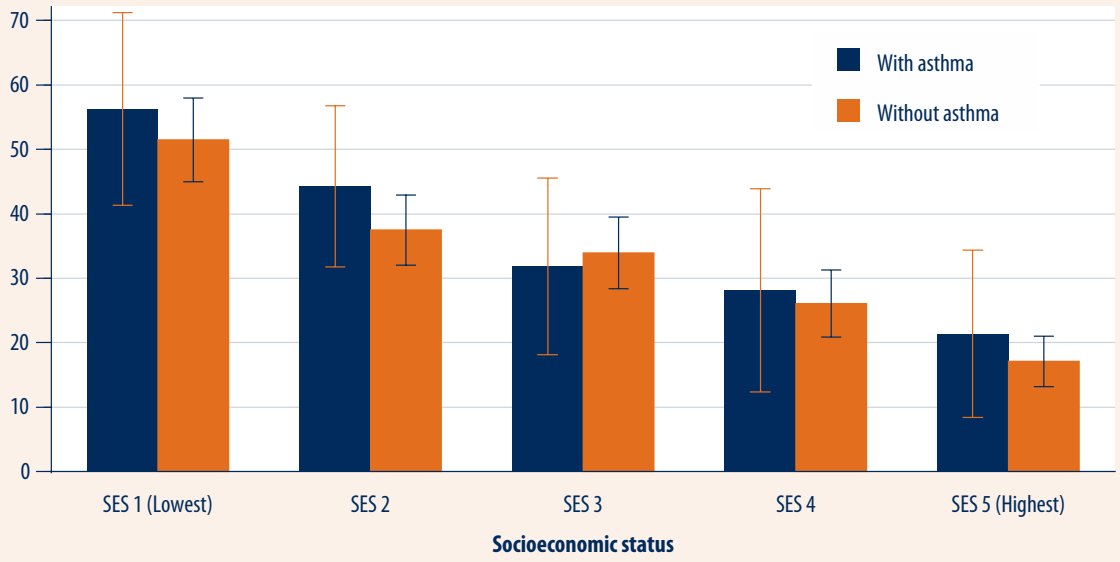


Note: Age-standardised to the Australian population as at June 2001
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 7.4: Proportion of children aged 0–14 years with one or more daily smokers in the household, by age group and current asthma status, 2007–08

Socioeconomic status

In the lowest socioeconomic status localities, more than half (56%) of children with current asthma reside with a smoker but in the highest socioeconomic status localities only 21% of children with asthma reside with a smoker (Figure 7.5). However, the relation between asthma status and living with a smoker did not change with the level of socioeconomic status (p=0.8).



SES = Socioeconomic status, see Appendix 1, Section A1.13.3.

Notes

1. Estimates for children with current asthma for SES 4 and 5 have a relative standard error between 25 and 50% and should be interpreted with caution.
2. Age-standardised to the Australian population as at June 2001.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 7.5: Proportion of children aged 0–14 years with one or more daily smokers in the household, by socioeconomic status and current asthma status, 2007–08

7.3 Occupational asthma

Occupational asthma represents the most prevalent occupational lung disease in the developed world (Nicholson et al. 2005). The term refers to asthma caused, or made worse, by exposures in the workplace. International studies have suggested that 9–15% of cases of asthma in adults of working age are either caused or aggravated by occupational factors (Nicholson et al. 2005). More recently, it was estimated that the likely population burden of occupational asthma is nearly 18% (Toren & Blanc 2009).

There are over 400 substances that are recognised as triggers for asthma in the workplace including various chemicals used in paints, manufacturing and cleaning products, latex gloves, animals and dusts from grain, flour and wood (Nicholson et al. 2005). These agents pose most risk for people employed in the plastics, rubber and chemical industries, nurses, timber workers and welders, and jobs involving painting (particularly spray painting), dyeing, cleaning, baking and food processing, farming, laboratory work and working with animals (NAC 2006; Nicholson et al. 2005).

Environmental tobacco smoke (ETS) is also recognised as a trigger for asthma in the workplace. The harmful effects of ETS exposure have resulted in the introduction of smoking bans in a number of workplaces, particularly licensed pubs, restaurants and hotels.

The importance of occupational asthma is that it is relatively common and it is preventable. A population-based study in Canada (Johnson et al. 2000) concluded that the removal of exposure to known triggers could prevent as much as 18% of adult-onset asthma in that country, although a subsequent, similar study in Australia found a lower proportion of cases attributable to workplace exposures (see section on 'Prevalence of occupational asthma' below).

Early removal from exposure is important for treatment and preventing persistent disease. Reducing or eliminating exposure to the triggering agent(s) will usually reduce the severity of symptoms or, in some cases of early intervention, it may eliminate symptoms completely. People who remain exposed are more likely to have persistent and troublesome asthma.

The AIHW published a review of occupational asthma (AIHW 2008c) that summarises known occupational risk factors for asthma, current knowledge about incidence and prevalence and approaches to prevention and disease monitoring, with particular reference to the Australian context. A brief coverage of those issues is detailed below.

7.3.1 Current surveillance

Since occupational exposure represents a potentially preventable cause of asthma, exposure to occupational allergens and the occurrence of occupational asthma are important targets for surveillance. Surveillance for occupational asthma may include the following elements:

- monitoring exposure to, and the impact of, occupational risk factors for asthma
- evaluating population health interventions to prevent the onset and exacerbations of asthma (in the occupational setting)
- monitoring the provision of a safe environment for people with asthma.

Currently, there is no consistent, thorough and reliable scheme to monitor the incidence or prevalence of occupational asthma in Australia. Conventional monitoring for chronic diseases is largely based on measures of late-stage events such as hospitalisation and mortality and on cross-sectional prevalence surveys. Unfortunately, both of these sources provide very limited and potentially biased evidence about the impact of occupational asthma. Furthermore, causal exposures are very rarely recorded in hospitalisation and mortality data and, hence, there is virtually no information on the contribution of occupational exposures to these outcomes of asthma.

A more fundamental problem is that the disease may be transient and the main impact may cause someone to leave his or her job. People who find that their work is causing or aggravating asthma (or other symptoms) tend to seek alternative employment or leave the workforce altogether (Blanc et al. 1999).

Some cross-sectional surveys have been performed to estimate the prevalence of occupational asthma. These have generally asked respondents about previous employment or exposures that may have caused asthma or asthma-like symptoms. Australian data from two surveys are reported below in the section entitled 'Prevalence'.

For those industries at particularly high risk for cases of occupational asthma, there may be value in conducting surveillance in specific workplaces. However, workplace-based cross-sectional surveys are particularly likely to underestimate the burden of the disease since many of the affected workers will have left the workplace. The remaining workers will tend to be the healthy ones. This bias is a major problem in surveillance for occupational disease and is known as the 'healthy worker effect'.

In order to accurately estimate the impact of occupational asthma in the community or in a specific workplace, it is necessary to measure the incidence of asthma in a cohort followed over time. Well-conducted cohort studies will not be affected by the healthy worker bias described above. Some examples of measures of the incidence of occupational asthma in Australia are cited in the section below entitled 'Incidence'.

7.3.2 Prevalence

It was estimated that occupational exposures cause 9.5% of cases of adult-onset asthma in New South Wales (Johnson et al. 2006). This estimate was based on data from a self-completed postal questionnaire administered to a randomly selected sample of adults in New South Wales. Information on adult-onset asthma and ever being employed in occupations identified as being of high risk for the development of occupational asthma were collected. The triggering agents associated with the greatest risk of adult-onset asthma were exposure to ammonia (OR 2.54, CI: 1.72–3.78%) and photographic development (OR 2.25, CI: 1.04–4.85%). One of the strengths of this study is its population-based design, which allows for the inclusion of people who have had occupational asthma and have left the workplace. This estimate for the proportion of adult-onset asthma attributable to occupational exposures in New South Wales falls towards the lower end of the range observed in international studies (Nicholson et al. 2005).

Data from the National Health Survey in 2004–05 estimated that the prevalence of work-related asthma among those with asthma was 2.2% (CI: 1.5–2.8%). Among those aged 35–64 years, 3.1% (CI: 1.9–4.3%) of all asthma cases in 2004–05 were attributed to work while among those aged 15–34 years, 0.7% (CI: 0.1–1.3%) of people with asthma reported that their condition was work-related. The most recent National Health Survey (2007–08) did not collect data on work-related asthma.

7.3.3 Incidence

Population-based surveillance for incident cases of occupational asthma is established in three Australian states.

The Surveillance of Australian Workplace-Based Respiratory Events (SABRE) is a voluntary notification scheme that has been in operation in Victoria and Tasmania since 1997 and in New South Wales from 2001 until 2008. In this scheme, respiratory physicians, occupational physicians and, in the case of New South Wales, accredited general practitioners report newly diagnosed cases of occupational respiratory diseases.

Since the scheme started, the incidence of occupational asthma was 5 cases per million employed people per year in Tasmania and Victoria combined, 2 cases per million employed people per year in New South Wales (Hannaford-Turner K M et al. 2007) and 5 cases per million employed males per year in New South Wales (Hannaford-Turner et al. 2010).

As there is no legislative requirement to report occupational lung disease (as there is for certain infectious diseases and for cancer, for example) and there is no comprehensive compensation scheme for people with occupational asthma, there is no incentive for patients or health-care professionals to notify new cases. Furthermore, the notification scheme does not impose a standard for the diagnosis of occupational asthma. Hence, estimates of the incidence of occupational asthma based on these notifications may be inaccurate. The net effect is likely to be an underestimate.

International estimates of the incidence of occupational asthma average around 47 cases per million workers (range 12–174 cases per million workers) (Nicholson et al. 2005; Karjalainen et al. 2000).

In the United Kingdom, the annual incidence of occupational asthma was reported as 42 million cases of the working population between 1991 and 2005. There were no consistent trends in incidence over this period (Bakerly et al. 2008).

In contrast to the Australian environment, in Finland physicians are required by law to report all cases of known or suspected work-related disease to a national register. In addition, all employees in Finland must carry insurance for occupational diseases. Reports of disease and accident diagnoses, recorded by the insurance companies, are provided to the national register. The mean annual incidence of occupational asthma in Finland, where all cases of occupationally-related disease are captured in the Finnish Registry of Occupational Diseases, is 174 cases per million employed workers (Karjalainen et al. 2000).

7.3.4 Improving surveillance

Cross-sectional community-based population studies do provide some valuable information on the prevalence of occupational asthma in the population. However, they are only successful if they are truly population-based—that is, they include both individuals who have left the workforce and a detailed historical record of respondents' occupational exposures. Since this is very time-consuming, it is best achieved using a nested survey design in which this information is only sought from respondents with adult-onset asthma and a sample of controls without asthma.

Workplace and community surveillance for incident cases is the 'gold standard' for monitoring the impact of occupational asthma and also for managing the problem in real time. For the reasons outlined above, community-level surveillance has been difficult to achieve in Australia. Improved rates of notification require incentives in the form of a legislative requirement or, preferably, a link to compensation payments, and the application of standards for the diagnosis.

Summary

Despite the known adverse effects of smoking, people with asthma continue to smoke at least as commonly as people without asthma. In fact, among women the prevalence of smoking is higher in those with asthma than in those without asthma.

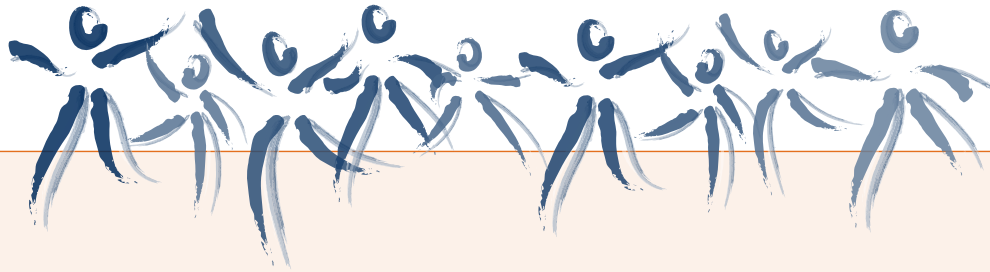
It seems that having asthma does not immediately encourage people to quit smoking, which probably reflects the highly addictive nature of smoking. It is also plausible that some of the observed association between smoking and self-reported asthma is attributable to the causal association between smoking and respiratory disease, including chronic obstructive pulmonary disease.

Socioeconomic status has an important effect on the risk of smoking among people with asthma. Although smoking is more common in all people living in areas of lower socioeconomic status than those living in areas of higher socioeconomic status, this discrepancy is much greater in the population with asthma.

Children with asthma continue to be exposed to passive smoke in their home. Almost 40% of children with asthma lived with smokers and an estimated 7.8% of children with asthma were living in homes where smoking occurred inside the home. There was a substantial socioeconomic gradient in exposure to environmental tobacco smoke. Children living in areas where socioeconomic status was lower were more likely to be exposed to environmental tobacco smoke.

Asthma caused or aggravated by exposures at work is the one truly preventable form of the disease. It is estimated, based on data from New South Wales, that around 9.5% of adult-onset asthma is caused by occupational exposures and, hence, could be prevented if exposure to triggering agents in the workplace was eliminated. There are limited surveillance data on occupational asthma in Australia and there is a need to improve the completeness of notification to existing voluntary schemes in Victoria, Tasmania and New South Wales.

8. Chronic obstructive pulmonary disease in people aged 55 years and over



Key points

- The prevalence of self-reported COPD among people aged 55 years and over in Australia was estimated at 5.3% in the 2007–08 National Health Survey. This is likely to underestimate the true prevalence when using objective measures.
- The prevalence of self-reported COPD increases progressively with age, from 4.0% among people aged 55–69 years to 9.1% among those aged 85 years and over.
- In 2007, there were 5,051 deaths attributed to COPD among people aged 55 years and over. This represented 100 per 100,000 population aged 55 years and over and 4% of all deaths in this age group.
- Many more deaths were attributed to COPD than to asthma (100 compared with 6 per 100,000 population).
- Between 1997 and 2007, the rate of mortality attributed to COPD decreased by 65%.
- The rate of general practice encounters for COPD decreased between 2000–01 and 2009–10, although the rate has remained relatively stable in recent years.
- Between 1998–99 and 2008–09, the rate of hospital separation for COPD remained relatively stable but substantially higher than the rate for asthma.
- Among people aged 55 years and over, hospital separation rates for COPD are higher in:
  - males compared with females
  - people living in remote areas compared with those living in major cities
  - Indigenous people compared with other Australians
  - people from an English-speaking background compared with those from a non-English-speaking background
  - people living in areas of lower socioeconomic status compared with those living in areas of higher socioeconomic status.
- People with COPD admitted to hospital have higher rates of assisted ventilation (non-invasive and invasive mechanical ventilation) compared to those with asthma.
- Cancer was commonly listed as an associated diagnosis among people aged 55 years and over admitted to hospital for COPD.
- Access to pulmonary rehabilitation programs is very limited, despite evidence that these programs are effective.
- Long-term home oxygen therapy is recommended for patients with COPD and low levels of oxygen in the blood. There is no national database or register of use of oxygen therapy to help assess the use of this intervention.
- The prevalence of current smoking is twice as high among people aged 55 years and over with COPD (20%) compared to those without the disease (11%).

Introduction

The purpose of this chapter is to focus on the impact of chronic obstructive pulmonary disease (COPD) in people aged 55 years and over in Australia. Data on the prevalence, health service utilisation and management of COPD specifically relating to people aged 55 years and over is presented. Information on quality of life, mortality and comorbidities are also included. Where possible, relevant data for asthma are included to facilitate comparison and contrast.

COPD is a serious long-term lung disease that mainly affects older people. It is characterised by airflow limitation that is not fully reversible with bronchodilator medications. Some people with COPD also have frequent cough with sputum due to excessive mucus production in the airways. This condition is often referred to as 'chronic bronchitis'. People with COPD may also have evidence of destruction of lung tissue with consequent enlargement of the air sacs and further impairment of lung function. This condition is known as 'emphysema' (Thurlbeck 1990). In common parlance, the terms COPD, emphysema and chronic bronchitis tend to be used interchangeably.

COPD is a progressive disease and is largely irreversible, often leading to impaired quality of life and sometimes leading to premature death. People with the disease experience shortness of breath, initially on strenuous exertion and later with minimal or no exertion, as well as cough and wheeze. It is commonly associated with comorbidities such as cardiovascular disease and diabetes mellitus, due to common causes such as smoking and/or systemic effects of COPD (GOLD 2009). In addition, the prevalence of bronchiectasis among people with COPD was estimated at 29–50% (Patel et al. 2004; O'Brien et al. 2000).

Tobacco smoking is the predominant cause of COPD (Fletcher & Peto 1977). However, COPD also occurs in non-smokers indicating that genetic and/or other environmental factors are likely to be involved. Exposure to biomass fuels, outdoor air pollution, and occupational fumes and dusts, as well as a history of pulmonary tuberculosis, childhood respiratory infections, or chronic asthma are all associated with an increased risk of having a diagnosis of COPD (Salvi & Barnes 2009).

Among older people, COPD and asthma can be difficult to distinguish as the current definitions of asthma (GINA 2009a) and COPD (GOLD 2010) are not mutually exclusive and both conditions have similar manifestations. There is considerable overlap between self-reported diagnoses of asthma, chronic bronchitis and emphysema (Abramson 2005). Furthermore, the attribution of causes of death in the elderly is difficult, particularly in differentiating between COPD and asthma (Jones et al. 1999b; Smyth et al. 1996; Sears et al. 1986). Indeed, it has recently been argued that obstructive lung disease in older people represents a heterogeneous group of disorders or a spectrum of disease that may not be adequately characterised by the terms 'asthma' and 'COPD' (Gibson et al. 2010; Marks et al. 2009).

There are some important features differentiating typical 'COPD' from 'asthma'. The development of COPD occurs over many years and therefore mainly affects older people whereas asthma affects people of all ages. People with COPD continue to lose lung function despite taking medication, which is not a common feature of asthma. While medications are the foundation for asthma management, guidelines in the management of COPD (GOLD 2009) focus on smoking cessation, oxygen therapy, pulmonary rehabilitation and pharmacological treatment.

8.1 Prevalence

Since COPD is defined in terms of lung function abnormalities, that is, airflow limitation that is not fully reversible after bronchodilator (GOLD 2009), estimating the prevalence of the disease requires estimating the prevalence of self-reports of diagnosis based on lung function measurements or estimates based on population surveys of lung function. Unfortunately, there is good evidence that most reported diagnoses of COPD (including reports of chronic bronchitis or emphysema) are not assigned on lung function criteria (Halbert et al. 2006; Halbert et al. 2003), and lack of COPD data sources limits the ability to accurately estimate the prevalence of COPD. Population surveys that obtain objective measures of airflow limitation are needed.

Recently, a large international population based study—Burden of Obstructive Lung Disease (BOLD)—of nearly 10,000 people aged 40 years and over estimated that the overall prevalence of COPD in 12 countries was 10% (Buist et al. 2007). This COPD estimate was based on lung function criteria of GOLD stage II or higher. There was one Australian site (in Sydney) in this international study. The prevalence of COPD at that site was 10.8% among people aged 40 years and over. Nearly one-quarter of adults aged 70 years and over in the Sydney study population were found to have COPD. Currently, a study using identical methodology is being conducted in five other centres around Australia. When the study is completed there will be a more comprehensive picture of the prevalence of COPD in Australia.

There have been other studies estimating the prevalence of COPD in Australia, but a variety of cutpoints (or criteria) have been used to distinguish normal lung function from airflow limitation consistent with COPD. In the Northwest Adelaide Health Cohort study 5.4% of people aged 18 years and over met the definition for COPD using criteria similar to those reported above. However, the prevalence estimates ranged from 3.5% to 10.9% in people aged 18 years and over depending on the diagnostic criteria that were applied (British Thoracic Society, American Thoracic Society, European Respiratory Society or Global Initiative for Chronic Obstructive Lung Disease) (Wilson et al. 2005a). In this same survey, the authors also defined the presence of asthma using spirometric criteria and estimated that the prevalence was 14.7% among people aged 55 years and over (Wilson et al. 2005b).

The ABS National Health Survey (NHS) provides data on self-reported diagnoses of emphysema or bronchitis to estimate the prevalence of COPD. Based on this criterion the prevalence of COPD among people aged 55 years and over in Australia was estimated at 5.3% (CI: 4.5–6.1%) in 2007–08. However, evidence suggests this is probably an underestimate of the true prevalence when measured using objective criteria (Buist et al. 2007).

In comparison, the prevalence of self-reported current asthma among people aged 55 years and over from the same survey was 9.6% (CI: 8.5–10.7%) (Figure 8.1; see also Table A2.8 & A2.9).

8.1.1 Trends in COPD prevalence

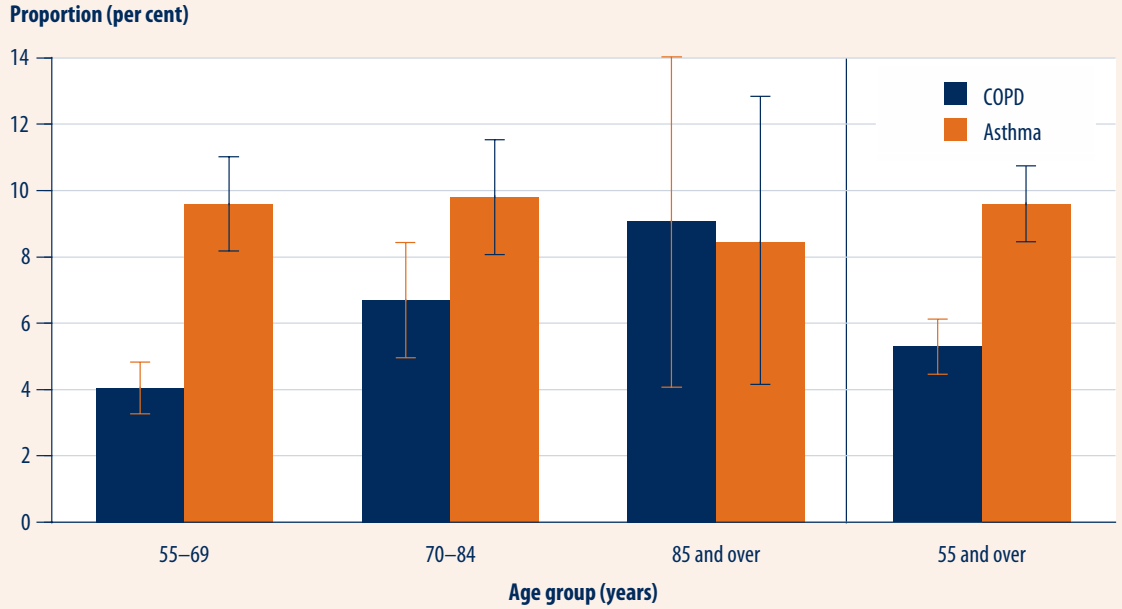
Comparison of results from the 2007–08 NHS with those reported in 2004–05 and 2001 shows that, overall, the prevalence of self-reported diagnoses of COPD did not significantly differ from 6.8% in 2001 (CI: 6.0–7.6%), 6.6% in 2004–05 (CI: 5.8–7.3%) and 5.3% in 2007–08 (CI: 4.5–6.1%).

8.1.2 Age and sex

In 2007–08, the prevalence of self-reported COPD among people aged 55 years and over increased with increasing age ($p<0.0001$) (Figure 8.1). Among those aged 55–69 years the prevalence of self-reported COPD was estimated at 4.0% (CI: 3.3–4.8%) while those aged 70–84 and 85 years and over were 6.7% (CI: 5.0–8.4%) and 9.1% (CI: 4.1–14.0%), respectively.

In comparison, the prevalence of self-reported current asthma among people aged 55 years and over did not increase with age.

In the 2007–08 NHS, the prevalence of self-reported COPD in Australians aged 55 years and over did not differ between males and females (5.7% and 4.8% respectively, p=0.13). In the BOLD study, the prevalence of objectively defined COPD in people aged 40 years and over for Sydney was higher among females (12.2%) than males (9.3%), with the difference being greater for those aged 40–59 years compared with those aged 60–69 years and 70 years and over (Buist et al. 2007).



*Age-standardised to the Australian population as at June 2001.
Note: See also Appendix 2, Table A2.8 & A2.9
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 8.1: Prevalence of self-reported chronic obstructive pulmonary disease (COPD) and asthma, people aged 55 years and over, by age group, 2007–08

8.1.3 Cities, regions and remote areas

From the 2007–08 NHS, the prevalence of self-reported COPD among people aged 55 years and over did not differ between people living in *Major cities* (5.2%), *Inner regional* areas (5.3%) or *Other* areas (5.8%). *Other* areas include *Outer regional* and *Remote* categories of remoteness.

8.2 Mortality

In 2007, COPD was certified as the underlying cause of 5,051 deaths among people aged 55 years and over, representing 4.1% of all deaths in this age group. The COPD mortality rate was 99.7 (CI: 97.0–102.5) per 100,000 population aged 55 years and over.

Chronic obstructive pulmonary disease is the 4th leading cause of death worldwide and by 2020 it is estimated that it will be the 3rd leading cause of death (WHO 2008).

The reported rates of death from COPD may be underestimates of true death rates. COPD is underreported as a cause of death. In a series of deaths independently adjudicated as attributed to COPD in a large international clinical trial, one-in-three of the death certificates failed to mention COPD as the underlying cause of death (Drummond et al. 2010).

Asthma was certified as the underlying cause of 308 deaths in 2007 among people aged 55 years and over, representing only 0.25% of all deaths among this age group. This corresponded to an asthma mortality rate of 6.0 (CI: 5.3–6.7) per 100,000 population aged 55 years and over.

Among people aged 55 years and over, between 1997 and 2003, COPD was listed as one of multiple causes of death 10 times more commonly than asthma (ACAM 2006).

8.2.1 Time trends in COPD and asthma deaths

Between 1997 and 2007, there was a significant decreasing trend in death rates attributed to COPD among people aged 55 years and over ($p<0.0001$) (Figure 8.2; see also Table A2.10). The overall decrease in the mortality rate was 65% over this period.

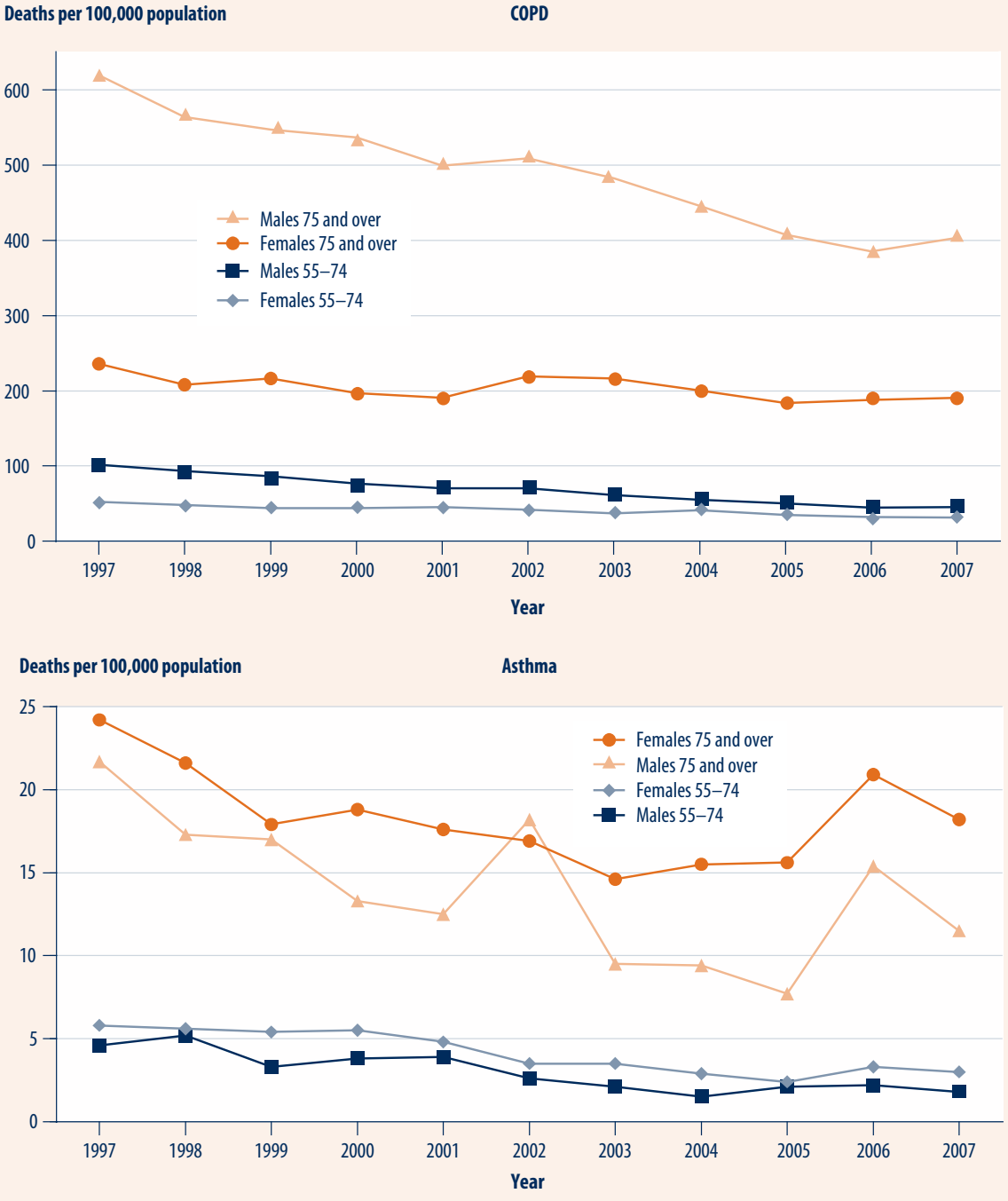
The rate of mortality attributed to COPD was higher among males than females in each year over this period ($p<0.0001$).

Between 1997 and 2007 the age-standardised mortality rate attributed to COPD among people aged 55–74 years decreased by 45% in males and by 60% in females. Over the same period the mortality rate attributed to COPD among people aged 75 years and over decreased by 65% among males and by 81% among females.

Over this period, there was a significant decreasing trend in deaths attributed to asthma in males and females aged 55 years and over ($p<0.0001$) (Figure 8.2; see also Table A2.11). This trend was significant for males aged 55–74 years ($p<0.0001$), males aged 75 years and over ($p=0.01$) and females aged 55–74 years ($p<0.0001$) but not among females aged 75 years and over ($p=0.1$) (Figure 8.2).

8.2.2 International comparison

In the Asia-Pacific region between 1991 and 2004, reported mortality rates attributed to COPD among people aged 40 years and over ranged from 30 per 100,000 population in South Korea to 73 per 100,000 population in Hong Kong. In this same period, the reported rate for Australia (56 per 100,000 population) was within this range (Tan et al. 2009). The authors suggest that the differences may be attributable to different smoking rates for males and females in these countries. Other factors that may have had an impact include the diverse database systems and coding interpretations in the different countries.



Notes

1. Conditions classified according to International Classification of Diseases, 10th Revision (ICD-10) codes—Asthma (J45 and J46); COPD (J40–J44).
2. Age-standardised to the Australian population as at June 2001.
3. See also Appendix 2, Table A2.10 & A2.11

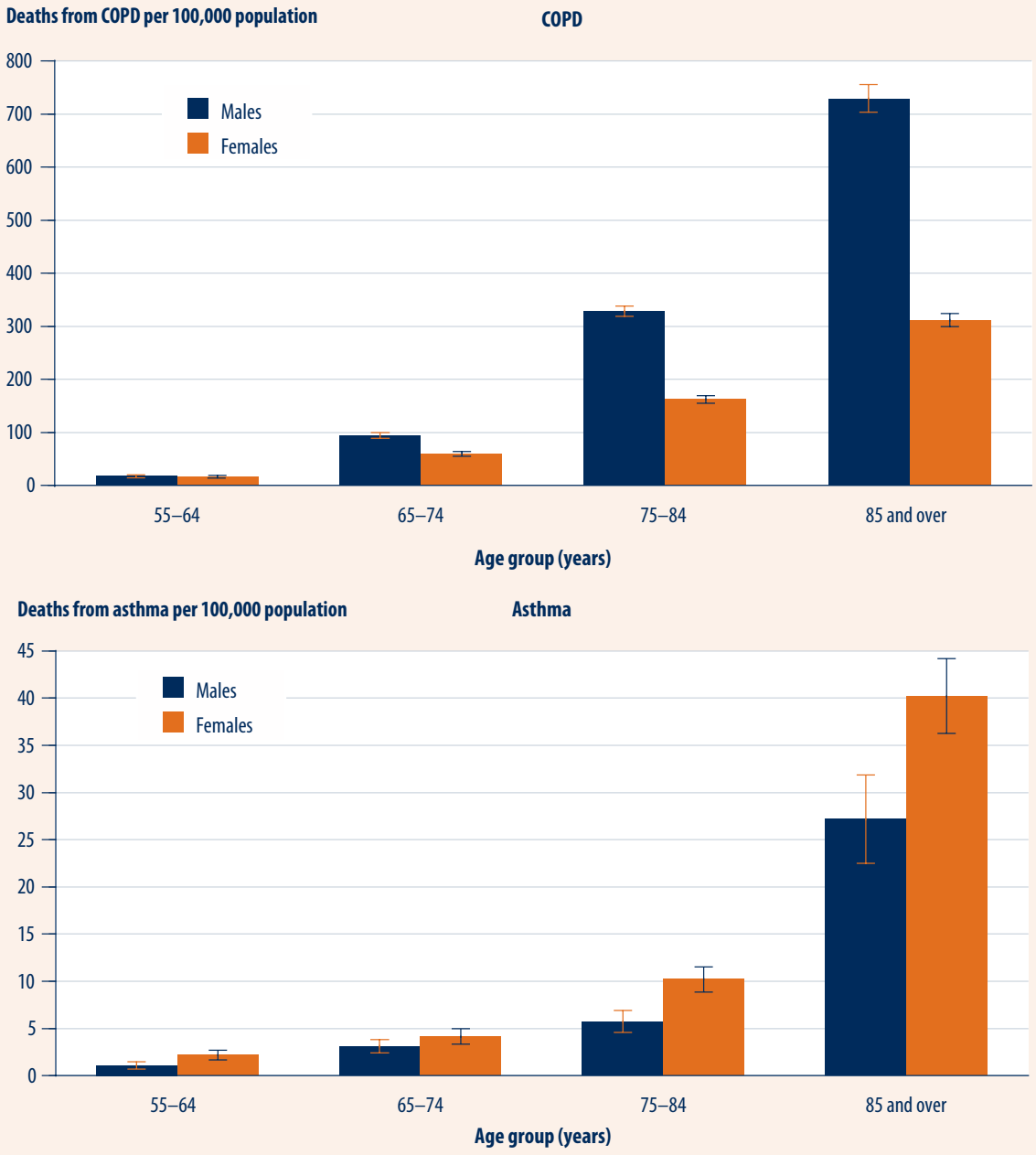
Source: AIHW National Mortality Database.

Figure 8.2: Deaths attributed to chronic obstructive pulmonary disease and asthma per 100,000 population, by sex and broad age group, people aged 55 years and over, 1997–2007

8.2.3 Age and sex

Between 2003 and 2007, among people aged 55 years and over, the risk of dying from COPD increased with age (Figure 8.3) and was 2.5 times higher in males (141 per 100,000 population) than females (55 per 100,000 population).

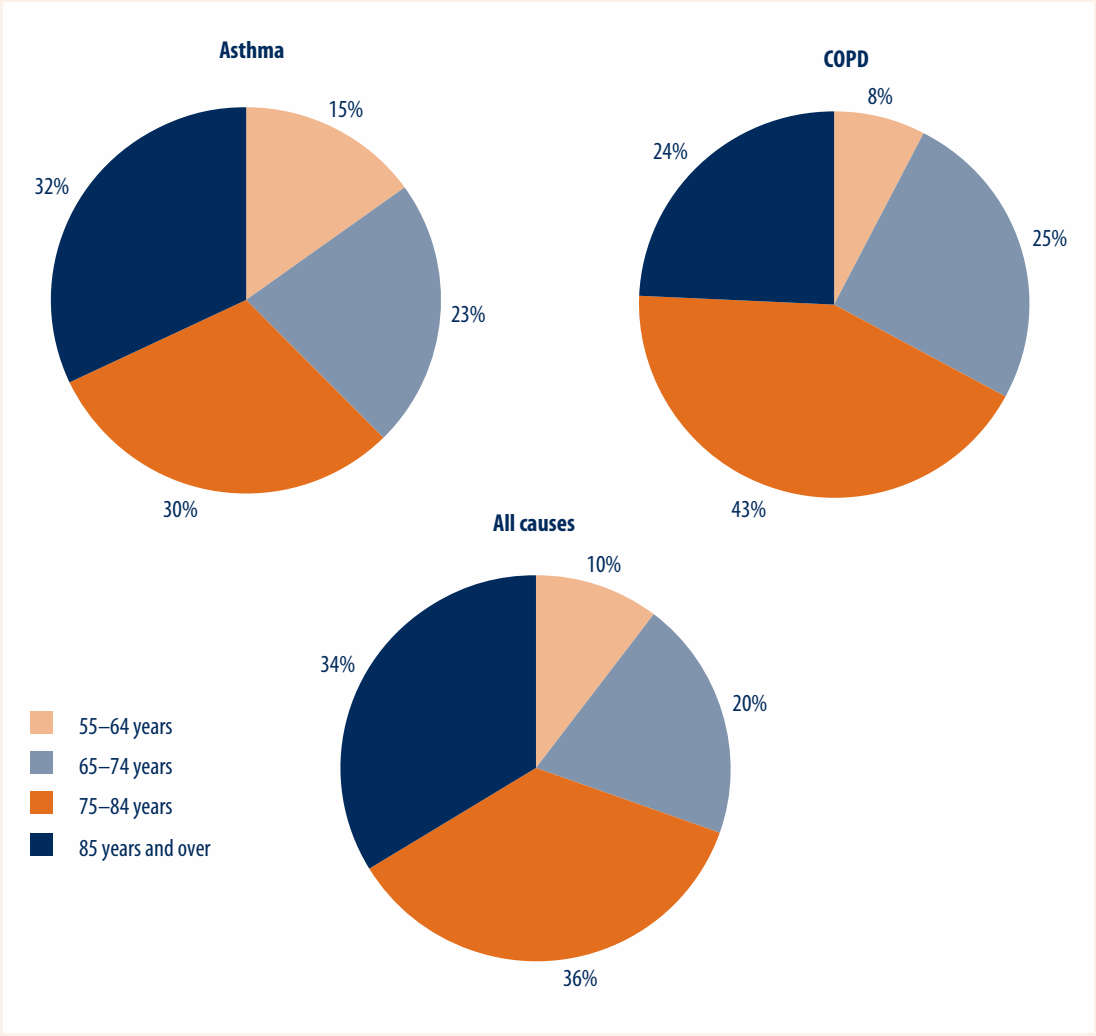
Deaths attributed to asthma over the same period were higher among females (7.1 per 100,000 population) than males (4.0 per 100,000 population) in this age range. The relative importance of sex differences in the risk of having COPD and asthma and gender differences in the labelling of airway disease in this older age group is uncertain.



Note: Conditions classified according to International Classification of Diseases, 10th Revision (ICD-10) codes—Asthma (J45 and J46); COPD (J40–J44).
Source: AIHW National Mortality Database.

Figure 8.3: Deaths attributed to COPD and asthma per 100,000 population, by broad age groups and sex, people aged 55 years and over, 2003–2007

Most deaths attributed to COPD occurred in people aged 75–84 years (Figure 8.4). The proportion of COPD-related deaths that occurred at this age (42.8%) was greater than the proportion of deaths attributed to asthma (30.4%) and to all causes (35.8%) (Figure 8.4). In contrast, deaths among people aged 55–64 years represented a smaller proportion of COPD deaths (7.6%) compared with asthma (15.1%) and all-cause deaths (10.3%).



Note: Conditions classified according to International Statistical Classification of Diseases, 10th Revision (ICD-10) codes—Asthma (J45 and J46); COPD (J40–J44).
Source: AIHW General Record of Incidence of Mortality (GRIM) books.

Figure 8.4: Age distribution of deaths attributed to asthma, COPD and all causes, 1997–2007

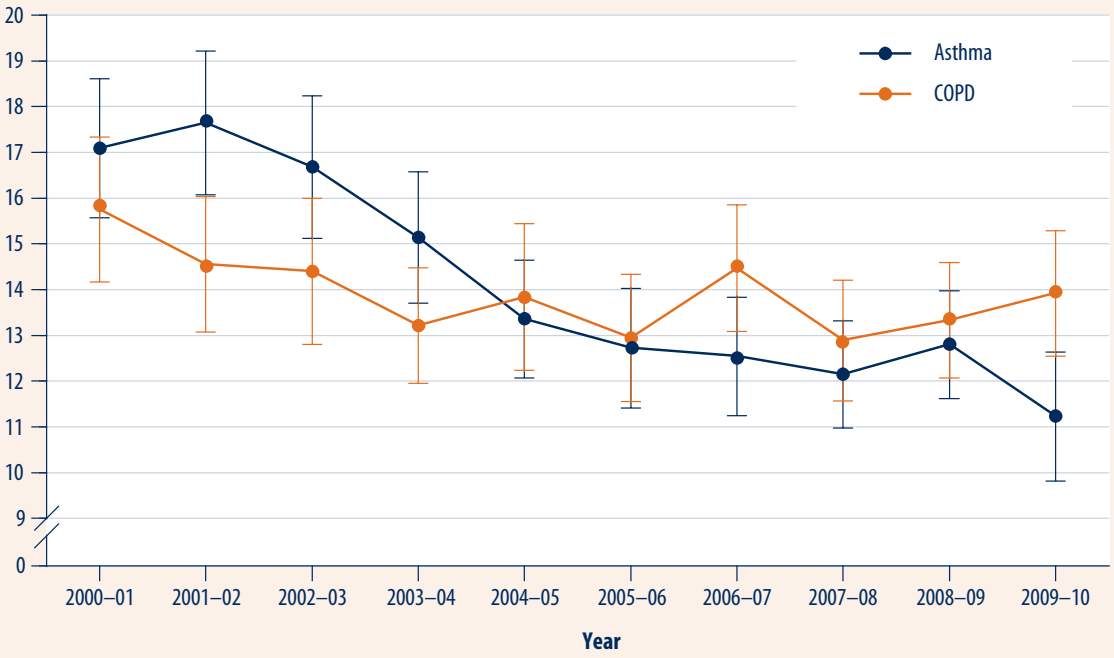
8.3 Use of health services

Acute exacerbations of COPD are frequently due to bacterial or viral respiratory tract infections and have also been associated with increases in exposure to ambient air pollution or changes in ambient temperature (Donaldson et al. 1999). Exacerbations often require GP consultations, ED visits or hospitalisation. Those that are life-threatening sometimes require temporary assistance with breathing in the form of non-invasive or invasive ventilatory support.

This section presents information on these components of health-care utilisation for COPD and asthma among people aged 55 years and over.

8.3.1 General practice encounters for COPD and asthma

The rate of GP encounters where COPD or asthma were problems managed in people aged 55 years and over decreased significantly between 2000–01 and 2009–10 (Figure 8.5). For COPD, the rate of encounters per 100 population fell from 15.8 in 2000–01 to 13.9 in 2009–10 (p=0.03), although the rate has remained relatively stable in recent years. For asthma, the rate fell from 17.1 in 2000–01 to 11.2 in 2009–10 per 100 population (p<0.0001).



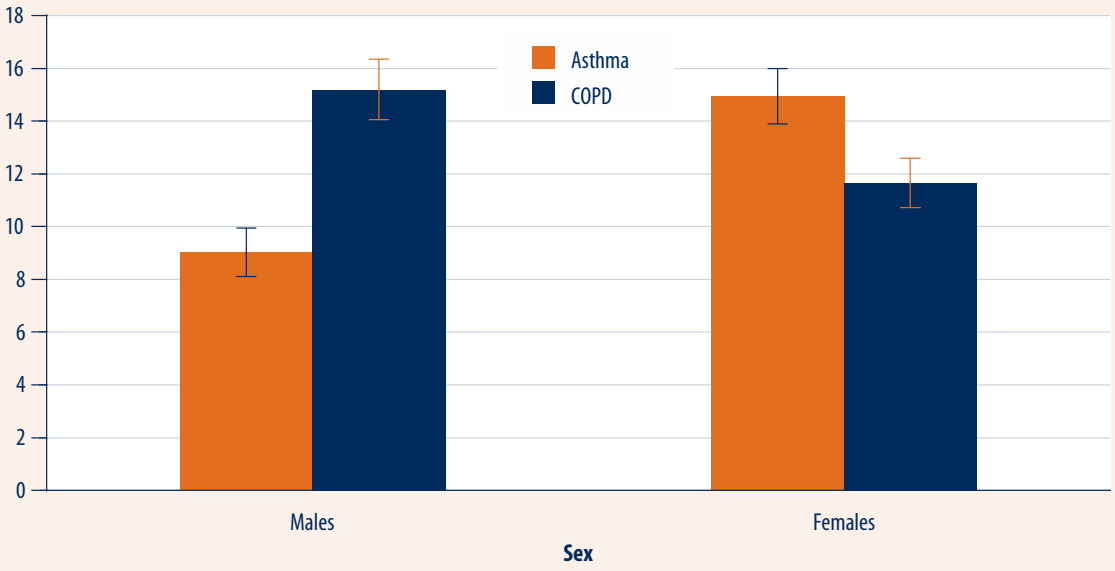
Notes

1. Asthma classified according to International Classification of Primary Care, 2nd edition (ICPC-2) code R96.
2. COPD classified according to ICPC-2 codes R79001, R79003 and R95.
3. Bettering the Evaluation and Care of Health (BEACH) year is April to March. See also Appendix 2, Table A2.12 and A2.13.

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

Figure 8.5: General practice encounters for asthma and COPD per 100 population, aged 55 years and over, April 2000 to March 2010

Males aged 55 years and over were more likely than females of the same age to have COPD managed at a general practice encounter (Figure 8.6). In contrast, asthma as a problem managed at GP encounters was more common among females aged 55 years and over compared with males. This reflects the relative prevalence of COPD and asthma in males and females in this age group.



Notes

1. Asthma classified according to the International Classification of Primary Care, 2nd edition (ICPC-2) code R96.
2. COPD classified according to ICPC-2 codes R79003 and R95.
3. BEACH year is April to March.

Sources: BEACH Survey of General Practice; Medicare Australia (see Appendix 1, Section A1.3.1 for details).

Figure 8.6: General practice encounters for asthma and COPD per 100 population, by age and sex, adults aged 55 years and over, April 2007 to March 2010

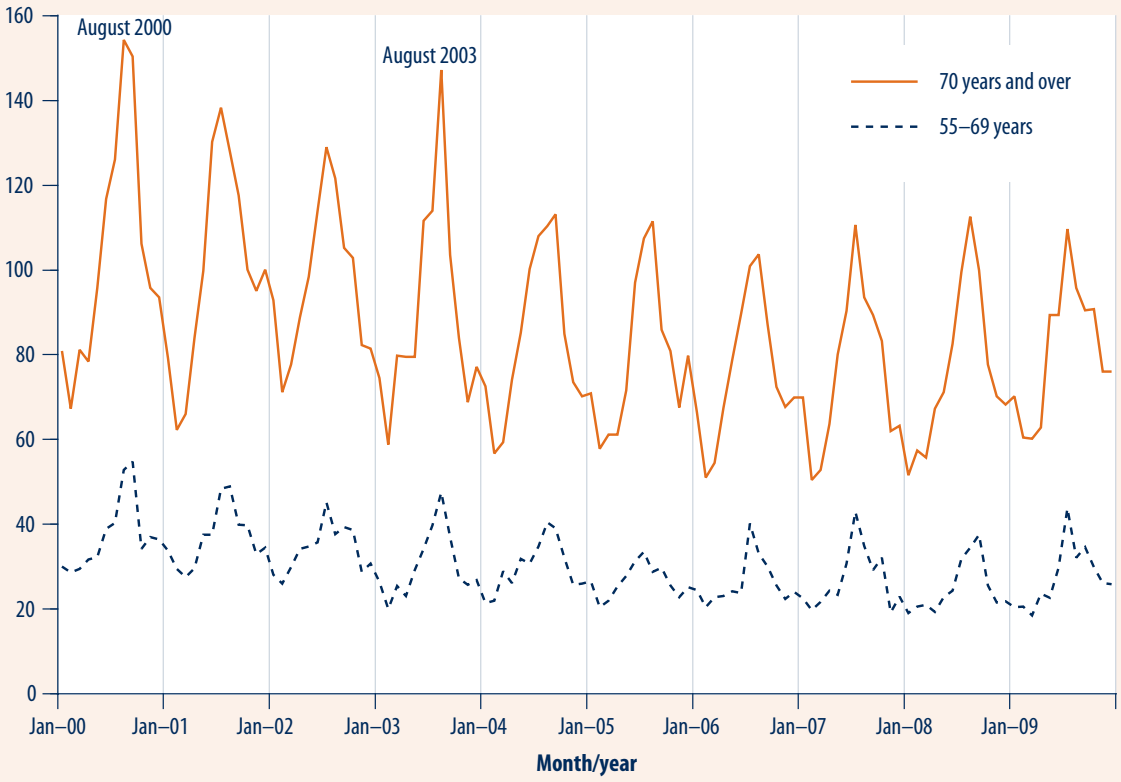
Between April 2008 and March 2009, three-quarters of patients who had COPD managed at a GP visit were aged 65 years and over. Furthermore, COPD was managed in a GP consultation at a rate of 21 per 1,000 encounters with people in this older age group (Charles et al. 2010).

8.3.2 Emergency department visits

Data from the New South Wales Emergency Department Data Collection (EDDC) between 2000 and 2009 show that there was marked month-to-month fluctuation in the rate of ED visits for COPD among people aged 55 years and over with peaks in visit rates tending to occur in the winter months (Figure 8.7).

While the timing of peaks in rates of ED visits was the same for those aged 55–69 years and those aged 70 years and over, the magnitude of the winter peaks was greater in the older age group, as was the overall level (Figure 8.7). The highest peaks in ED attendance rates were in August 2000 and 2003. Overall, the winter timing of these peaks in ED visits for COPD is consistent with the known seasonal variation in incidence of respiratory viral infections, including influenza, in adults. A similar seasonal pattern was observed in the Northern Hemisphere (Johnston 2007).

In 2009, 79% of people aged 55 years and over who attended ED for an exacerbation of COPD in New South Wales were admitted to hospital rather than discharged home. The proportion admitted to hospital was higher among people aged 70 years and over (82%) than among people aged 55–69 years (72%).



Notes

1. As the coverage of the emergency department data is less than 100%, these rates will be an underestimate of the true ED visit rate among people with COPD in NSW. Of 150 EDs in New South Wales, 89 EDs participated in the EDDC. In this analysis there were 43 EDs with complete data sets for the period January 2000 and December 2009.
2. Data contains a mix of diagnoses coded using International Classification of Diseases, 9th and 10th revisions (ICD-9 and ICD-10) and Systematized Nomenclature of Medicine–Clinical Terms (SNOMED-CT).

Source: New South Wales (NSW) Emergency Department Data Collection (EDDC) Health Outcomes and Information Statistical Toolkit (HOIST), Centre for Epidemiology and Research, NSW Department of Health.

Figure 8.7: Emergency department visits attributed to COPD per 100,000 population, by age and month/year, New South Wales, January 2000 to December 2009

8.3.3 Hospitalisations

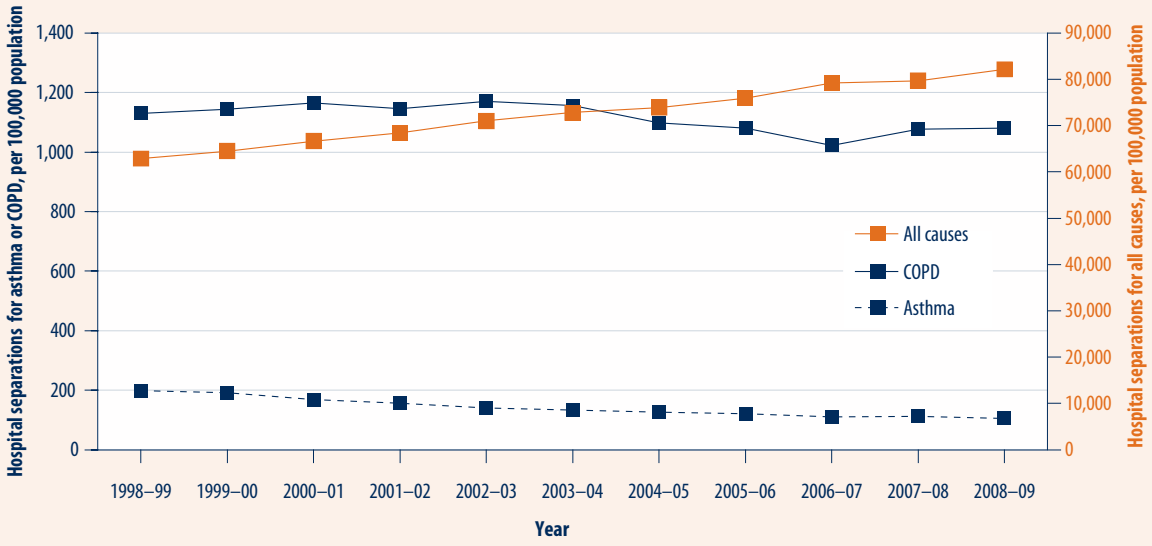
This section presents data on hospitalisations for COPD from the National Hospital Morbidity Database, maintained and held at the AIHW. In these data, the term 'hospital separation' refers to the formal process by which a hospital records the completion of treatment or care for an admitted patient. This includes completion due to discharge, death, transfer to another hospital or change in the type of care. Each separation represents one episode of hospitalisation (or admission). For more information on this database, see Appendix 1, Section A1.10.

There were 56,201 hospital separations for people aged 55 years and over with a principal diagnosis of COPD in 2008–09 in Australia. COPD accounted for 1.3% of all hospital separations during that period for people aged 55 years and over.

Time trends in hospital use for COPD

The time trends in rates of hospitalisation among people aged 55 years and over for COPD, asthma and all-causes between 1998–99 and 2008–09 are shown in Figure 8.8. The rate of hospitalisation for COPD in this age group remained relatively stable, with a slight decrease in 2006–07. In comparison, hospitalisation rates for asthma in this age group consistently decreased, while all-cause hospitalisations steadily increased over this period.

In 2008–09, the overall rate of hospital separations per 100,000 people aged 55 years and over was 1,081 for COPD and 105 for asthma.



Notes

1. Age-standardised to the Australian population as at 31 December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.
4. See also Appendix 2, Table A2.14 & A2.15.

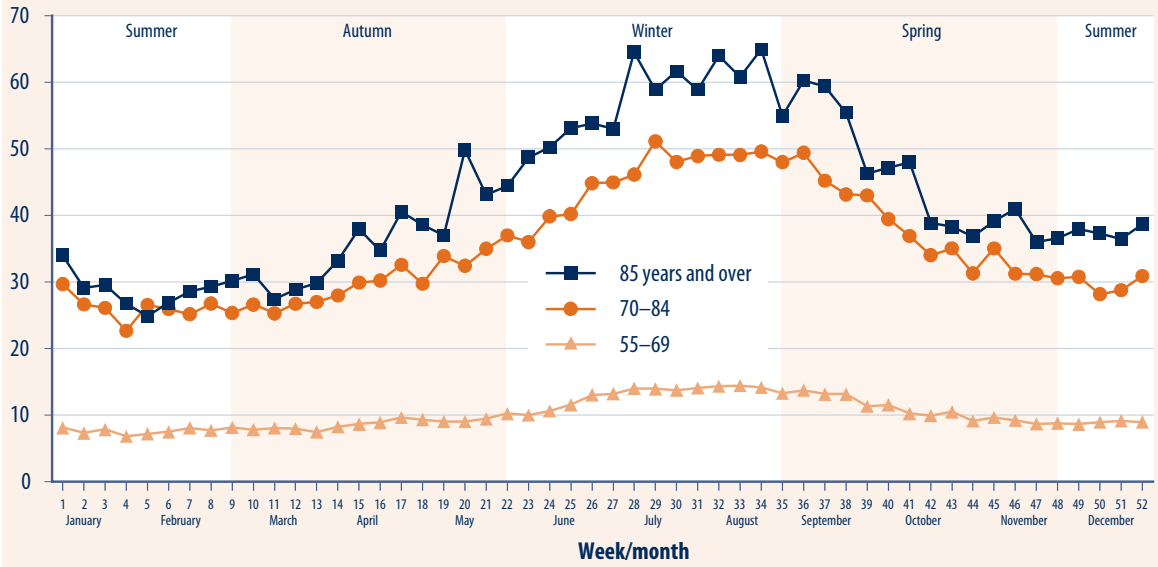
Source: AIHW National Hospital Morbidity Database.

Figure 8.8: Hospital separation attributed to asthma, COPD , and all causes per 100,000 population, ages 55 years and over, 1998–99 to 2008–09

Seasonal variation

The monthly rates of hospitalisation attributed to COPD, like those for ED visits, were highest in late winter and early spring (Figure 8.9). The peaks were more pronounced in those aged 85 years and over and in those aged 70–84 years compared with those aged 55–69 years.

Among older adults the seasonal patterns in hospitalisations for COPD and asthma are similar. Similar findings have been noted in New Zealand and in the Northern Hemisphere (Johnston 2007).



Notes

1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. COPD classified according to International Classification of Diseases, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44.

Source: AIHW National Hospital Morbidity Database.

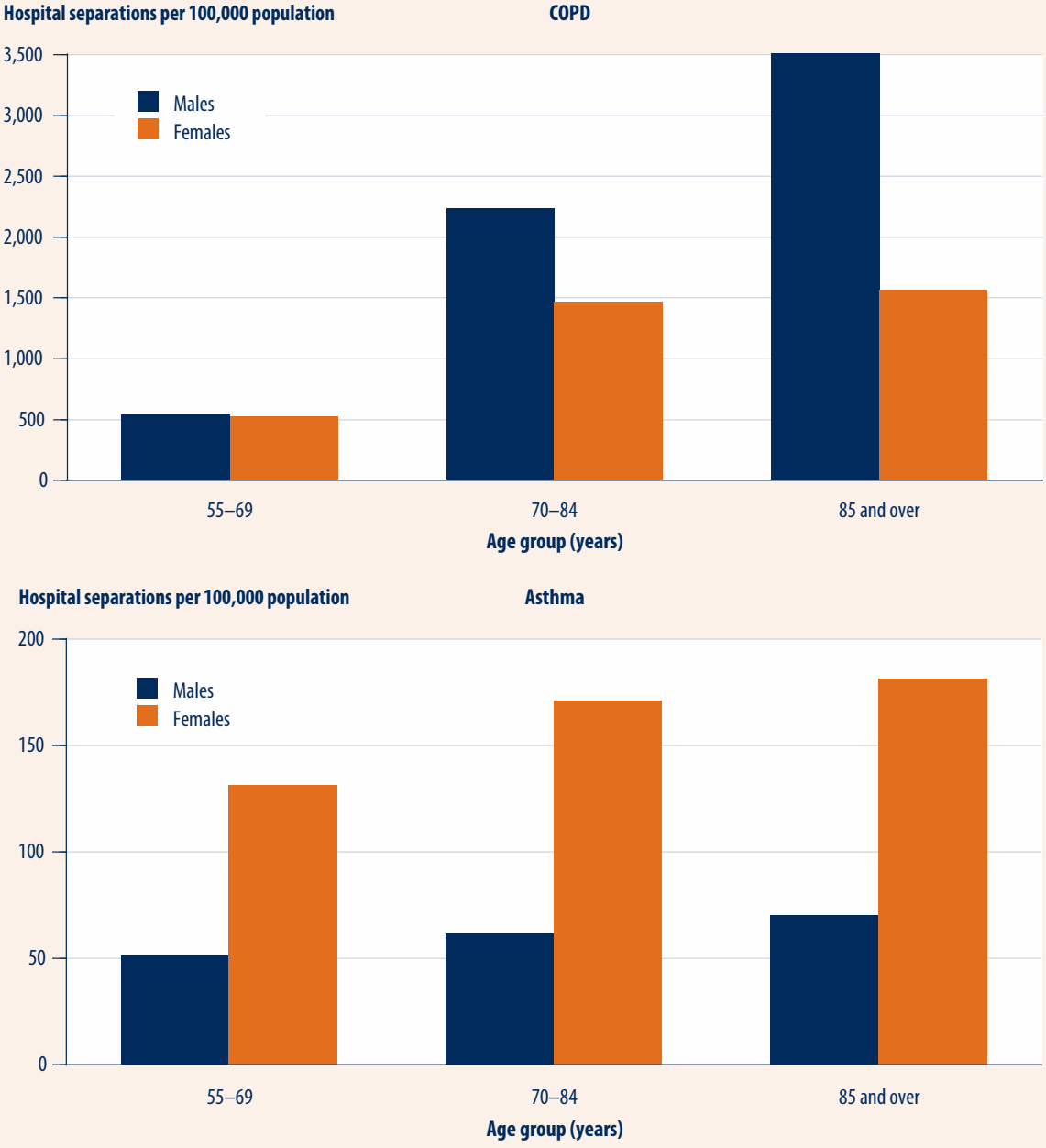
Figure 8.9: Seasonal variation in hospital separation rates attributed to chronic obstructive pulmonary disease (COPD) among people aged 55 years and over, by age group, 2007 and 2008

Population subgroups

Age and sex

In 2008–09, males aged 55 years and over were more likely to be admitted to hospital for COPD (1,311 per 100,000 population) than females of the same age (915 per 100,000 population). Hospitalisations for COPD increased with age among males. However hospitalisation rates for females increased up to the age of 70 years but did not increase further at older ages (Figure 8.10). In people aged 85 years and over the rate of hospitalisation for COPD was 2.2 times higher for males than for females.

Hospital separation rates for asthma are much lower than the rates for COPD among those aged 55 years and over, with more females (148 per 100,000 population) than males (56 per 100,000 population) being hospitalised in 2008–09 (Figure 8.10). The highest rate of hospital separation for asthma was observed among people aged 85 years and over, particularly females where the rate was 2.6 times higher than males.



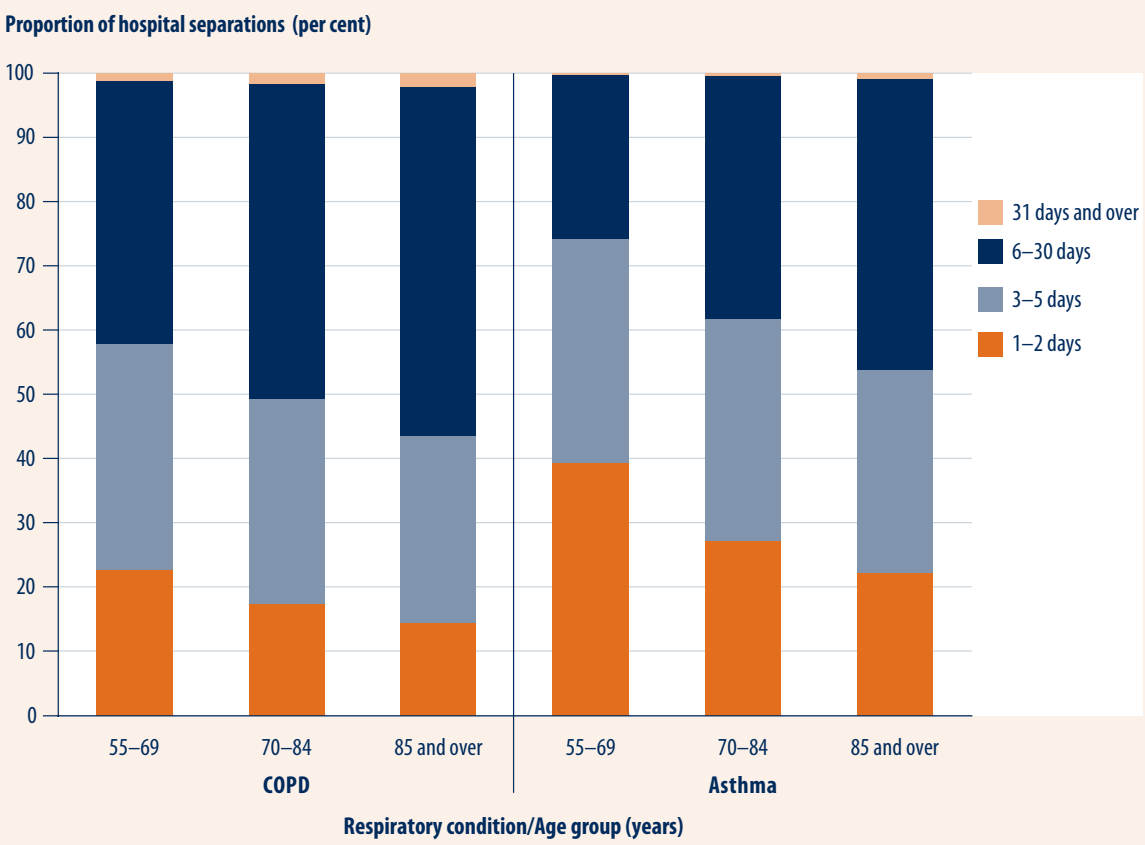
Notes

1. Age-standardised to the Australian population as at 31 December 2001.
2. Separation records for which the care type was reported as *Newborn* with no qualified days, *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.

Source: AIHW National Hospital Morbidity Database.

Figure 8.10: Hospital separations attributed to COPD and asthma per 100,000 population, aged 55 years and over, by age group and sex, 2008–09

Length of stay for people hospitalised for COPD or asthma increases with age (Figure 8.11). In 2008–09, the median length of stay for COPD separations was 5 days among people aged 55–69 years rising to 6 days for those aged 85 years and over. In the same year the median length of stay for asthma separations was 3 days among people aged 55–69 years rising to 5 days for those aged 85 years and over.



Notes

1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.

Source: AIHW National Hospital Morbidity Database.

Figure 8.11: Relative frequency of length of stay for COPD and asthma among people aged 55 years and over, by broad age group, 2008–09

Cities, regions and remote areas

In 2008–09, the hospital separation rate for COPD among people aged 55 years and over increased with increasing remoteness (Figure 8.12). The rate was significantly higher among those residing in *Very remote* areas (2,069 per 100,000 population) compared with those residing in *Major cities* (981 per 100,000 population) ($p< 0.0001$). Similarly, people who live in *Remote* areas of Australia had higher rates of hospital separations for asthma (207 per 100,000 population) than those living in *Major cities* (101 per 100,000 population) ($p< 0.0001$) (Figure 8.12).

These nationwide observations are supported by local data from Victoria, where hospital admission rates for COPD were significantly higher in rural areas compared with metropolitan areas (Ansari et al. 2007).

Notes

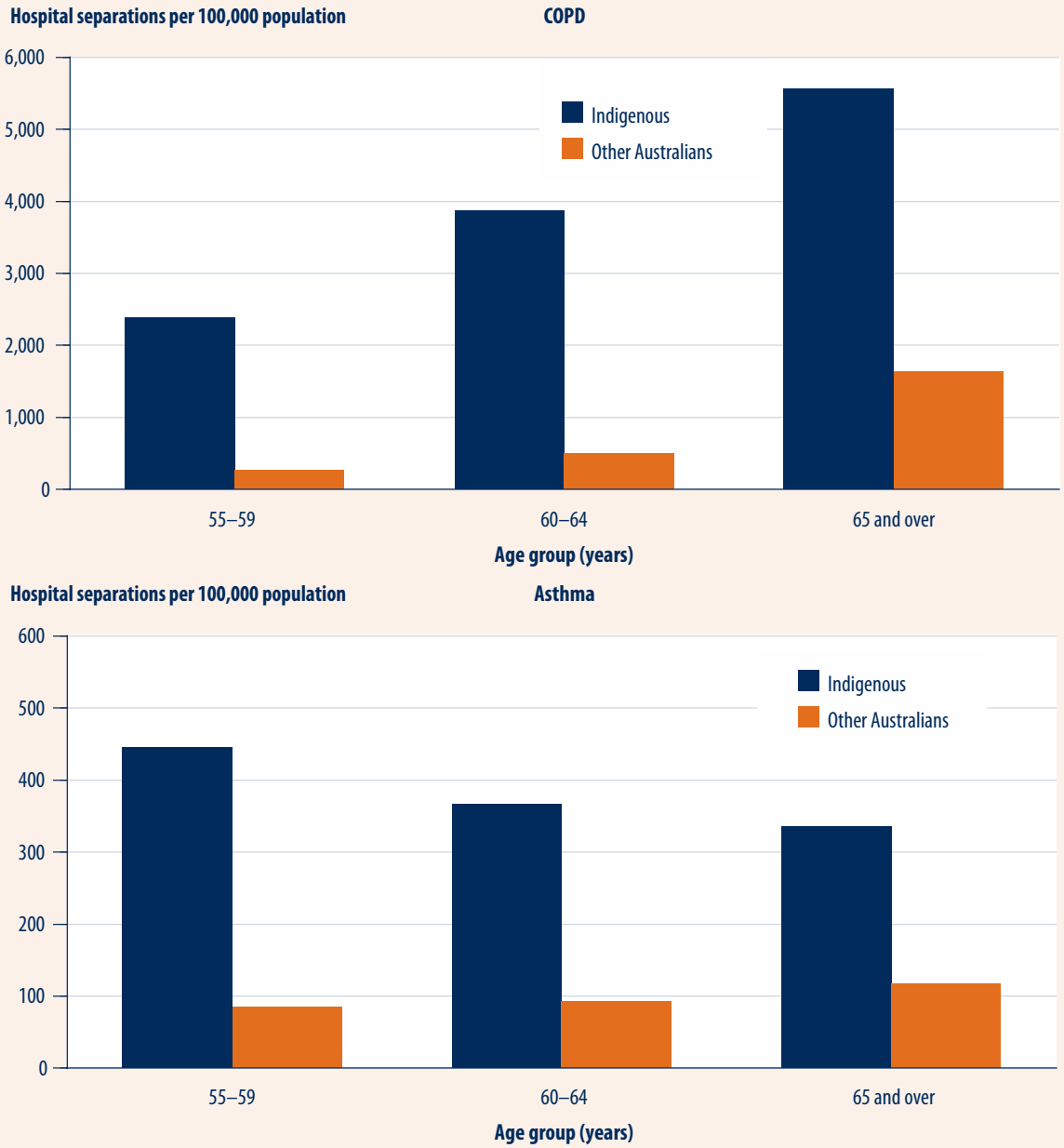
1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.
3. 2006 Statistical local area boundaries were used to map to Australian Standard Geographical Classification (ASGC) level of remoteness.

Source: AIHW National Hospital Morbidity Database.

Figure 8.12: Hospital separations attributed to COPD and asthma per 100,000 population, by remoteness, people aged 55 years and over, 2008–09

Aboriginal and Torres Strait Islander Australians

Among people aged 55 years and over, rates of hospital separation for both COPD and asthma were higher in Indigenous Australians than in other Australians (p<0.0001) (Figure 8.13). Rates of hospitalisation for COPD among Indigenous Australians increased with increasing age, as they did in other Australians (Figure 8.14).



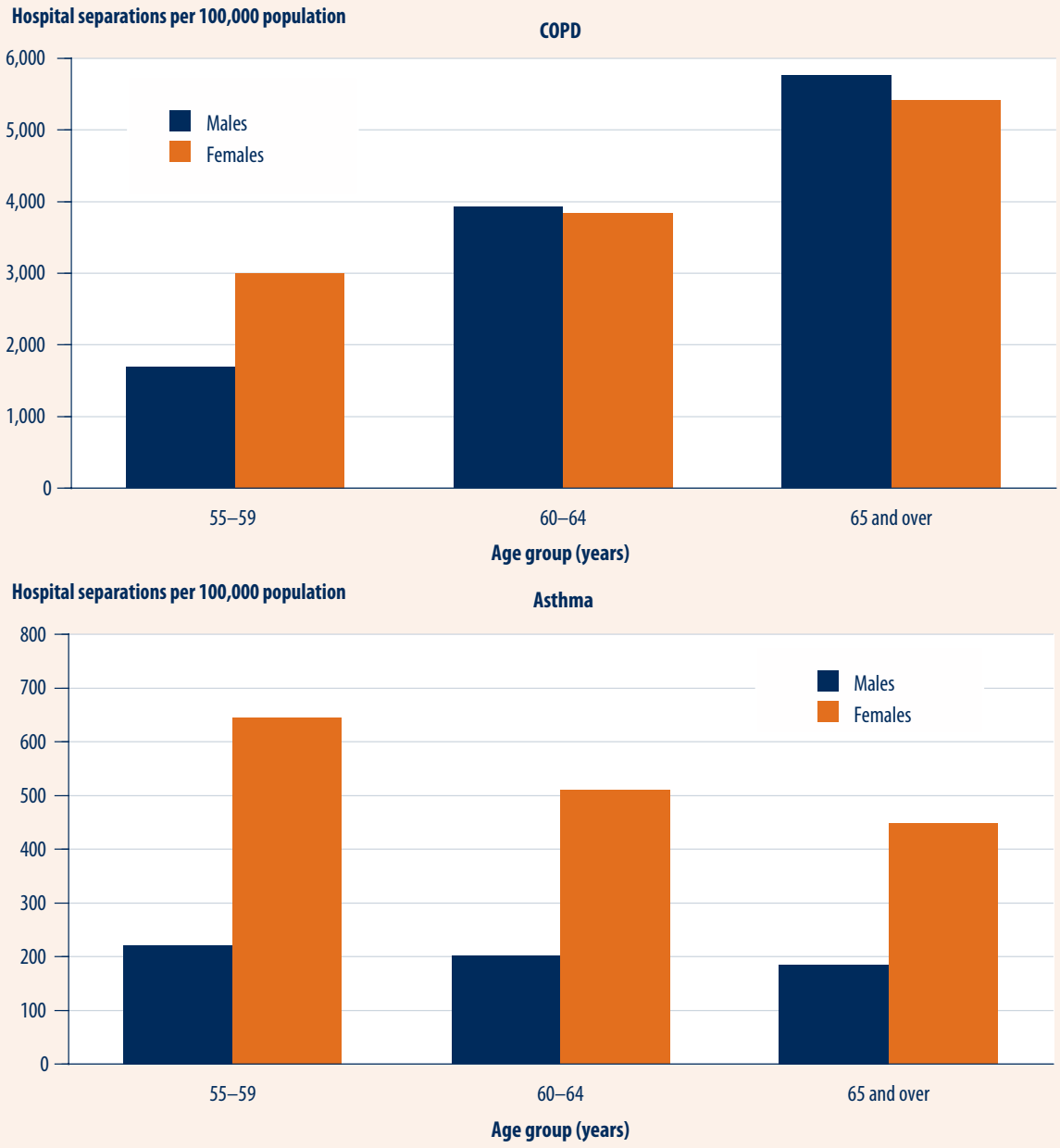
Notes

1. Crude rates presented.
2. Data are included only for those states/territories for which the Indigenous identification was considered reliable, that is, New South Wales, Victoria, Queensland, Western Australia, South Australia and the Northern Territory (public hospitals only for the Northern Territory). The data are not necessarily representative of the jurisdictions excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.
4. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

Source: AIHW National Hospital Morbidity Database.

Figure 8.13: Hospital separations attributed to COPD and asthma per 100,000 population, by age group and Indigenous status, 2008–09

Among Indigenous Australians aged 55 years and over the rate of hospital separations for COPD was similar in females and males (4,538 and 4,445 per 100,000 population, respectively), except for those aged 55–59 years where females were higher than males (3,001 and 1,692 per 100,000, respectively) (Figure 8.14). The rate of hospital separations for asthma was higher among females (506 per 100,000 population) than males (197 per 100,000 population) for people aged 55 years and over.



Notes

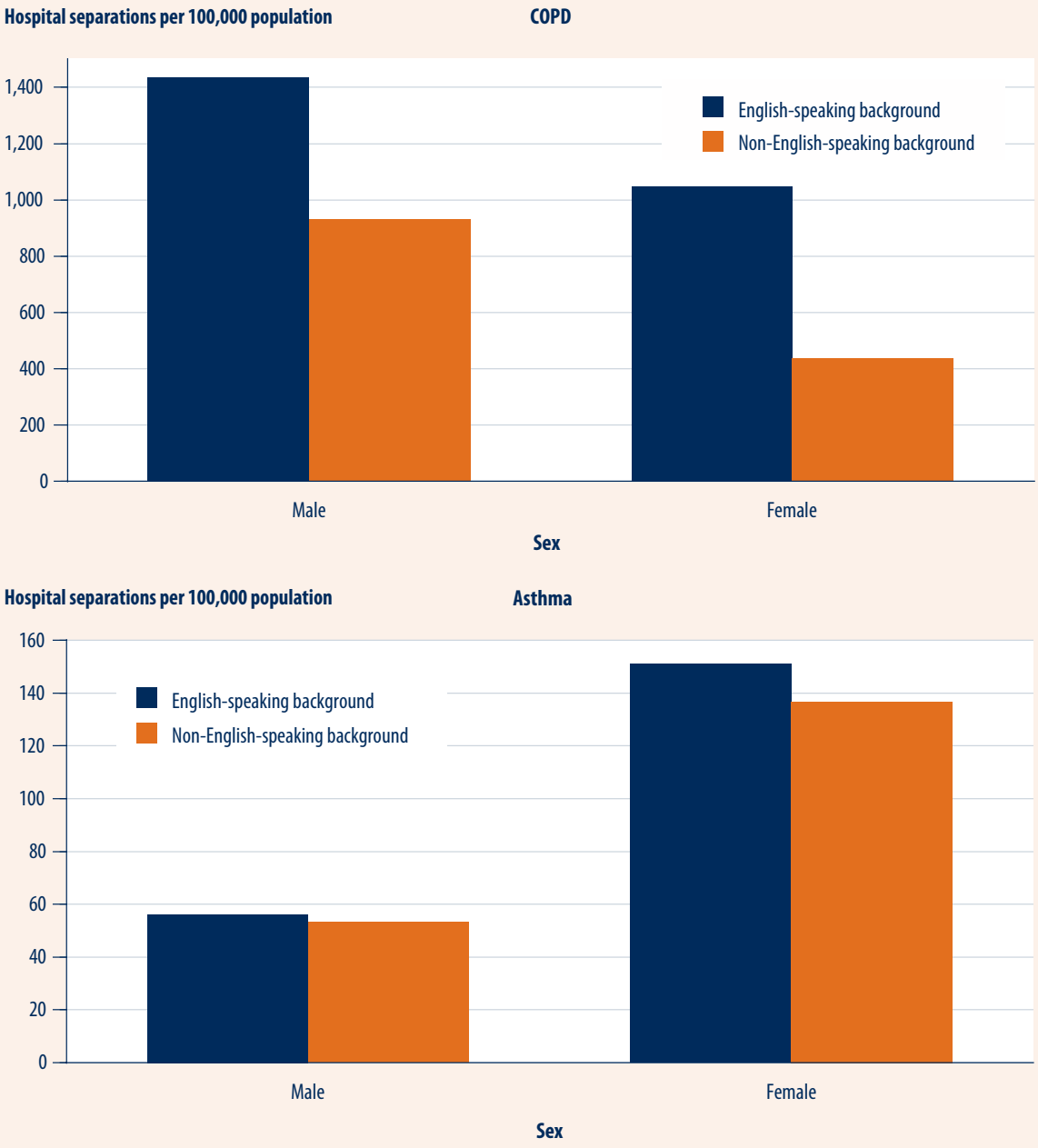
1. Crude rates presented.
2. Data are included only for those states/territories for which the Indigenous identifier was considered reliable, that is, New South Wales, Victoria, Queensland, Western Australia, South Australia and the Northern Territory (public hospitals only for the Northern Territory). The data are not necessarily representative of the jurisdictions excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.
4. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

Source: AIHW National Hospital Morbidity Database.

Figure 8.14: Hospital separations attributed to COPD and asthma per 100,000 population among Indigenous Australians, by age group and sex, 2008–09

Country of birth

Overall, the rate of hospital separation for COPD among those aged 55 years and over was higher among those from an English-speaking background (1,208 per 100,000 population) than among those from a non-English-speaking background (671 per 100,000 population) ($p<0.0001$), for both males and females (Figure 8.15).



Notes

1. Age standardised to the Australian population as at 30 June 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.
4. English-speaking background includes anyone born in Australia, New Zealand, Canada, United Kingdom, Ireland, United States of America, South Africa or Zimbabwe. Non-English-speaking background includes all those born in other countries. See Appendix 1, Section A1.12.2 for further information on country-of-birth classifications.

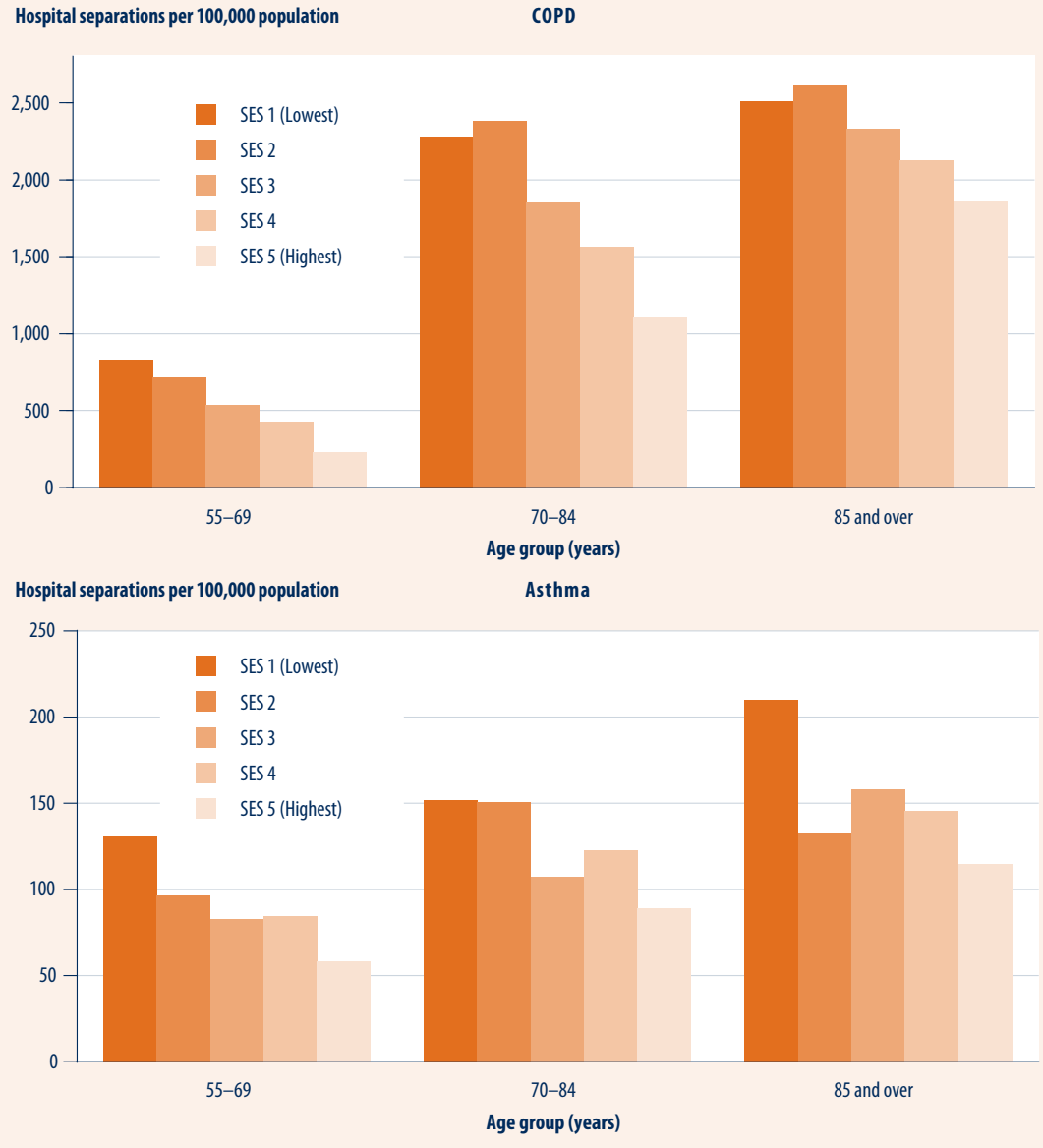
Source: AIHW National Hospital Morbidity Database.

Figure 8.15: Hospital separations attributed to COPD and asthma per 100,000 population, by country of birth and sex, people aged 55 years and over, 2008–09

Females aged 55 years and over from an English-speaking background had a higher rate of hospital separation for asthma than females from a non-English-speaking background (p=0.01). There was no difference in the rate of hospital separations for asthma among males aged 55 years and over between those from an English-speaking and non-English-speaking background (p=0.4) (Figure 8.15).

Socioeconomic status

Hospital separations for COPD among people aged 55 years and over decreased with increasing socioeconomic status (p<0.0001) (Figure 8.16). This trend was observed for all age groups over 55 years. A similar trend was observed for admissions attributed to asthma in the same age groups (Figure 8.16).



SES = Socioeconomic status (see Appendix 1, Section A1.13.3).

Notes

1. Age standardised to the Australian population as at 30 June 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.

Source: AIHW National Hospital Morbidity Database.

Figure 8.16: Hospital separations attributed to COPD and asthma per 100,000 population, people aged 55 years and over, by age group and socioeconomic status, 2008–09

8.3.4 Assisted ventilation

Some patients with very severe exacerbations of COPD are helped with breathing using a device that delivers positive pressure to the airways during inspiration. In the most severe cases, including when the patient has actually stopped breathing, this may be delivered via an endotracheal tube attached to a positive pressure ventilator, commonly known as a 'life-support machine'. This procedure is sometimes referred to as *invasive* mechanical ventilation.

In less severe circumstances the positive pressure ventilation is delivered via face or nasal mask, without the necessity to insert an endotracheal tube. This form of assisted ventilation is known as *non-invasive* ventilation.

The risk of infection, specifically pneumonia, associated with assisted ventilation is lower for patients undergoing *non-invasive* ventilation compared with those undergoing *invasive* mechanical ventilation (Kohlenberg et al. 2010; Girou et al. 2000).

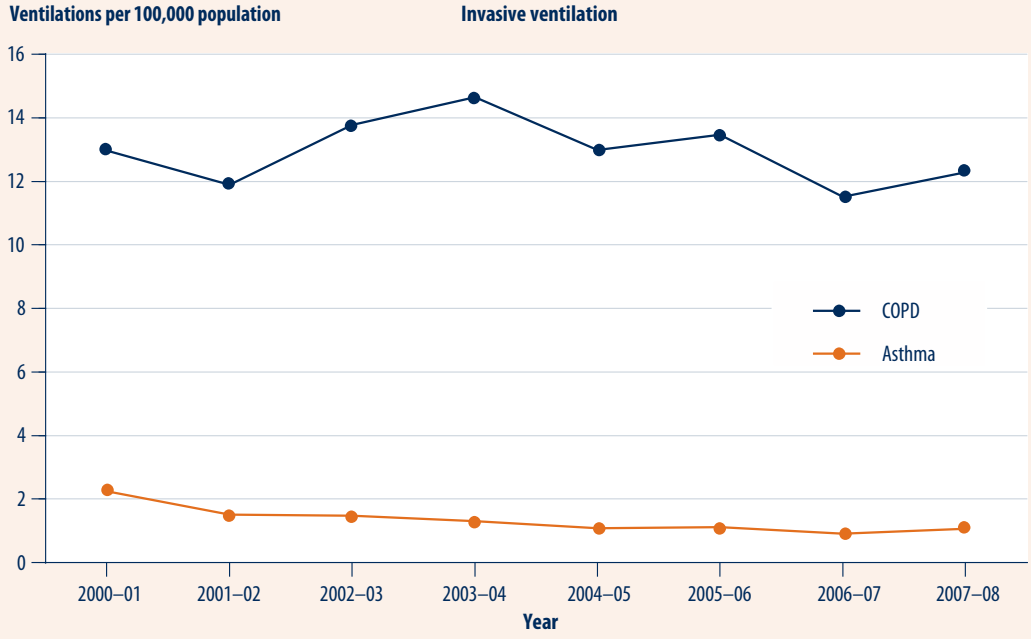
This section presents data from the AIHW's National Hospital Morbidity Database relating to the use of assisted mechanical ventilation (*non-invasive* and *invasive*) in admitted patients aged 55 years and over with a principal diagnosis of COPD. Comparisons are made with asthma among this age group. A list of all the procedure codes included in these analyses is provided in Appendix 1 (Section A1.10.4).

Between 2003–04 and 2007–08, among hospital separations for people with a principal diagnosis of COPD, 4,617 (1.8% of all separations) involved a period of *non-invasive* ventilation and 3,096 (1.2%) involved a period of *invasive* mechanical ventilation. In 2007–08, the overall age-adjusted rates of *non-invasive* and *invasive* mechanical ventilation for COPD were 21.5 and 16.7 per 1,000 hospital separations for COPD, respectively.

Time trends

Among people aged 55 years and over the rate of hospital separations for COPD receiving *non-invasive* mechanical ventilation declined between 2001–02 and 2004–05 (31.7 and 18.6 per 100,000 population, respectively) and remained relatively stable thereafter (21.2 per 100,000 population in 2007–08) (Figure 8.17). In the same age group the rate of hospital separations for asthma receiving *non-invasive* mechanical ventilation was lower and remained relatively constant between 2000–01 and 2007–08 (less than 2.0 per 100,000 population) (Figure 8.17).

The rate of *invasive* mechanical ventilation for people with COPD remained relatively stable over the period 2001–02 and 2007–08, with a slight peak in 2003–04. In 2007–08 the rate was 12.3 per 100,000 population. The rate of hospital separations for asthma receiving *invasive* ventilation has remained low but stable over the same period (less than 3.0 per 100,000 population) (Figure 8.17).



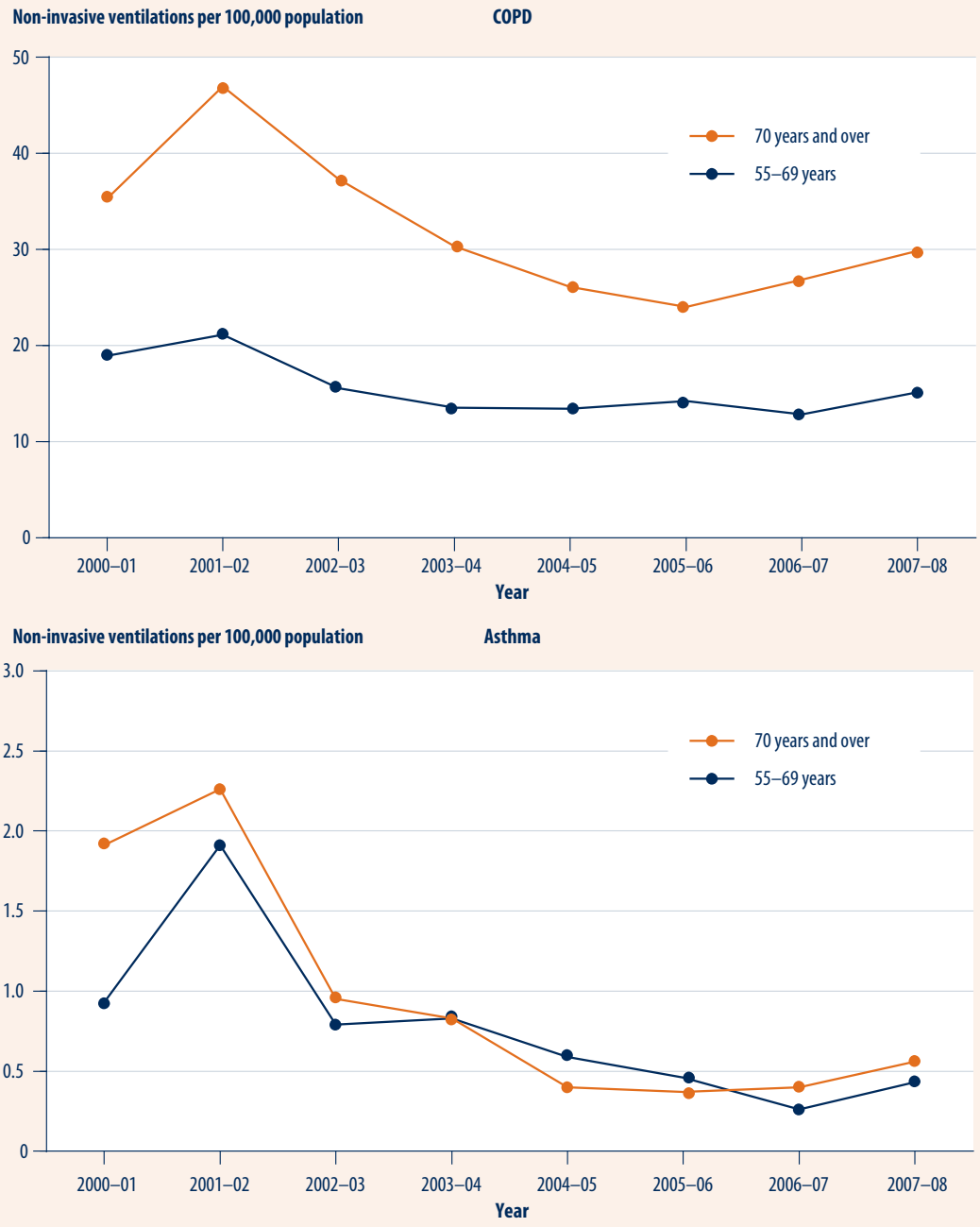
Notes

1. Age-standardised to the Australian population as at 31 December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.

Source: AIHW National Hospital Morbidity Database.

Figure 8.17: Hospital separations attributed to COPD or asthma with non-invasive or invasive mechanical ventilation per 100,000 population, aged 55 years and over, 2000–01 to 2007–08

Between 2000–01 and 2007–08, people aged 70 years and over had a higher rate of hospital separation for COPD receiving *non-invasive* mechanical ventilation compared with those aged 55–69 years. Over the same period, there was no difference in the rate of admission for asthma receiving *non-invasive* ventilation between people aged 55–69 years and those aged 70 years and over (Figure 8.18).



Notes

1. Age-standardised to the Australian population as at 31 December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.

Source: AIHW National Hospital Morbidity Database.

Figure 8.18: Hospital separations attributed to COPD or asthma with non-invasive mechanical ventilation per 100,000 population, aged 55 years and over, by age group, 2000–01 to 2007–08

Similar age differences in time trends were observed among people admitted to hospital for COPD or asthma receiving *invasive* mechanical ventilation (Figure 8.19).

Notes

1. Age-standardised to the Australian population as at 31 December 2001.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
3. COPD and asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.

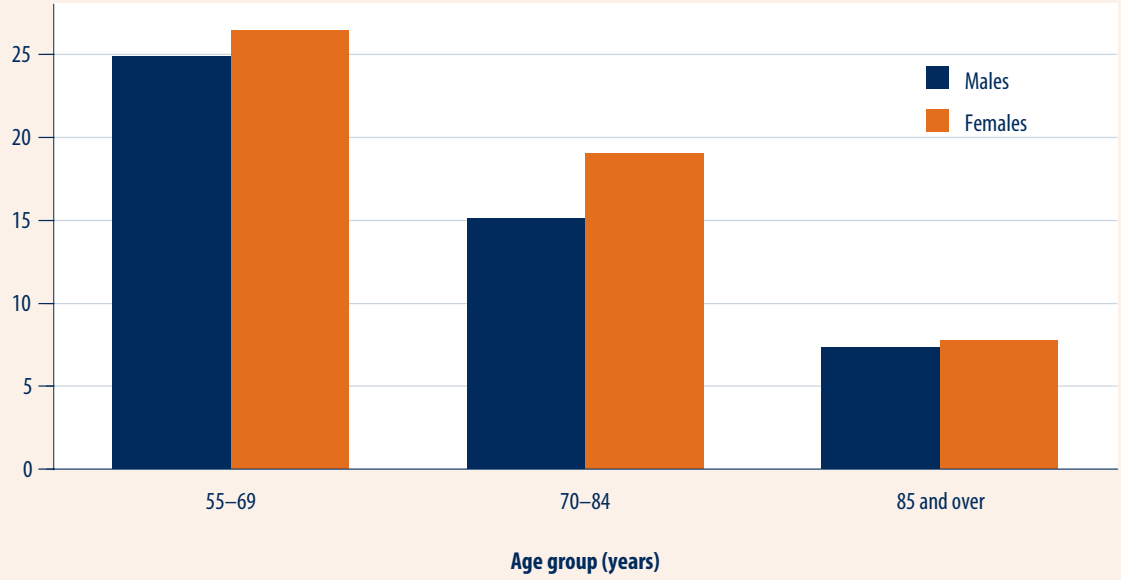
Source: AIHW National Hospital Morbidity Database.

Figure 8.19: Hospital separations attributed to COPD or asthma with invasive mechanical ventilation per 100,000 population, aged 55 years and over, by age group, 2000–01 to 2007–08

Age and sex

Between 2003–04 and 2007–08, the proportion of hospital separations for COPD that were associated with *non-invasive* mechanical ventilation was highest among people aged 55–69 years (25.6 per 1,000 hospital separations) and decreased with age (Figure 8.20). Among people aged 70–84 years admitted to hospital for COPD females had a significantly higher rate of *non-invasive* ventilation than males (19.1 and 15.2 per 1,000 hospital separations, respectively). The rates for males and females did not differ in other age groups.

Non-invasive ventilations per 1,000 hospital separations for COPD



Notes

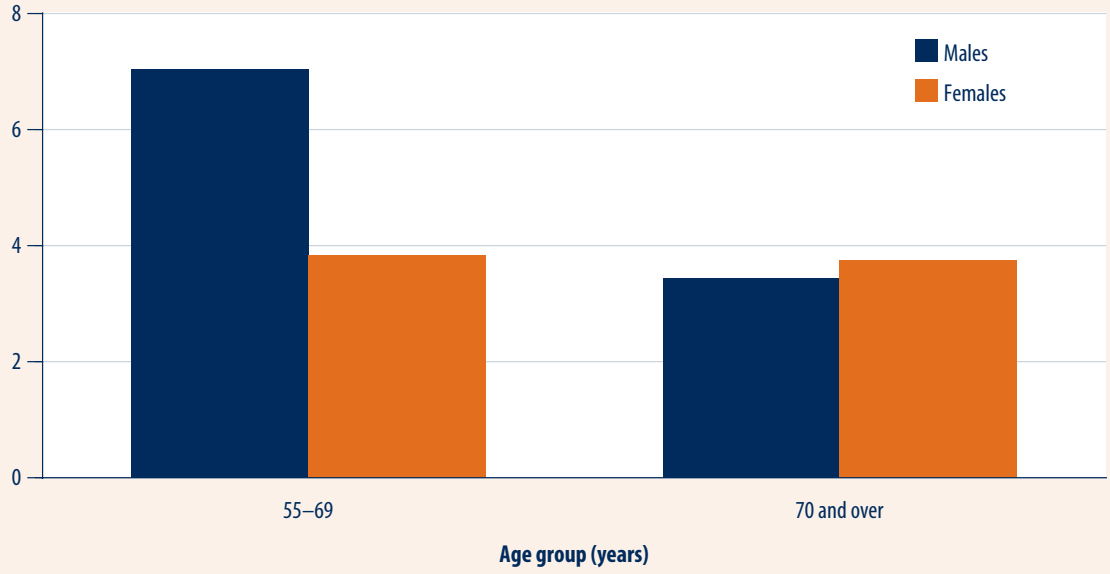
1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. COPD classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44.

Source: AIHW National Hospital Morbidity Database.

Figure 8.20: Rate of hospital separations attributed to COPD with non-invasive mechanical ventilation, people aged 55 years and over, by age group and sex, 2003–04 to 2007–08

In comparison, the proportion of hospital separations for asthma that were associated with *non-invasive* mechanical ventilation among people aged 55–69 years was higher among males than females (7.0 and 3.8 per 1,000 hospital separations, respectively) (p<0.009) (Figure 8.21). Among people aged 70 years and over there was no difference in this rate between males and females (p=0.6).

Non-invasive ventilations per 1,000 hospital separations for asthma



Notes

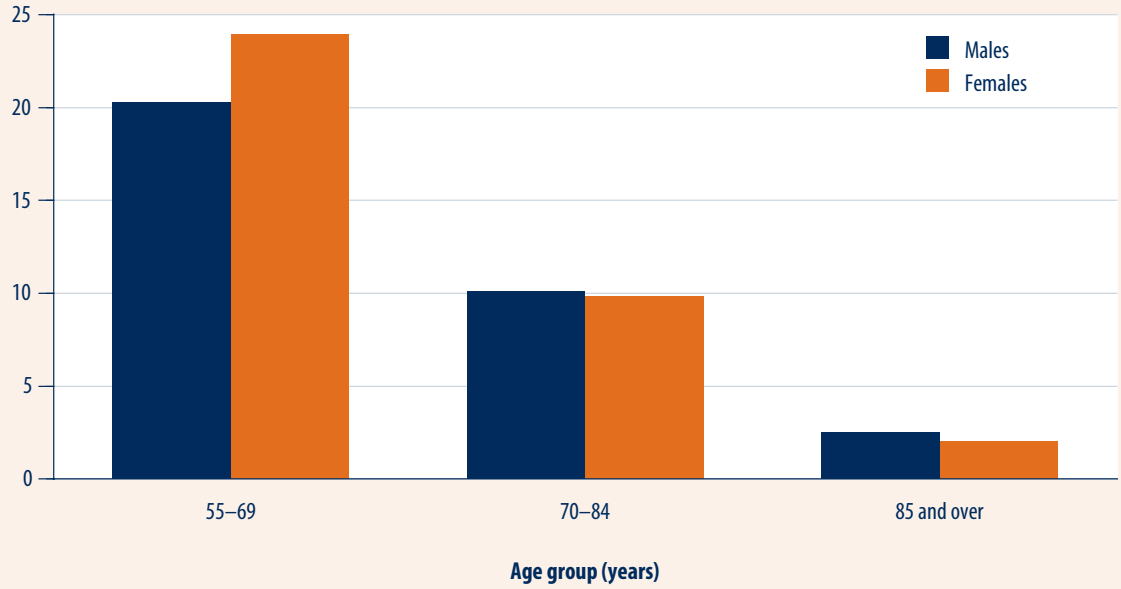
1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and Posthumous organ procurement have been excluded.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45–J46.

Source: AIHW National Hospital Morbidity Database.

Figure 8.21: Rate of hospital separations attributed to asthma with non-invasive mechanical ventilation, people aged 55 years and over, by age group and sex, 2003–04 to 2007–08

The proportion of hospital separations for COPD that were associated with *invasive* mechanical ventilation was highest among people aged 55–69 years (22.2 per 1,000 hospital separations), particularly among females (Figure 8.22). The rate decreased markedly with age: 10.0 and 2.3 per 1,000 hospital separations for those aged 70–84 years and 85 years and over, respectively. Males and females aged 70 years and over had similar rates of *invasive* ventilation attributed to COPD.

Invasive ventilations per 1,000 hospital separations for COPD



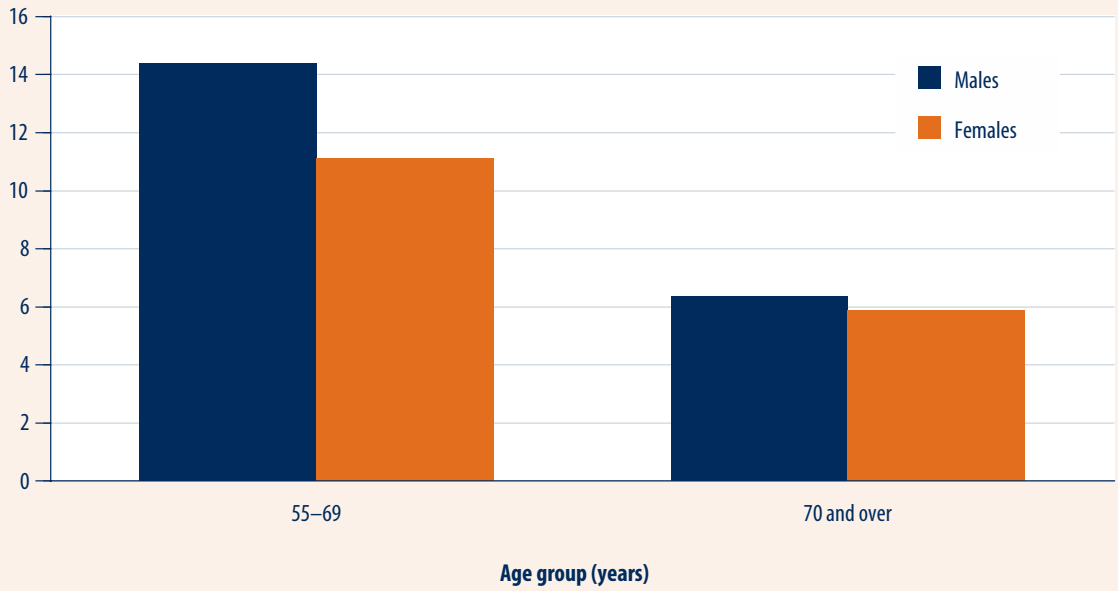
Notes

1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. COPD classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44.

Source: AIHW National Hospital Morbidity Database.

Figure 8.22: Rate of hospital separations attributed to COPD with invasive mechanical ventilation, people aged 55 years and over, by age group and sex, 2003–04 to 2007–08

The proportion of hospital separations for asthma that were associated with *invasive* mechanical ventilation was also highest among people aged 55–69 years (12.1 per 1,000 hospital separations) compared with those aged 70 years and over (6.1 per 1,000 hospital separations) (Figure 8.23). Among people aged 70 years and over who were admitted to hospital for asthma there was no difference between males and females in the rate of *invasive* ventilation (p=0.8).



Notes

1. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.
2. Asthma classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J45–J46.

Source: AIHW National Hospital Morbidity Database.

Figure 8.23: Rate of hospital separations attributed to asthma with invasive mechanical ventilation, people aged 55 years and over, by age group and sex, 2003–04 to 2007–08

In summary, among people aged 55 years and over, the rate of hospital separations for COPD receiving assisted ventilation was significantly higher than the rate for asthma. Among people admitted to hospital for COPD who received assisted ventilation, *non-invasive* ventilation was received more commonly than *invasive* mechanical ventilation.

8.3.5 Comorbidities in patients admitted to hospital with COPD

This section describes the prevalence of selected comorbid conditions in people aged 55 years and over who were admitted to hospital with a principal diagnosis of COPD. Comparisons with the prevalence of these comorbid conditions among people admitted to hospital with asthma as the principal diagnosis are also presented.

The prevalence of comorbid conditions was deduced from the list of associated diagnoses recorded at the time of hospital separation. However, it should be noted that conditions or disorders that did not affect the course of illness or treatment received by the patient during their hospital stay are not recorded as additional diagnoses. Hence, the prevalence of comorbid conditions may be underestimated in these data.

Of all hospitalisations in people aged 55 years and over that were attributed to COPD in 2008–09, 12.4% had an acute respiratory infection (ARI) (ICD-10-AM codes J0–J22) listed as an additional diagnosis (Table 8.1).

Respiratory infections were a more common comorbid condition associated with hospitalisations for asthma than COPD (Table 8.1).

Cancer was the most common comorbidity among people aged 55 years and over admitted to hospital with COPD (58.0%) and asthma (35.5%). 'Heart, stroke and vascular disease' was a common comorbidity among those with COPD (14.5%) and the fourth most common among those with asthma (6.3%). Diabetes was listed as an additional diagnosis in 9.4% of COPD admissions and 8.3% of admissions for asthma in people aged 55 years and over.

Table 8.1: Selected comorbidities among people admitted to hospital with a principal diagnosis of COPD or asthma, age 55 years and over, by sex, 2008–09

	Proportion of all COPD or asthma separations (per cent)		
Comorbidity	Males	Females	Persons
COPD as principal diagnosis			
Respiratory infections	13.1	11.5	12.4
Asthma	0.3	0.9	0.4
Non-infectious upper respiratory conditions	0.4	0.7	0.6
Cancer	58.9	57.2	58.0
Diabetes mellitus	9.5	9.3	9.4
Heart, stroke and vascular disease	15.3	13.6	14.5
Arthritis and osteoporosis	2.3	2.9	2.6
Mental and behavioural disorders	4.0	5.4	4.7
Asthma as principal diagnosis			
Respiratory infections	18.6	23.5	22.2
COPD (emphysema and bronchitis)	3.1	3.5	3.4
Non-infectious upper respiratory conditions	1.7	1.6	1.7
Cancer	31.1	37.1	35.5
Diabetes mellitus	7.4	8.6	8.3
Heart, stroke and vascular disease	6.1	6.2	6.3
Arthritis and osteoporosis	0.8	1.6	1.4
Mental and behavioural disorders	2.2	3.2	2.9

Notes

1. COPD and asthma were classified according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) codes J40–J44 and J45–J46, respectively.
2. Comorbidities were classified as follows: asthma (J45–J46); respiratory infections (J0–J22); chronic obstructive pulmonary disease (emphysema and bronchitis) (J40–J44); non-infectious upper respiratory conditions (includes rhinitis, sinusitis, laryngitis) (J30–39); malignant neoplasms (i.e. cancer) (C00–C97); diabetes mellitus (including Type I and Type II) (E10–E14); heart, stroke and vascular disease (I20–I25, I60–I69, I50, I70–I79); arthritis and osteoporosis (M00–M25, M80–M82); and mental and behavioural disorders (F30–F39, F40–F48, F90–F98).
3. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

Source: AIHW National Hospital Morbidity Database.

8.4 Management and care

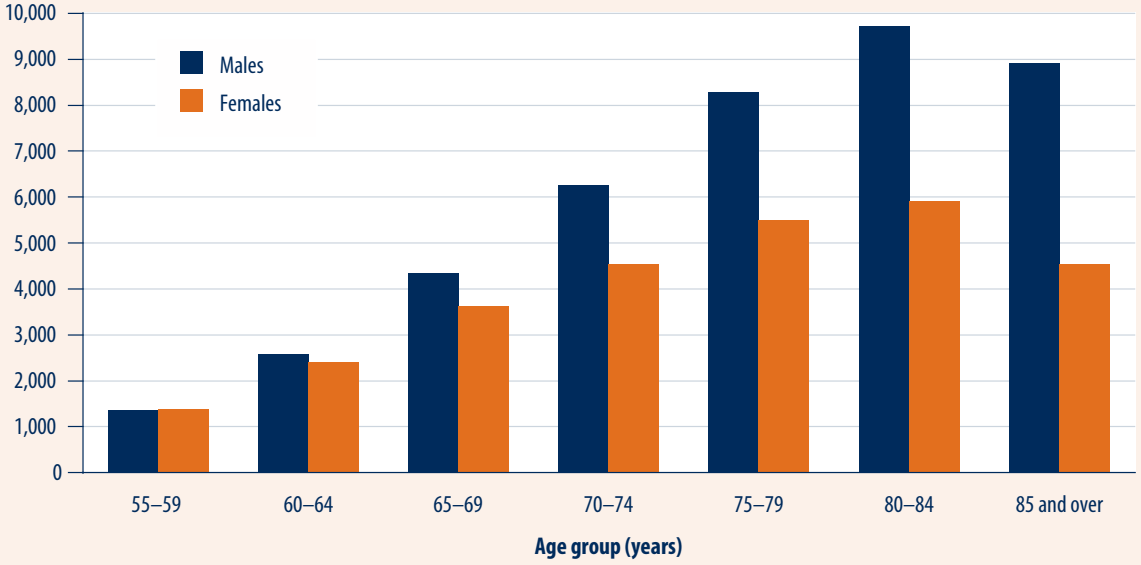
Since COPD is a chronic and progressive disease, management is mainly focused on slowing or preventing disease progression and maintaining function and quality of life for people with the disease. Strategies employed in the management of COPD include smoking cessation, treatment with medications, oxygen therapy and pulmonary rehabilitation.

8.4.1 Use of medication for COPD

Pharmacological therapy is used to prevent and control symptoms, reduce the frequency and severity of exacerbations and improve exercise tolerance in people with COPD (Tashkin et al. 2010; Celli et al. 2008). However, there is no convincing evidence that medical therapy modifies the long-term decline in lung function, and hence disease progression, in patients with COPD. The only intervention that achieves this objective is smoking cessation among those who continue to smoke.

In Australia, the long-acting anti-cholinergic inhaled medication tiotropium bromide (Spiriva™) is approved only for use in the treatment of COPD, whereas long-acting beta-agonists and inhaled corticosteroids and their combination are often used in the treatment of asthma as well as COPD (see Glossary for medication descriptions). For this reason, only data on dispensing of tiotropium prescriptions among people aged 55 years and over is reported. Data on other classes of medications that are used for both asthma and COPD are found in Chapter 6.

In 2009, the proportion of people aged 55 years and over who were dispensed tiotropium prescriptions increased with age for people between 55–84 years, and decreased after the age of 85 years (Figure 8.24). Overall, males aged 55 years and over had a higher number of prescriptions dispensed for tiotropium compared with females of the same age. This reflects the higher prevalence of COPD in males compared with females of this age group.



Note: Includes prescriptions for tiotropium bromide only.
Source: Pharmaceutical Benefits Scheme.

Figure 8.24: Proportion of people dispensed tiotropium prescriptions, aged 55 years and over, by age group and sex, 2009

8.4.2 Long-term home oxygen therapy

Long-term home oxygen therapy is prescribed for people with persistently low levels of oxygen in the blood (hypoxaemia) due to chronic lung disease, most commonly COPD. In this situation increasing oxygen concentration in the blood improves survival (Medical Research Council Working Party 1981) and possibly also improves quality of life. In Australia, long-term home oxygen therapy is predominantly delivered using an oxygen concentrator, a mains-powered device that extracts nitrogen from room air, thereby increasing the concentration of oxygen. Sometimes oxygen cylinders are provided for short-term use. The concentrated oxygen is delivered from the oxygen concentrator or cylinder by tubing connected to a face mask or similar apparatus.

There is no national database or register of use for oxygen therapy in Australia. Hence, no comprehensive data on long-term home oxygen therapy supply or use are available. In 2005, a nationwide survey of government departments and health services identified 20,127 patients using home oxygen therapy and found that prescription rates of oxygen, costs of oxygen therapy, and types of oxygen services varied across the states and territories (Serginson et al. 2009). Overall, the rate of prescriptions for oxygen in Australia was 100 per 100,000 population. The lowest rate was reported in the Northern Territory (44 per 100,000 population) and the highest in Tasmania (133 per 100,000). Prescription rates for oxygen therapy were not associated with access to thoracic physicians, admission rates to hospital or remoteness of residence (Serginson et al. 2009).

8.4.3 Pulmonary rehabilitation

Pulmonary rehabilitation is an effective management strategy for patients with COPD (Griffiths et al. 2000; Goldstein et al. 1994). It is a system of care that includes education, exercise training, nutrition counselling, and psychosocial support. Exercise training includes aerobic training of upper and lower limbs and trunk muscles, flexibility and muscle strength as well as teaching breathing control. Education improves the patient's knowledge about breathing and assists smokers to quit and sustain quitting. Patients are trained to optimise activities and nutrition, gain control over anxiety, panic or depression, and use appropriate medications and therapeutic devices effectively (Frith 2008).

Pulmonary rehabilitation has shown to reduce symptoms of COPD, increase exercise capacity and health-related quality of life (Lacasse et al. 2006) and decrease health-care utilisation (Cecins et al. 2008). A study of 187 patients in Western Australian reported that pulmonary rehabilitation improves functional exercise capacity and health-related quality of life in the short-term, and is associated with a reduction in hospitalisation for COPD exacerbations in the 12 months following rehabilitation (Cecins et al. 2008). Commencement of outpatient pulmonary rehabilitation soon after hospitalisation for COPD exacerbation reduces readmission rates (Seymour et al. 2010). Hence, there is both international and Australian evidence to support the implementation of pulmonary rehabilitation programs for patients with COPD.

While there is strong evidence that pulmonary rehabilitation is effective for people with moderate to severe COPD, access to pulmonary rehabilitation programs is very limited. In 2007, there were 131 pulmonary rehabilitation programs in existence around Australia (The Australian Lung Foundation 2007). Nearly 80% of these programs had a waiting list and more than half (51%) had a length of waiting time greater than 4 weeks after the start of the next program.

In a survey of 38 hospitals in New South Wales in 2007:

- 5–10% of patients with moderate to severe COPD had accessed pulmonary rehabilitation services.
- Over three-quarters of pulmonary rehabilitation programs have a waiting period of greater than 4 weeks and 37% of programs have a waiting period of greater than 2 months.
- Less than half of the programs are able to assess and admit more than 100 patients per year to pulmonary rehabilitation.
- A large proportion of programs do not accept referrals from GPs, allied health or nursing professionals.
- 60% of programs couldn't offer maintenance exercise programs and follow-up assessment and care (Greater Metropolitan Clinical Taskforce 2007).

8.5 Smoking

Cigarette smoking is well established as the main causal risk factor for COPD (see Chapter 7, Figure 7.1 for trends on the prevalence of smoking among the general population in Australia).

Among 8,775 people aged 40 years and over from 12 countries, males were more likely than females to have ever smoked. In the Sydney study site, more than half the males (54.3%; *n*=291) reported having ever smoked compared with 45.0% (*n*=294) of females, while approximately 14% of males and females reported being current smokers (Buist et al. 2007).

The estimated prevalence of COPD, based on lung function testing, increased with pack-years of smoking and the differences in COPD prevalence across study sites tended to mirror the differences in smoking prevalence among males and females. However, the study also reported a high prevalence of COPD among never-smokers, suggesting that risk factors other than smoking are strongly associated with COPD (Buist et al. 2008). Recently, a further report from the same authors found that among people aged 40 years and over with COPD (GOLD stage II or higher), 23.3% reported never smoking (Lamprecht et al. 2010). The study also found that the prevalence of COPD among people aged 40 years and over in Sydney who had never smoked was 7.5%. This rate was reported higher in females than males (Lamprecht et al. 2010).

Passive smoking has also been implicated as a potential risk for COPD. There is strong evidence that exposure to passive smoke during adulthood, whether in the home or at work, increases the risk for COPD (Yin et al. 2007; Eisner et al. 2005).

The most important risk factors for COPD other than smoking include:

- exposure to biomass smoke
- occupational exposure to dust and fumes
- exposure to fumes from cooking appliances
- a history of tuberculosis (Buist et al. 2008)
- age
- a prior diagnosis of asthma
- lower education levels among women
- a low or high BMI weight range, particularly among men (Lamprecht et al. 2010).

8.5.1 People with COPD who smoke

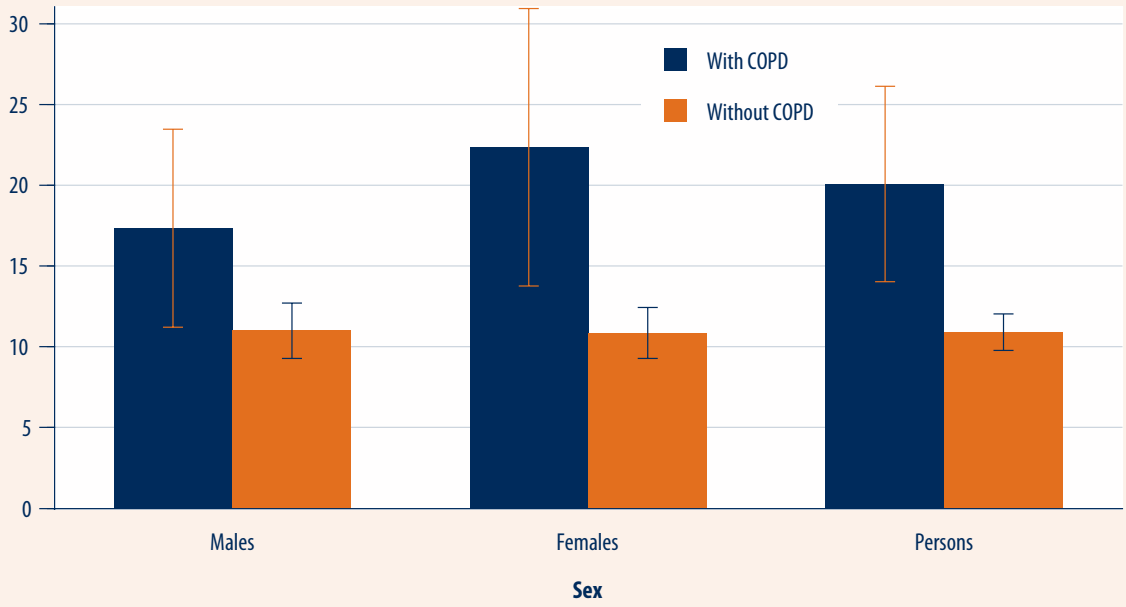
In 2007–08, the prevalence of smoking at least once a week in people aged 55 years and over was 20.1% (CI: 14.1–26.0%) among those with COPD and 10.9% (CI: 9.9–12.0%) among those without COPD (Table 8.2). In comparison, 13.1% of people aged 55 years and over with current asthma smoked at least once a week while 11.2% smoked among those without current asthma in 2007–08. High rates of current smokers and ex-smokers among people with COPD reflect the causal relationship between smoking and COPD.

Table 8.2: Smoking status among people aged 55 years and over with and without self-reported COPD, 2007–2008

	People with COPD		People without COPD	
Smoking status	Rate (%)	95% CI	Rate (%)	95% CI
Current smoker[(a)]	20.1	14.1–26.0	10.9	9.9–12.0
Ex-smoker	51.8	45.1–58.4	40.5	38.6–42.3
Never smoked	28.2	20.4–35.9	48.6	46.8–50.4
	(*n*=313)		(*n*=5,363)	

CI = Confidence interval.
n = Number.
(a) Includes people who reported smoking at least once a week.
Source: ACAM analysis of ABS National Health Survey 2007–08.

In 2007–08, the rates of smoking were higher in people with COPD compared to males and females without COPD (Figure 8.25). Among females aged 55 years and over, 22.4% of those with COPD compared to 10.8% of those without COPD reported being current smokers. Among males aged 55 years and over, 17.3% of those with COPD were smokers compared to 11.0% of those without the disease ($p<0.0001$).



Note: Age-standardised to the Australian population as at June 2001.
Source: ACAM analysis of ABS National Health Survey 2007–08.

Figure 8.25: Prevalence of current smoking among adults aged 55 years and over, by COPD status and sex, 2007–08

8.5.2 Smoking cessation

Smoking cessation is an effective strategy for slowing the rate of decline in lung function and hence preventing the onset or decreasing the progression of COPD (Anthonisen et al. 1994). The main approach to reducing the population burden of COPD is through primary prevention smoking programs or early secondary prevention following disease diagnosis.

A British study of 51,804 people with COPD reported that, between 2001 and 2005, there was a 2.5% reduction in the rate of smoking ($p<0.001$). Among people with COPD from the most disadvantaged areas, the reduction in the proportion smoking was less than among those from the most affluent areas (Simpson et al. 2010). There are no Australian data on participation rates in smoking prevention or cessation programs.

Summary

Based on self-report, the prevalence of COPD among people aged 55 years and over in Australia was estimated at 5.3% in 2007–08. However, evidence suggests this is probably an underestimate of the true prevalence when measured using objective criteria.

The prevalence of self-reported COPD declined among people aged 70 years and over from 2001, 2004–05 to 2007–08, but has remained relatively stable among people aged 55–69 years.

The rate of general practice encounters for COPD decreased between 2000–01 and 2009–10, although the rate has remained relatively stable in recent years.

Among people aged 55 years and over, hospital separation rates for COPD are higher in:

- males compared with females
- people living in remote areas compared with those living in major cities
- Indigenous people compared with other Australians
- people from an English-speaking background compared with those from a non-English-speaking background
- people living in areas of lower socioeconomic status compared with those living in areas of higher socioeconomic status.

The rate of hospital separation for COPD remained relatively stable between 1998–99 and 2008–09. These rates were substantially higher compared with the rates of hospital separation for asthma. In addition, people with COPD admitted to hospital have higher rates of assisted ventilation compared with those admitted to hospital with asthma.

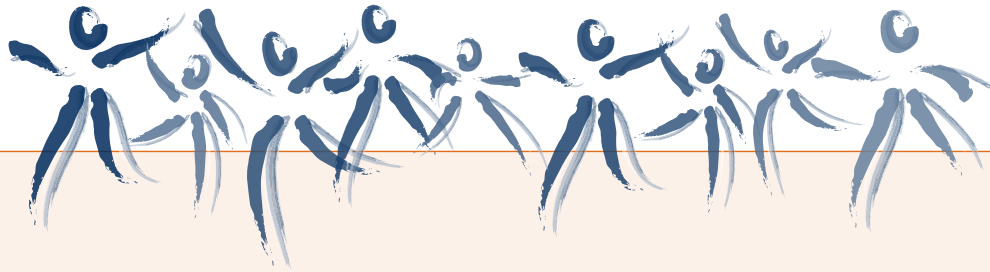
Among people aged 55 years and over admitted to hospital for COPD, 'heart, stroke and vascular disease' was the most common associated diagnosis.

The mortality rate attributed to COPD decreased by 65% between 1997 and 2007. In 2007, the mortality rate attributed to COPD was 100 per 100,000 population. Deaths attributed to COPD were 2.5 times higher in males than females and 16 times higher among people aged 55 years and over than those of the same age with asthma.

Access to pulmonary rehabilitation programs is very limited, despite evidence that these programs are effective and national guidelines strongly recommending this treatment for people with moderate to severe COPD. There is no national database or register of oxygen therapy use to enable assessment of this intervention.

The prevalence of current smoking is twice as high among people with COPD compared to those without the disease. In 2007–08, 20% of people aged 55 years and over with COPD continued to smoke and more than half were ex-smokers.

Appendix 1: Data sources, definitions and population groups



This appendix details the data sources used for the analyses presented in this report and explains the methods used when preparing data for this report. A more detailed description of statistical methods used by ACAM can be found in *Statistical methods for monitoring asthma* (ACAM 2008b).

A1.1 Analysis methods

A1.1.1 Rates

Rates are used to describe the incidence of an event or the prevalence of a condition in a population or a population subgroup. Incidence rates refer to the number of events occurring in a population over a specified time interval divided by the size of the population. Prevalence rates refer to the number of people with a specified condition within a population divided by the size of the population. For rare events, rates per 100,000 people have been calculated. For less rare events or conditions, other bases (e.g. per 100 people or percentage) were used.

Population-based rates were calculated using relevant ABS Estimated Resident Population data that the AIHW provided.

Population-based rates

Crude rates

Crude rates have been calculated by dividing the number of people with a condition in a population or the number of events that occurred in a population in a year by the size of that population at the middle of that year. The mid-year population is an estimate of the average population during the whole year.

$$n/\text{population} \times 100{,}000$$

where n=number of people with a condition or number of events, and population is the mid-year population for the relevant year.

Age-specific and sex-specific rates

Where required, rates have been estimated separately for individual age groups and for males and females. For these analyses the relevant cases or events (for the numerator) are those within the specific age–sex group and the relevant population (for the denominator) is the specified age–sex group within the whole population.

Age-standardised rates

Age-standardised rates are used in this report to adjust for differences in population age structures when comparing rates for different periods of time, geographic areas, and/or population subgroups.

Direct age-standardisation

Direct age-standardisation was used when the populations under study were large and the age-specific rates were considered reliable.

Age-standardised rates have been calculated using the following formula:

Age standardised rate (ASR) = $\sum(r_i P_i)/\sum P_i$

where

r_i is the sex- and age-group specific rate for sex and age group i in the population being studied

P_i is the population of age group i in the standard population

The Australian population as at 30 June 2001 was the standard population in all analyses except for analysis of hospitalisation data for which the Australian population as at 31 December 2001 was used as the standard population.

For trend data that are presented in broad age groups (e.g. 5–14 years, 15–34 years, 35–64 years, 65 years and over) the rates for these broad groups are age-standardised to adjust for variation in age structure within them.

The standard error (SE) for an age-standardised rate per 100,000 population was calculated as:

$$se(ASR) = \sqrt{\left(\sum\left[\left((r_i \times P_i^2)/n_i\right) \times 100000\right] / P^2\right)}$$

where r_i = age-specific rate per 100,000 for age group *i*

n_i = population for age group *i*

P_i = standard population for age group *i*

$P = \sum P_i$ = total standard population

The 95% confidence interval for an age-standardised rate was calculated as:

$$95\%\ CI = ASR \pm [1.96 \times se(ASR)]$$

When the number of cases was small, confidence intervals for direct age-standardised rates were estimated using a Poisson approximation to the gamma distribution and therefore are asymmetrical (Anderson & Rosenberg 1998).

Asthma case-based rates

For some analyses, in which the event or condition is only relevant to people with asthma (for example, management or asthma-specific outcomes), rates are expressed as case-based rates in which the population with asthma is the denominator. These are based on the number of people with asthma as estimated from the most recent ABS National Health Survey conducted in 2007–08.

For some analyses, both population-based rates and case-based rates are presented. This demonstrates the extent to which variation in population-based rates (for example, in hospitalisations for asthma) are attributable to variation in the prevalence of asthma.

It should be noted that, for reasons discussed in this report, the estimation of the prevalence of asthma entails inherent uncertainty. Hence, rates that include this estimate as a denominator are subject to this uncertainty.

A1.1.2 Trends in rates

Prevalence rates have been estimated in several series of surveys, some of which used different definitions. We have used a generalised linear model with fixed and random effects (a mixed model) to estimate the trends over time. In this model the individual series were treated as random effects (with random intercept) and the definition used to identify asthma and the year of the study were treated as fixed effects. Each prevalence rate observation was weighted by the inverse of its variance.

First we tested whether the rate of change of prevalence over years varied according to the definition used to identify asthma using an interaction term. Then we refitted the model using the main effects for year and definition only. The coefficient for year was interpreted as the annual rate of change in prevalence.

A1.1.3 Confidence intervals

The rates and proportions contained within this report represent estimates derived from the available enumerated sample or aggregated data. These estimates contain inherent uncertainty, which is larger where the size of the sample or population from which it was estimated is smaller. Confidence intervals are used to demonstrate the extent of this uncertainty (that is, the precision of the estimates). The 95% confidence interval is presented in this report and is an estimate of the range of values within which the 'true' population value is expected to lie, with 95% certainty (see Figure A1.1).

In the tables, 95% confidence intervals are presented as ranges of values (in the form, xx to xx). In the figures, 95% confidence intervals are depicted by vertical lines extending above and below each point or top of the column.

Confidence intervals are not reported for the analyses of administrative datasets, such as the National Hospital Morbidity Database and the Pharmaceutical Benefits Scheme, due to the data source.

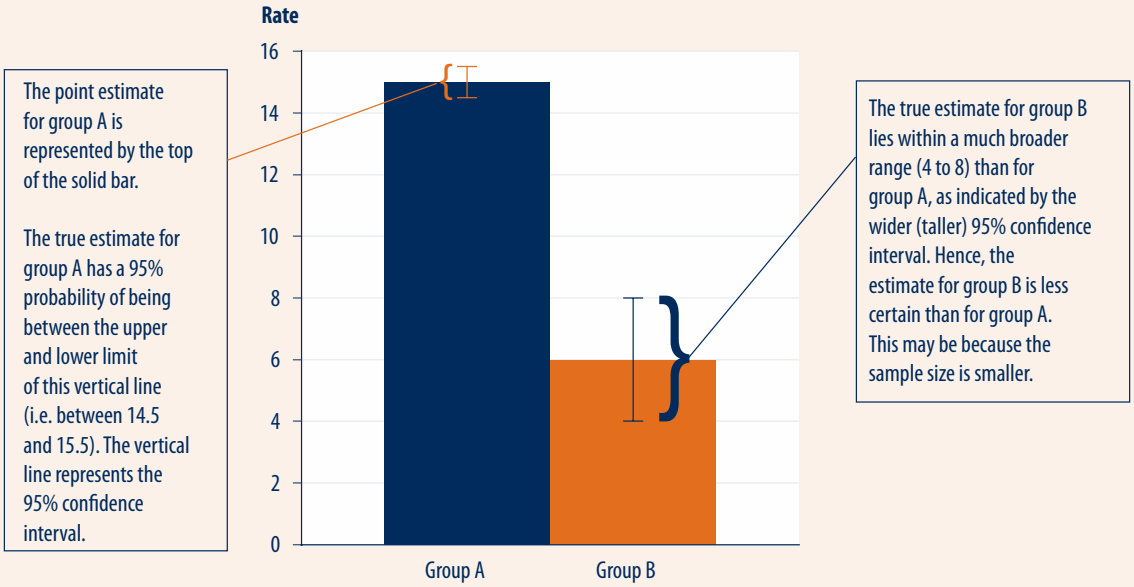


Figure A1.1: Point estimates and 95% confidence intervals

The quadratic method of Fleiss was used to calculate 95% confidence intervals for crude, age-specific and sex-specific rates (Fleiss 1981). This method gives an asymptotic confidence interval that does not include logically impossible negative numbers. It differs from the more familiar normal approximation only for rates near zero. The 95% confidence intervals for age-standardised rates in this report were calculated as described above in Section A1.1.1.

A1.1.4 Tests of statistical significance and association

Linear trends in rates have been tested using the chi square test for trend or Poisson regression. Differences in rates among groups have been tested by the chi square test or Poisson regression.

Multivariate regression methods are used to assess the independent effects of age, gender, socioeconomic status (SEIFA Index of Relative Social Disadvantage quintile), remoteness (ASGC classification) and Indigenous status on mortality, hospitalisation rates and smoking status. Logistic models have been constructed in which the independent effects of these characteristics on event rates are estimated. Interactions between factors have been tested and, where these were found to be

significant, subgroup analyses are presented. Results are expressed as adjusted (independent) odds ratios, with 95% confidence intervals and/or as p values for the relevant chi square test.

A1.2 Asthma definitions used for measuring prevalence

A number of definitions for asthma have been applied in the various surveys cited in this report. These were used where the estimation of the prevalence of asthma is the primary purpose or where the purpose is to measure the prevalence of outcomes or treatments in people with asthma. In the latter case, the definition of asthma is used to identify a denominator population. Table A1.1 lists the definitions of 'ever asthma' and 'current asthma' that have been used in the surveys most commonly cited within this report.

Previously the definition of 'current asthma' based on data from the 2001 and 2004–05 National Health Surveys was determined from responses to the two questions—'Have you ever been told by a doctor or a nurse that you have asthma?' and 'Do you still get asthma?' (Table A1.1). In the 2007–08 National Health Survey, respondents with 'ever asthma' were also asked 'Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?' and those who answered 'yes' were defined as having 'current asthma'. This is the definition recommended by ACAM (ACAM 2007b).

As respondents with 'ever asthma' in 2007–08 were also asked 'Do you still get asthma?' it was possible to compare the agreement between the old and new definitions of 'current asthma' and this was done by calculating Cohen's kappa. Cohen's kappa is a measure of agreement beyond the level of agreement expected by chance alone (Altman et al. 2000). It can be used to quantify the agreement between two different measures of the same characteristic in an individual. A kappa value of +1 indicates perfect agreement, 0 indicates agreement no better than chance alone and <0 indicates agreement worse than chance alone. The agreement between the old and new definitions of 'current asthma' was 0.87, which is considered very good agreement (Byrt 1996).

Table A1.1: Asthma definitions used in the National Health Survey and state CATI surveys

Ever asthma	Current asthma	Survey(s)
Have you ever been told by a doctor or a nurse that you have asthma?	Do you still get asthma? (old definition)	ABS National Health Survey (Trends based on 2001, 2004–05 and 2007–08)
	Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months? (new definition)	ABS National Health Survey 2007–08
Has a doctor ever told you that you have asthma?	Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?	Western Australia Health and Wellbeing Surveillance System
	Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?	South Australian Monitoring and Surveillance System
Have you ever had asthma? Was your asthma confirmed by a doctor?	Do you still have asthma?	South Australian Omnibus Survey
Have you ever been told by a doctor that you have asthma?	In the last 12 months, have you had symptoms of asthma (coughing, wheezing, shortness of breath and chest tightness when you don't have a cold or respiratory infection)?	Victorian Child Health and Wellbeing Survey
		Victorian Population Health Survey
Have you ever been told by a doctor or at a hospital that you have asthma?	Have you had symptoms of asthma or taken treatment for asthma in the last 12 months?	New South Wales Health Survey (child and adult)
		Queensland Omnibus Survey

A1.3 BEACH (Bettering the Evaluation and Care of Health) and SAND (Supplementary Analysis of Nominated Data)

The BEACH data are collected through a continuous survey of general practice activity in Australia, which began in April 1998. BEACH is an activity of the Australian General Practice Statistics and Classification Centre (AGPSCC), a collaborating Unit of the Family Research Centre of the University of Sydney and the AIHW. A rolling random sample of GPs is selected from the HIC Medicare database (AIHW: Britt et al. 2007a; Britt et al. 2007). To be eligible to participate, GPs must have claimed at least 375 general practice Medicare items in the previous 3 months. Approximately 1,000 GPs participate annually, with about 20 different GPs recording each week. Data are collected for 50 weeks each year. Each GP collects information on 100 consecutive encounters using a recording pack containing 100 forms. Each form is divided into two main sections. The first and larger section collects information on the current encounter for the BEACH data (see Section A1.3.1) and the data items/questions do not vary. The bottom section collects data for the SAND collection (see Section A1.3.2).

A1.3.1 BEACH data

The BEACH collection includes information about the following:

the encounter

- date and type of consultation
- up to four diagnoses or problems managed
- Medicare/Veterans' Affairs item number.

the patient

- age and sex
- postcode of residence
- health care card status; Veterans' Affairs card status
- non-English-speaking background status
- whether the patient identifies as Aboriginal and/or Torres Strait Islander
- up to three reasons for the encounter.

the management of each problem

- medications prescribed, supplied or advised including brand, form, strength, dosage and drug status ('new' or 'continuing')
- non-pharmacological management including counselling, referrals, procedures, pathology and imaging ordered.

the GP characteristics

- age and sex
- years working in general practice
- number of sessions worked per week
- postcode of main practice, etc (AIHW: Britt et al. 2007a).

For further information on BEACH see <www.fmrc.org.au/beach.htm>.

International Classification of Primary Care

Information on diagnosis and problem managed during GP encounters, obtained from the BEACH dataset, was classified according to the International Classification of Primary Care—2nd edition (ICPC-2) (AIHW: Britt et al. 2001). An extended vocabulary of terms called ICPC-2 PLUS is available from <www.aihw.gov.au/publications/index.cfm/subject/19>.

To classify 'asthma' from BEACH data we have selected ICPC-2 rubric R96 and excluded code R96006 'extrinsic allergic alveolitis'. The following ICPC-2 PLUS codes were included:

R96001—asthma

R96002—bronchitis; asthmatic

R96003—bronchitis; allergic

R96005—status asthmaticus

R96007—bronchitis; wheezy

R96008—hyperactive airways

To classify 'COPD' from BEACH data we have selected ICPC-2 rubrics R79 (excluding R79002 'bronchiolitis; chronic' and R95). The following ICPC-2 PLUS codes were included:

R79001—smokers lung

R79003—bronchitis; chronic

R95001—chronic obstructive airways disease

R95002—chronic obstructive pulmonary disease

R95004—chronic obstructive lung disease

R95006—emphysema

R95008—chronic airways limitation

R95009—chronic airways disease

Analysis of BEACH data

Estimating the rate of general practice encounters for asthma

The number of general practice encounters where asthma was managed (i.e. general practice encounters for asthma) per 100 encounters was estimated from the BEACH data using a method which adjusts for the cluster (practice-based) sampling used in BEACH and also incorporates post-stratification weights to account for differences in age between the GP sample and the GP population. The data were also weighted for each participant's Medicare activity level, in order to better reflect total GP–patient encounters for Australia. This was implemented using the SURVEYMEANS® procedure in SAS software version 9 (SAS Institute 2005).

The estimated number of general practice encounters for asthma per 100 population was then estimated using the following information and formula:

$$\text{The estimated number of general practice encounters for asthma per 100 population} = \frac{\text{ARGPEs per 100 general practice encounters} \times \text{estimated total number of all general practice visits}}{\text{population}}$$

where:

ARGPEs = number of general practice encounters for asthma based on analysis of BEACH data

population = the mid-year population for the relevant year

The estimated total number of general practice visits was based on Medicare data for MBS Category 1 Service Items. This category includes all unreferred (i.e. primary care) attendances.

Derived variables for analysis of asthma-related BEACH data

Asthma medication

Asthma medication groupings were defined using BEACH in-house classification, the Coding Atlas for Pharmaceutical Substances (CAPS), which is mapped to the Anatomical Therapeutic Chemical (ATC), the Australian standard for classifying medications at the generic level (Table A1.2).

A medication variable was created and for each asthma-related encounter, defined as 'yes' or 'no' depending on whether or not at least one of the prescriptions provided at that encounter for the management of asthma belonged to the designated medication class. For example, the variable for inhaled corticosteroids alone was assigned a value of '1' (i.e. 'yes') if asthma was managed during the encounter and at least one of the prescriptions prescribed during that encounter for the management of asthma had a generic code of R501, R502, R506 or R510. Otherwise, ICS was assigned a value of '0' (i.e. 'no') if asthma was managed or remained blank (not defined) for non-asthma encounters.

Table A1.2: Variables for asthma medication groupings by name, ATC code and generic code

Variable	Medications included	ATC code	Generic code (CAPS)
Inhaled corticosteroids (ICS)	Beclomethasone Becloforte Becotide Qvar Respocort	R03BA01	R501
	Budesonide Pulmicort	R03BA02	R502
	Fluticasone propionate Flixotide	R03BA05	R506
	Ciclesonide Alvesco	R03BA05	R510
Long-acting beta-agonists combined with inhaled corticosteroids (ICS/ LABA)	Fluticasone/Salmeterol Seretide	R03AK06	R508
	Budesonide/Eformoterol Symbicort	R03AK07	R509
Oral corticosteroids (OCS)	Prednisolone Solone Panafcortelone Predsolone	H02AB06	H203
	Prednisone Sone Panafcort Predsone	H02AB07	H202
	Prednisolone sodium phos oral	H02AB06	H212
Leukotriene Receptor Antagonist (LTRA)	Montelukast Singulair	R03DC03	R410
	Zafirlukast Accolate	R03DC01	R410
Cromones	Nedocromil Tilade	R03BC03	R505
	Sodium cromoglycate Intal Cromese sterinebs	R03BC	R503

Procedures and referrals for asthma

Variables for procedures and referrals for the purposes of asthma management were defined using the ICPC-2 PLUS classification as described in Table A1.3.

Table A1.3: Variables for asthma-related procedures and referrals

Variable	BEACH data element	ICPC item included	ICPC code / rubric
Advice/consultation; smoking	Procedures, other treatments and counselling for asthma	Advice/consultation; smoking	P45004 P58008
Lung function test	Procedures, other treatments and counselling for asthma	Test; peak flow Test; pulmonary function Test; spirometry Test; lung function Test; physical function; respiratory Test; FEV_1 Test; respiratory function	R39
Asthma plan	Procedures, other treatments and counselling for asthma	Asthma plan	R49002
Hospital	Referrals for asthma	Referral; Hospital Admission; Hospital	A67010 A67022, A62010
Accident & Emergency (A&E) Emergency department (ED)	Referrals for asthma	Referral; A&E	A67011
Specialist	Referrals for asthma	Referral; Specialist Referral; physician Referral; paediatrician Referral; allergist Referral; immunologist Referral; respiratory physician	A67001 A67001 A67004 A67005 B67003 R67002
Lung function test	Referrals for asthma	Test; peak flow Test; pulmonary function Test; spirometry Test; lung function Test; physical function; respiratory Test; FEV_1 Test; respiratory function	R39
Unspecified referral	Referrals for asthma	Referral	A68011

A procedure/referral variable was created and for each encounter, the variable was defined as 'yes' or 'no' if asthma was managed during that encounter and at least one of the procedures/referrals for management of asthma belonged to the designated procedure/referral group. For example, Specialist variable was assigned a value of 1 ('yes') if asthma was managed during the encounter and at least one of the referrals for the management of asthma belonged to the following ICPC-2 list: A67001, A67004, A67005, B67003 or R67002.

Limitations of BEACH data

Between 2001–02 and 2009–10 the response rate by GPs to the BEACH survey ranged from 22.9% in 2006–07 to 32.6% in 2008–09 (AIHW: Britt et al. 2010; AIHW: Britt et al. 2007a; AIHW: Britt et al. 2004). The proportion of BEACH GPs practicing in remote areas is only 1.5%, hence, the sample from remote areas is relatively small (*n*=15 in 2009–10) (AIHW: Britt et al. 2010). BEACH GPs were also significantly older in survey samples. To improve the representativeness of the sample, BEACH data are weighted for differences between the GP sample and the GP population and for participants' Medicare activity level.

The BEACH program has a quality assurance program to ensure the reliability of data entry. This includes computer-aided error checks during data entry, the validating of samples of data entered against original recording forms, and further logical data checks during the data cleaning and analysis using specific SAS programming (AIHW: Britt et al. 2002).

Britt et al. (1998) compared the recording of morbidity data by GPs for the BEACH program, with two trained observers independently viewing a videotape of the encounters. They found good agreement (87%) between the general practitioners observed and the observers (who were also general practitioners) at the broad disease level (ICPC chapter), but agreement at the condition-specific level (ICPC rubric) was lower (67%). Thus the labelling of certain conditions varies between GPs. The AGPSCC uses features of the ICPC classification structure to ensure synonymous terms are classified to the correct rubric but this cannot deal with variation among GPs in the way they use the labels 'asthma', 'COPD' or other respiratory disease labels.

Furthermore, BEACH data does not identify prescriptions for budesonide/eformoterol as maintenance and reliever therapy.

A1.3.2 SAND data

The SAND data are collected as a supplementary dataset of the BEACH program (Britt et al. 2001). Organisations sponsoring blocks of SAND data collection ask questions on topics of their choice and have access to the detailed reports. GPs participating in SAND ask and record responses to specific questions in targeted patient groups. SAND modules relevant to asthma have been conducted in 1999, 2000–01, 2002–03, 2004–05, 2006–07 (AIHW: Britt et al. 2007b), 2007–08 (AIHW: Britt et al. 2008) and 2008–09 (AIHW: Britt et al. 2009).

A1.4 Emergency department data

Data on emergency department (ED) visits for asthma have been derived from the New South Wales Emergency Department Data Collection (NSW EDDC). An ED attendance 'index' was calculated for the five age groups in the population as the number of attendances per year per 100,000 population with asthma in that age group.

ED visits for asthma are identified using the 'principal diagnosis' for the visit and are classified using the International Classification of Diseases 9th Revision (ICD-9), 10th Revision (ICD-10) or SNOMED-CT coding systems. Comparability factors have been used to adjust for the changes in coding from ICD-9 to ICD-10 (see Table A1.4). Data from the NSW EDDC for the period 1999 to 2009 were provided by the NSW Department of Health's Centre for Epidemiology and Research.

A1.4.1 Comparability factors for emergency department data

Table A1.4 shows the age-group specific comparability factors calculated by the AIHW for converting ICD-9-CM to ICD-10-AM.

Table A1.4: Comparability factors for emergency department visits for asthma

Age group	Conversion factor
5–34 years	1.0326
35–64 years	0.7938
65 years and over	0.4813

A1.4.2 Limitations of emergency department data

In New South Wales, the ED dataset includes data from 90 of the 150 emergency departments in that state. Only EDs from public hospitals participate in the EDDC and this report used only data from 43 emergency departments where the data quality was good and complete. These EDs approximately cover 60% of the NSW population. Emergency departments in metropolitan Sydney and larger rural hospitals are more likely to be included. This incomplete coverage means that the denominator used in the calculation of the ED attendance index is an overestimate of the true population covered. Hence, the ED attendance index is an underestimate of the true population-based rate. Furthermore, the nature of the missing data means that the ED data tend to under-represent people visiting EDs in rural and remote areas.

A1.5 Expenditure data

Expenditure data used in this report were obtained from the AIHW's disease expenditure database. This report considers recurrent health expenditure allocated by health sector and disease.

It is not possible to allocate all expenditure on health goods and services by disease. Expenditure on most community and public health programs for instance, support the treatment and prevention of many conditions and cannot be allocated to one specific disease or injury. This is also true of capital expenditure on health facilities and equipment, which has the added problem of being characterised by large outlays that fluctuate greatly from year to year. The method used to derive the estimates in this report however, ensures that the estimates add across disease, age and sex groups to the total amount of health expenditure that could be allocated by disease in 2004–05—around two thirds (70%) of total recurrent health expenditure ($52.7 billion) (AIHW 2008b).

The expenditure that could not be allocated by disease includes capital expenditure, non-admitted patient hospital services, over-the-counter drugs, all other health practitioner services excluding optometry, community health expenditure (except community mental health), expenditure on public health programs (except cancer screening programs), health administration and health aids and appliances. Therefore, in this report, references to health-care expenditure always imply 'allocated recurrent' health-care expenditure. All expenditure data are in 2004–05 dollars.

A1.5.1 Expenditure for admitted patients

Expenditure for admitted patients comprises admitted patient public and private hospital services expenditure (same day as well as overnight admissions). The proportions of total public acute hospital expenditure which relate to admitted patients are estimated using the admitted patient fractions for hospitals in each state and territory and are published in *Australian hospital statistics 2005–06* (AIHW 2007a). Private hospital expenditure data are derived from the Australian Bureau of Statistics Private Health Establishments Survey.

The hospital morbidity expenditure method estimates acute hospital admitted patient costs by apportioning the total admitted patient expenditure to individual episodes of hospitalisation with an adjustment for the resource intensity of treatment for the specific episode (using the Diagnostic Related Groups, or DRGs) and the length of stay. The length of stay adjustment is made in such a way as to reflect the fact that some costs are proportional to length of stay (e.g. ward costs and meals), whereas others are independent of length of stay (e.g. theatre costs). The subdivision of episode costs into these cost 'buckets' was made using National Hospital Costs Data Collection data.

An adjustment is also made for the actual hospital where the treatment is provided. The standard DRG method for estimating costs uses state DRG weights, and so assumes that the hospital has the same average costliness as the average for the state. The Public Hospitals Establishments database contains the actual cost of treating admitted patients at each hospital, so these data are used to scale up or down the estimate that comes from using state DRG weights.

For sub-acute and non-acute patients, where there are no DRG weights, the most recent data on costs comes from the July to December 1996 sub-acute and non-acute patient (SNAP) study (Eagar et al. 1997). Costs per day were applied and inflated to 2004–05 estimates using the implicit price deflator for final government consumption expenditure on hospital care (AIHW 2006).

Estimates of expenditure on medical services for private patients in hospitals are included in admitted patient hospital costs. Expenditure for private medical services in 2004–05 was $2,746 million (AIHW 2008b). These estimates come from Medicare data.

Hospital encounters for asthma were identified as those where the principal diagnosis was asthma (International Classification of Diseases version 10 codes J45 and J46).

A1.5.2 Out-of-hospital medical services expenditure

'Out-of-hospital medical' is primarily care in the community from general practitioners as well as specialists, imaging and pathology services. Specifically it includes MBS unreferred attendances, imaging, pathology, specialist, other medical MBS and any other medical services expenditure for 2004–05 reported in *Health expenditure Australia 2005–06* (AIHW 2007b) that has not been counted elsewhere.

Data from the BEACH survey was used to allocate private medical services provided by both GPs and specialists. The International Classification of Primary Care Version 2 codes used in BEACH were mapped to the disease costing groups to enable medical services expenditure to be allocated by disease.

Three years of the BEACH database, 2003–04, 2004–05 and 2005–06, were used in the analysis, which gave 297,000 encounters overall. The proportions of problems by disease were used to allocate medical expenditures. The total medical expenditures came from Medicare and the AIHW health expenditure database.

Expenditures for 'Unreferred attendances', 'Imaging' and 'Pathology' were allocated to disease on the basis of GP encounters, while expenditure for 'Other medical services' (mostly specialist services) was allocated to disease on the basis of the referral pattern in BEACH. Allocation of GP costs where there are multiple presenting conditions in the GP encounter was done on a pro-rata basis.

In-hospital medical expenditure for private patients was not included under medical services, but was allocated as part of admitted patient expenditure.

A1.5.3 Prescription pharmaceuticals expenditure

This includes benefit paid pharmaceuticals, under copayment prescriptions and private prescriptions.

The Department of Health and Ageing provided detailed costing data for pharmaceuticals issued under the Pharmaceutical Benefits Scheme (PBS) and the Department of Veterans' Affairs Repatriation Pharmaceutical Benefits Scheme (RPBS). It also provided volume data for private prescriptions and under-copayment drugs. These data originally came from a Pharmacy Guild survey and were adjusted by the Department to represent volume figures for all of Australia. Costing figures were applied to

these prescription drugs, to obtain a total expenditure figure for each prescription drug. Prescription drugs were coded by the fifth edition of the Anatomical Therapeutic Chemical classification, a system developed by the World Health Organization for classifying therapeutic drugs (WHO Collaborating Centre for Drug Statistics Methodology 2003). The codes were mapped to codes for prescription drugs used in the BEACH survey. As a result, data from BEACH were used to allocate expenditure on prescription drugs to each disease group, based on the medical problem in the GP encounter that related to the prescribing of the particular drug. An assumption was made that the pattern of diseases relating to each type of prescription drug is the same when prescribed by a GP and by a specialist. This assumption was applied because there are no data that permit allocation of specialist-written prescriptions to diseases.

Pharmaceuticals that are dispensed in hospitals are included in the estimates of hospital costs.

A1.5.4 Other costs

'Other' expenditure comprises expenditure on optometrical services, dental services, community mental health, public health cancer screening and research. For asthma expenditure, the category 'other' only comprises expenditure on research, since the other components were not applicable. Therefore, for the purposes of this report, we have only included research funding in the category 'other' for total recurrent health expenditure to ensure comparable growth rates for the category 'other' for asthma and all other diseases.

Total expenditure on 'Research' was obtained from *Health expenditure Australia, 2005–06* (AIHW 2007b) and was allocated to disease using data from the latest Australian Bureau of Statistics research and experimental development surveys. Most of the research data are classified at a fairly high level, but it does give a fairly good picture of the distribution of research expenditure at the burden of disease chapter level. Asthma research expenditure was a derived sub-component of research expenditure on respiratory diseases.

A1.5.5 Limitations of expenditure data

It is important that the interpretation and limitations of these estimates are clearly understood. Expenditure estimates for disease are based on the attribution of allocated recurrent health expenditure using the available information about the mix of diseases by age and gender and health sector utilisation. The accuracy of the expenditure estimates is limited by the accuracy of the source data on health-care utilisation. For further details on the interpretation and limitations of these estimates, refer to the technical notes in AIHW 2008b.

In relation to asthma there are substantial problems with diagnostic misclassification (Baker et al. 2004). These problems will particularly influence the estimates of expenditure on asthma in the elderly. Often in this age group, there is no certain clinical basis for distinguishing asthma from chronic obstructive pulmonary disease. However, the substantially higher cost-weight for chronic obstructive pulmonary disease, compared with asthma (National Centre for Classification in Health 2004), is an incentive for health-care providers to assign admissions to chronic obstructive pulmonary disease, rather than asthma. This may lead to underestimation of hospital bed utilisation, and, hence, expenditure for asthma in the elderly. There is less incentive for misclassification in the BEACH survey data but diagnostic uncertainty remains an issue.

Furthermore, in some instances, data were not available regarding how costs should be attributed. For example, there are no data relating to the patterns of prescriptions by specialists, therefore it was assumed these would be the same as for general practitioners. The validity of this assumption is untested and, hence, these data should be interpreted with some caution.

The Medicare broad type service category 'Allied Health', which includes outpatient physiotherapy services, was excluded from these analyses since it was not possible to obtain disease expenditure splits for allied health.

A1.6 Health survey data

A1.6.1 National Health Survey

The NHS, conducted by the ABS periodically since 1977, is designed to collect information on the health status, use of health services and facilities, and health and lifestyle characteristics of residents across Australia. It aims to get national information on a range of health issues, provide information on health indicators for National Health Priority Areas and for important population subgroups, and, where possible, enable trends to be monitored over time.

Households from all states and territories are sampled randomly using a stratified multi-stage area sample to ensure that all eligible members of the population within a given state and territory have an equal chance of selection. Residents from hospitals, nursing and convalescent homes, boarding schools, prisons, single quarters of military establishments and people living in Australia but not usually considered part of the Australian population are excluded. Non-private dwellings such as hostels, boarding houses, hotels and motels are also excluded.

In 2007–08, the NHS sampled approximately 17,426 households from *Major cities*, *Inner regional*, *Outer regional* and *Remote* areas (excluding *Very remote* areas) of all states and territories of Australia between August 2007 and July 2008 (ABS 2009). The response rate for all households surveyed was 90.6%. One adult, aged 18 years or over and, where applicable, one child aged 0–17 years, were included from each selected dwelling, providing a total sample of approximately 20,788 respondents. Parents or guardians were interviewed on behalf of children or, where possible, children aged 15 to 17 years were interviewed in person, with parental consent. The average survey time was 40 minutes per household.

In this report, data from the 2007–08, 2004–05 and 2001 surveys are used. The estimate of the prevalence of current asthma is derived from two questions asked in the survey (see Table A1.4). The proportion of the sample who had 'current' asthma (that is, 'still get asthma') was estimated. This subgroup of the population was asked additional questions from the asthma module of the survey, also described in Table A1.5. In order to make comparisons of various outcomes in people with and without asthma, the authors also analysed data from the NHSs that are designed for the general population (Table A1.6).

The 2007–08, 2004–05 and 2001 ABS NHS data presented in this report have been accessed through the ABS Remote Access Data Laboratory (RADL). This facility is available to authorised users to access confidentialised unit record files (CURFs), which are de-identified record level data. Grouping variables are incorporated in these data (for example, region of birth, age group) to ensure that information from these records cannot be used to identify an individual.

The 2007–08 NHS collected information that focused on the health status of Australians and health-related aspects of their lifestyle. Information was collected about respondents' long-term medical conditions, consultations with health professionals, and other actions recently taken in regard to their health (e.g. taken days away from work, used medication). Information was also collected on lifestyle factors which may affect health, such as smoking, alcohol consumption, diet and exercise. Respondents' physical measurements (height, weight, waist and hip) were taken for the first time in the 2007–08 NHS (ABS 2009).

There are two formats of the NHS CURF data—the expanded and the basic. The expanded CURF contains some information that is more detailed than that available in the basic CURF.

The expanded CURF can only be accessed through the RADL, while the basic CURF can be accessed either through the RADL or via CD-ROM (ABS 2009). For the purposes of this report, the expanded CURF was used, unless stated otherwise.

Table A1.5: Asthma-specific questions from the ABS National Health Survey relevant to this report

Question(s)	Chapter of this report where data presented
Have you ever been told by a doctor or a nurse that you have asthma? If yes, have you had any symptoms of asthma or taken treatment for asthma in the last 12 months? If yes, do you still get asthma?	Chapter 2.2 (Prevalence of ever-diagnosed asthma) Chapter 2.3 (Prevalence of current asthma)
In the last 12 months, have you stayed away from work/study/school for more than half a day because of your asthma? In the last 12 months, have you stayed away from work/study/school for more than half a day because of [any long term condition]?	Chapter 3.3 (Days away from work/study/school)
Do you have a written asthma action plan?	Chapter 6.1 (Written asthma action plans)
Have you taken any medication for asthma in the last 2 weeks? What are the names or brands of all the asthma medication you have used in the last 2 weeks?	Chapter 6.2 (Use of asthma medications)
I would now like to ask about any other long-term health conditions that have lasted or expected to last for 6 months or more. Do you have any of these conditions (shown prompt card)? If yes, which of these do you have? Bronchitis, Emphysema?	Chapter 8.1 (Prevalence of chronic obstructive pulmonary disease (COPD))

Table A1.6: General questions from the ABS National Health Survey relevant to this report

Question(s)	Section of this report where data presented
In general, would you say that your health is excellent, very good, good, fair or poor?	Chapter 3.3 (Self-assessed health status)
In the past 4 weeks: About how often did you feel tired out for no good reason? About how often did you feel nervous? About how often did you feel so nervous that nothing could calm you down? About how often did you feel hopeless? About how often did you feel restless or fidgety? About how often did you feel so restless that you could not sit still? About how often did you feel depressed? About how often did you feel that everything was an effort? About how often did you feel so sad that nothing could cheer you up? About how often did you feel worthless? Responses: 1. All of the time / 2. Most of the time / 3. Some of the time / 4. A little of the time / 5. None of the time	Used to calculate Kessler 10 score in Chapter 3 (Psychological distress)
Do you currently smoke? Do you smoke regularly, that is, at least once a day? Have you ever smoked regularly (that is at least once a day)?	Chapter 7.1 (People with asthma who smoke)
Does anyone else in this household smoke regularly that is at least once a day? How many other people in this household smoke regularly? Do you or does anyone in this household usually smoke inside the house?	Chapter 7.2 (Passive smoke exposure in children with asthma)

A1.6.2 National Health Survey (Indigenous)

The National Health Survey (NHS) 2004–05 included questions about whether the respondent came from an Aboriginal or Torres Strait Islander background. This sample was included in the main analyses. Indigenous data was not collected in the most recent NHS 2007–08.

The NHS 2004–05 has over-sampled in Indigenous Australian populations to enable more reliable estimates of health status in Indigenous Australians since 1995. This component of the NHS is referred to as the NATSIHS. A total sample of 10,439 Aboriginal and Torres Strait Islander Australians was included in the NATSIHS (ABS 2006). This component of the survey carried out further sampling of 4,904 Aboriginal and Torres Strait Islander Australians in remote Indigenous communities. The response rates for the NATSIHS non-remote and remote samples were 83.4% and 85.5%, respectively. The majority of questions used were the same as those administered in the 2004–05 NHS. However, some asthma-specific questions were not included in the 2004–05 NATSIHS, namely those about respiratory symptoms, type of medication used, nebuliser use or actions taken for asthma (Table A1.7). Furthermore, information about asthma action plans was only collected in non-remote areas.

The 2004–05 and 2001 ABS NATSIHS data presented in this report have also been accessed through the ABS RADL, using the expanded CURF, which is the only data and format available for the NATSIHS.

Table A1.7: Asthma-specific and other relevant questions included in the National Aboriginal and Torres Strait Islander Survey 2004–05

Data item	Non-remote	Remote
Ever diagnosed asthma	✓	✓
Current asthma	✓	✓
Whether has written asthma action plan	✓	X
Source of written asthma action plan	✓	X
Whether has standard written asthma action plan	✓	X
Whether used pharmaceutical medications for asthma in the last 2 weeks	✓	✓
Type of medication used	X	X
Use of nebuliser	X	X
Action taken for asthma	X	X

A1.6.3 State/territory CATI surveys

Most Australian states and territories now regularly conduct general health surveys within their jurisdictions. These are usually carried out using computer-assisted telephone interview (CATI) surveys that sample the population using random digit dialling. In this report, CATI survey data have been provided by New South Wales Department of Health, Queensland Health, South Australian Department of Human Services, Victorian Department of Human Services and Western Australian Department of Health. The questions used to define 'ever-diagnosed asthma' and 'current asthma' in these surveys is shown in Table A1.1.

A1.7 Longitudinal studies

A1.7.1 Longitudinal Study of Australian Children (LSAC)

This report includes results from ACAM's analysis of data from Growing Up in Australia: the Longitudinal Study of Australian Children. LSAC was initiated and is funded by the Australian Government Department of Families, Community Services and Indigenous Affairs (FaCSIA) and aims to explore a range of research questions about children's development and wellbeing. The study commenced in 2004 with a sample of approximately 10,000 children recruited from the Medicare enrolments database. With the exception of children living in some remote areas of Australia, the sample is broadly representative of Australian children in each of two selected age cohorts: children born between March 2003 and February 2004 and, hence, aged 3–19 months at baseline (infant cohort) and children born between March 1999 and February 2000 and, hence, aged 4 years and 3 months to 5 years and 7 months at baseline (kindergarten cohort). The intention of the study is to reassess the children every two years until 2010, at which time the infant cohort are aged 6–7 years and the kindergarten cohort are aged 10–11 years, using a combination of face-to-face interviews and mail-out surveys as shown in Figure A1.2. Further waves of the study have been planned beyond 2010.

	2004 Baseline (Wave 1)	2006 2 year follow-up (Wave 2)	2008 4 year follow-up (Wave 3)	2010 6 year follow-up (Wave 4)
Age of infant cohort	0–1 years	2–3 years	4–5 years	6–7 years
Age of kindergarten cohort	4–5 years	6–7 years	8–9 years	10–11 years

Note: Data for 2004, 2006 and 2008 are analysed in this report. Data for 2010 are collected but not yet available for analysis.

Figure A1.2: Timeline of the Longitudinal Study of Australian Children, indicating face-to-face interviews and mail-out surveys and the age of the cohorts at these times

The primary study informant is the person, such as the child's parent or main care giver, who knows the most about the child, their birth, history and current routines (FaHCSIA: Wake et al. 2008). Typically this was the child's biological mother (Sanson et al. 2002). In addition, the LSAC cohorts have been linked to the PBS and MBS databases, where consent was given for this linkage (approximately 93% of parents gave permission). This will facilitate the acquisition of data on the child's use of medicines and medical care during the course of the study.

Definitions

Current asthma is defined as a positive response to the question 'Has a doctor ever told you that [child] has asthma?' from Waves 1 to 3, and a positive response to 'In the last 12 months, has [child] had an illness with wheezing in the chest which lasted for a week or more?' and/or 'In the last 12 months has [child] taken any medication for asthma?'

Incidence is defined as the number of new cases (of a disease, condition or event) occurring in a population during a given period.

Incidence rates are calculated as the number of *new* cases in a period of time divided by the total person-years at risk during that period.

In this report, incidence rates have been calculated for:

- the incidence of wheeze or asthma by the age of 4–5 years among the infant cohort
- the incidence of asthma between ages 6 and 8 years among the child cohort (see Box A1.7).

Box A1.7 Cumulative incidence definitions in the Longitudinal Study of Australian Children (LSAC)

Infant cohort at age 4–5 years

Ever asthma

Yes to the question 'Has a doctor ever told you that [child] has asthma?' at ages 2–3 years (2-year follow-up/Wave 2) or 4–5 years (4-year follow-up/Wave 3).

Illness with wheezing

Yes to the question 'In the last 12 months, has [child] had an illness with wheezing in the chest which lasted for a week or more?' at ages 0–1 year (baseline/Wave 1) or 2–3 years (2-year follow-up/Wave 2) or 4–5 years (4-year follow-up/Wave3).

Ever asthma or illness with wheezing

Yes to the questions 'In the last 12 months, has [child] had an illness with wheezing in the chest which lasted for a week or more?' at ages 0–1 year (baseline/Wave 1) or 2–3 years (2-year follow-up/Wave 2) or 4–5 years (4-year follow-up/Wave3) or 'Has a doctor ever told you that [child] has asthma?' at age 2–3 years (2-year follow-up/Wave 2) or 4–5 years (4-year follow-up/Wave3).

Kindergarten cohort at age 8–9 years

Ever asthma

'Yes' to the question 'Has a doctor ever told you that [child] has asthma?' at ages 4–5 years (baseline/Wave 1) or 6–7 years (2-year follow-up/Wave 2) or 8–9 years (4-year follow-up/Wave3).

Illness with wheezing

Yes to the question 'In the last 12 months, has [child] had an illness with wheezing in the chest which lasted for a week or more?' at ages 4–5 years (baseline/Wave 1) or 6–7 years (2-year follow-up/Wave 2) or 8–9 years (4-year follow-up/Wave3).

Ever asthma or illness with wheezing

Yes to the questions 'In the last 12 months, has [child] had an illness with wheezing in the chest which lasted for a week or more?' or 'Has a doctor ever told you that [child] has asthma?' at ages 4–5 years (baseline/Wave 1) or 6–7 years (2-year follow-up/Wave 2) or 8–9 years (4-year follow-up/Wave3).

Study data

At baseline of the LSAC, 5,107 infants and 4,983 4–5 year old children were recruited, representing 57% and 50%, respectively, of those approached to participate (Table A1.8). The main reasons for non-participation at baseline were refusals, or non-contact due to PO Box or families having moved. Children with a name matching that of a child that had died were removed from the sample. A design weight was calculated for each child selected in the survey, to adjust for initial non-response (Soloff et al. 2006). Ninety percent of both cohorts participated in the 2-year follow-up assessment and almost 97% participated in the 4-year follow-up.

Table A1.8: Sample sizes and response rates by cohort and wave

	Infant cohort			Kindergarten cohort		
	Wave 1 (baseline) (0–1 years)	Wave 2 (follow-up) (2–3 years)	Wave 3 (follow-up) (4–5 years)	Wave 1 (baseline) (4–5 years)	Wave 2 (follow-up) (6–7 years)	Wave 3 (follow-up) (8–9 years)
Number sent a letter of invitation	8,921	..	..	9,893	..	..
Number recruited	5,107	4,606	4,386	4,983	4,464	4,331
Response rate	57%	90%	95%	50%	90%	97%

.. = Not applicable.

Note: Response rates for wave 3 (follow-up) are based on the number of participants retained from wave 2 and response rates for wave 2 are based on those from wave 1 (baseline).

Representativeness of the data

The LSAC sample is broadly representative of the Australian population (FaHCSIA 2008). However, there are aspects of the LSAC sample design that have introduced bias into the sample. These include a selection design based on geographical representation and voluntary participation.

The Medicare database was used as the sampling frame for LSAC to ensure that the sample chosen was representative of infants and 4–5 year old children in Australia. In the first stage of the design postcodes were selected for inclusion. Some remote postcodes were excluded from the sample due to the small number of children residing in these remote areas and the excessive costs that would have been associated with data collection (Soloff et al. 2005). As a consequence, the sample frame excludes 40% of children living in remote areas (FaHCSIA 2008; Hunter 2008). Furthermore, the study design explicitly excluded Indigenous communities in remote areas. The under-representation of children, especially Indigenous children, living in remote areas significantly impedes our analysis of associations between these factors and asthma.

The Health Insurance Commission (HIC) invited selected families to participate in the study by letter. Families could opt out of the study by either phoning a 1800 number or returning a reply paid form (Soloff et al. 2006). Parents or carers of 31% of infants and 35% of 4–5 year old children declined to participate. This non-participation rate might potentially be a source of selection bias. In fact, mothers who had not completed Year 12 at school and those who spoke a language other than English were more likely refuse to participate in LSAC (Soloff et al. 2006). Non-response was also more common for single-parent families, Indigenous children, families that spoke a language other than English at home, the child's father not having completed Year 12 and the child not having any siblings (FaHCSIA 2008; Soloff et al. 2006). The effect of this potential selection bias due to non-response was minimised by the use of a data-weighting scheme designed to adjust for differences between the sociodemographic structure of the LSAC sample and that of the Australian population.

In summary, the results presented in this report are broadly representative of Australian infants and children between the ages of 4 and 9 years, except for children living in very remote areas.

A1.7.2 Longitudinal Study of Indigenous Children (LSIC)

Some of the data on Indigenous children presented in this report was from the first year of data collection of Footprints in Time: the Longitudinal Study of Indigenous Children. Footprints in Time is a study of Aboriginal and Torres Strait Islander babies aged between 6 and 18 months, and children aged 3½ to 4½ years, in different parts of Australia. The study started collecting data in April 2008. Participants in this study will be visited each year to find out how they are going and what is happening in their lives.

A non-representative sampling design was implemented from which eligible families were approached and voluntary consent obtained. In the first year of Footprints in Time, the parents and carers of 1,687 Aboriginal and Torres Strait Islander children were interviewed between April 2008 and February 2009 in eleven sites around Australia. Table A1.9 shows the timeline of the study.

Table A1.9: Timeline of the Longitudinal Study of Indigenous Children

	2008	2009	2010	2011	2012
Wave 1	Data collection: April–early Feb 2009	Feedback to communities: Sept–Dec	Data release: Feb		
Baby=1, Child=4 [(a)]		Key summary report release: Oct			
Wave 2	Content development: Mar–April	Data collection: March–Dec	Feedback to communities: Sept–Dec	Key summary report and data release: April	
Baby=2 Child=5	Pilot: Sept–Oct				
Wave 3		Content development: Mar–April	Data collection: March–Nov	Feedback to communities: Sept–Dec	
Baby=3 Child=6		Pilot: Sept–Oct		Key summary report and data release: Oct	
Wave 4			Content development: Mar–April	Data collection: March–Nov	Feedback to communities: Sept–Dec
Baby=4 Child=7			Pilot: Sept–Oct		Key summary report and data release: Oct

(a) The ages are the midpoint of the desired sample for each wave.

After the study sites were selected and initial consultation with communities indicated support for the study, Medicare and Centrelink records were used to create lists of children in the target age ranges based on site postcodes. Although there is considerable overlap in the Medicare and Centrelink records, the evaluation of the pilot study by the Australian Bureau of Statistics (ABS) indicated that Medicare records improved coverage considerably. Children were also recruited through word-of-mouth, both through local knowledge provided by interviewers and through recommendations made by other study families.

The reference population was Aboriginal and Torres Strait Islander children living in Australia and born between December 2003 and November 2004 (Child cohort), and between December 2006 and November 2007 (Baby cohort).

Prevalence of asthma as a health condition was determined from the question 'Has (child's name) ever had…asthma?'

A1.8 Medicare Benefits Schedule (MBS) statistics

Medicare Australia provides statistics on the claims submitted to and paid by the Medicare Benefits Schedule (MBS). These include items claimed by general practitioners, doctors and specialists in the community.

A1.8.1 Asthma Cycle of Care (formerly the Asthma 3+ Visit Plan) Practice Incentive Program

Data from Medicare Australia were obtained for the Practice Incentives Program (PIP) Asthma Cycle of Care and the Asthma 3+ Visit Plan. Online interactive data reports were accessed at: <www.medicareaustralia.gov.au/statistics/mbs_item.shtml> and collated by time period. On 1 November 2006, the Asthma Cycle of Care Practice Incentive Program payment was introduced to replace the Asthma 3+ Visit Plan, which had been in operation since November 2001. The initiatives, both funded by the Australian Government, were introduced to recognise the key role general practice plays in the monitoring and management of asthma and encourage a structured approach to diagnosis, assessment, and management of patients with moderate or severe asthma in general practice (DoHA 2002). The Practice Incentives Program item numbers that were analysed for this report were 2546, 2547, 2552, 2553, 2558, 2559, 2664, 2666, 2668, 2673, 2675 & 2677. These items can only be claimed when the requirements of the Asthma Cycle of Care have been met for an individual patient.

More detailed data on the Asthma Cycle of Care was obtained directly from the Medicare Financing and Analysis Branch/Medical Benefits Division, Australian Government Department of Health and Ageing. In particular, this allowed the analysis of claims by socioeconomic status and remoteness of residence.

A1.9 Medication data

A1.9.1 IMS Health pharmaceutical data

Data on sales of pharmaceutical products into the Australian market are collected and provided by IMS Health Australia. The value of these data is that they reflect supply (and, hence, purchases) of specific medications. As many of these medications are sold without prescription or are below the PBS subsidy threshold, equivalent data are not available through the PBS.

We have calculated the annual aggregate number of packs (sale units) distributed each year for each product relevant to the treatment of asthma for the period January 1996 to December 2009. Parenteral forms were excluded. Data reflect sales from major manufacturers and wholesalers operating in Australia. Usage, measured in units of defined daily doses (DDDs)/1,000 persons/day were calculated according to methods presented in Section A1.8.3.

Limitations of IMS data

The nature of the IMS data is that they contain no information on the characteristics of the purchasers or consumers. As most of the drugs used by people with asthma are also commonly used by people with COPD, it is not possible to directly ascribe the trends and differentials observed in these data to the population with asthma. Furthermore, socioeconomic and geographic trends and differentials in the utilisations of drugs cannot be assessed using these data.

A1.9.2 Pharmaceutical Benefits Scheme and Repatriation Pharmaceutical Benefits Scheme data

Since early 2002, prescriptions recorded in the Pharmaceutical Benefit Scheme (PBS) database have included the patients' Medicare numbers. Use of the Medicare number has created the ability to anonymously identify prescriptions for the same individuals within the PBS data and also to link information on age, sex and home postcode. This is done using an encrypted Medicare patient identification number (PIN) so that patient confidentiality is protected.

ACAM has obtained these data from the Australian Government Department of Health and Ageing for people who were prescribed asthma medications during the period July 2002 to December 2009. In this report ACAM has used these newly available PBS data to investigate the patterns of use of asthma medication by Australians.

These data were then used to calculate the DDDs/1,000 persons/day for each PBS item using the methods described in Section A1.7.3.

Limitations of PBS and RPBS data

Most respiratory medications are subsidised under the PBS and the RPBS. However, some 'reliever' medications are frequently purchased without prescription (over-the-counter) and, when purchased on prescription, cost less than the copayment for general patients. These drugs do attract a subsidy when purchased on prescription by health care cardholders or pensioners. Leukotriene receptor antagonists only attract a PBS/RPBS subsidy when prescribed for children. Hence, for some medications the PBS/RPBS data only record purchase by a section of the Australian population and substantially underestimate total usage.

The PBS does not collect any information on the underlying disease or the reasons for prescribing. Thus, there is no way of identifying whether a patient using these medications has asthma, COPD or an acute respiratory infection.

The patient copayment increases yearly. Prescriptions that were dispensed for some medications that are below the threshold do not get recorded in the PBS database. The following table (Table A1.10) shows the yearly status (from 2006–2009) of some inhaled corticosteroids and long-acting beta agonists medications, that is, if they were above or below the copayment threshold, and whether or not they were included in the PBS schedule in a particular year.

Table A1.10: Inhaled corticosteroids and long-acting beta-agonists items in the PBS (2006–2009)

Medication (ATC code)	PBS item code	Proprietary name	2006	2007	2008	2009
Inhaled corticosteroids						
Beclomethasone Dipropionate (R03BA01)	8406K	Qvar 50 pMDI	<	<	<	<
	8407L	Qvar 100 pMDI	✓	✓	✓	✓
	8408M	Qvar 50 Autohaler	<	<	<	<
	8409N	Qvar 100 Autohaler	✓	✓	✓	✓
Budesonide (R03BA02)	2065Q	Pulmicort 0.5 Respules	✓	✓	✓	✓
	2066R	Pulmicort 1.0 Respules	✓	✓	✓	✓
	2070Y	Pulmicort 100 Turbuhaler	<	<	<	<
	2071B	Pulmicort 200 Turbuhaler	✓	<	✓	<
	2072C	Pulmicort 400 Turbuhaler	✓	✓	✓	✓
Fluticasone (R03BA05)	8147T	Flixotide jnr 100 Accuhaler	<	<	<	<
	8148W	Flixotide 250 Accuhaler	<	<	<	<
	8149X	Flixotide 500 Accuhaler	✓	✓	✓	✓
	8345F	Flixotide 125 pMDI	<	<	<	<
	8346G	Flixotide 250 pMDI	✓	✓	✓	✓
	8516F	Flixotide jnr 50 pMDI	<	<	<	<
	8853Y	Alvesco 80 pMDI	<	<	<	<
	8854B	Alvesco 160 pMDI	✓	✓	✓	✓
Long-acting beta agonists						
Salmeterol (R03AC12)	3027H	Serevent 25 pMDI	✓	✓	-	-
	8141L	Serevent 50 Accuhaler	✓	✓	✓	✓
Eformoterol (R03AC13)	8136F	Foradile 12 Handyhaler	✓	✓	✓	✓
	8239P	Oxis 6 Turbuhaler	<	<	<	<
	8240Q	Oxis 12 Turbuhaler	✓	✓	✓	✓
Combination inhaled corticosteroid/long-acting beta agonist						
Fluticasone propionate/ Salmeterol (R03AK06)	8517G	Seretide 50/25 MDI	✓	✓	✓	✓
	8518H	Seretide 125/25 MDI	✓	✓	✓	✓
	8519J	Seretide 250/25 MDI	✓	✓	✓	✓
	8430Q	Seretide Accuhaler 100/50	✓	✓	✓	✓
	8431R	Seretide Accuhaler 250/50	✓	✓	✓	✓
	8432T	Seretide Accuhaler 500/50	✓	✓	✓	✓
Budesonide/Eformoterol (R03AK07)	8796Y	Symbicort Turbuhaler 100/6	✓	✓	✓	✓
	8625Y	Symbicort Turbuhaler 200/6	✓	✓	✓	✓
	8750M	Symbicort Turbuhaler 400/12	✓	✓	✓	✓
Patient copayment for the year		**No concession**	**$29.50**	**$30.70**	**$31.30**	**$32.90**
		Concession card	**$4.70**	**$4.90**	**$5.00**	**$5.30**

- not included in the PBS schedule
< dispensed price is less than the copayment for those without a concession card. Therefore, only prescriptions purchased with a concession card are captured in the database.
✓ dispensed price is greater than or equal to the copayment for those without a concession card. Therefore all prescriptions, regardless of concession card possession, are captured in the database.

PBS = Pharmaceutical Benefits Scheme.
ATC = Anatomical Therapeutic Chemical classification system.
pMDI = pressurised metered dose inhaler.
Source: DoHA 2009.

A1.9.3 Calculation of defined daily dose per 1,000 population per day

Medication usage, measured as defined daily doses per 1,000 people per day (DDD/1,000/day), is used in this report to compare respiratory drug sales and reimbursed prescriptions dispensed over time and across drug groups where information about actual drug consumption is not available. The information in this report is based on unpublished data prepared and supplied by IMS Health Australia and published data from the PBS and RPBS item reports calculated at the HIC website.

For each medication, the relevant defined daily dose (DDD) was obtained from the website of the WHO Collaborating Centre for Drug Statistics Methodology (<www.whocc.no/atcddd>) (see Table A1.11). All PBS items are classified by the ATC classification system, and can be directly linked to DDD units using the ATC Index. The DDD is defined as 'the assumed average maintenance dose per day for a drug used for its main indication in adults'. The DDD is used internationally as a unit of measurement for drug utilisation studies. Each medication pack or sale unit (for IMS Health data) or maximum quantity dispensed (for PBS or RPBS items) is converted to a number of DDDs per unit or item.

For each of these items the DDD/1,000 persons/day (Department of Health and Ageing 2004) is then calculated using the following formula:

$$\text{DDD/1,000 persons/day} = \frac{N \times M \times Q \times 1{,}000}{\text{DDD} \times P \times D}$$

where:

N = total number of subsidised prescriptions dispensed per year (HIC data) or total number of items sold per year (IMS Health data)

M = mass of each dosage unit (e.g. mg per tablet or mcg per inhaler dose)

Q = total number of dosage units dispensed per prescription or sold unit

P = mid-year Australian population (ABS mid-year population estimates) for year of data collection

D = number of days in the year

The DDD/1,000 persons/day for individual medications are then summed across the members of each class of medications to estimate the total number of DDD/1,000 persons/day for each class. For example, among inhaled corticosteroids, one DDD unit of budesonide is 800 µg, one DDD unit of beclomethasone is 800 µg and one DDD unit of fluticasone is 600 µg. Therefore, 800 µg of budesonide plus 600 µg of fluticasone is equivalent to 2 DDDs of inhaled corticosteroid. Combined medications contribute DDDs to both classes of medications they contain. DDDs do not necessarily correspond to current recommendations in guidelines, but provide a way of comparing dispensing rates over time. It is not possible to identify the condition for which a medication was prescribed or used from the above data sources. While the DDD for salbutamol (800 µg) is consistent with current treatment guidelines for COPD, as-needed rather than regular use of salbutamol has been recommended for patients with asthma for the past 20 years, and only patients with very poorly-controlled asthma would be expected to receive 1 DDD of salbutamol.

Table A1.11: Classification of respiratory medications

Category	Medications included	Formulation	Daily Defined Dose (DDDs)
Short-acting beta-agonists	Salbutamol	Inhalation aerosol	0.8 mg
		Inhalation powder	0.8 mg
		Inhalation solution	10 mg
	Terbutaline	Inhalation aerosol	2 mg
		Inhalation powder	2 mg
		Inhalation solution	20 mg
Long-acting beta-agonists	Salmeterol	Inhalation aerosol	0.1 mg
		Inhalation powder	0.1 mg
	(e)Formoterol	Inhalation powder	24 mcg
Short-acting anti-cholinergics	Ipratropium bromide	Inhalation aerosol	0.1 2mg
		Inhalation solution	0.3 mg
Long-acting anti-cholinergics	Tiotropium bromide	Inhalation powder	18 mcg
Cromones	Sodium cromoglycate	Inhalation aerosol	40 mg
		Inhalation powder	80 mg
		Inhalation solution	80 mg
	Nedocromil sodium	Inhalation aerosol	8 mg
Inhaled corticosteroids	Beclomethasone dipropionate	Inhalation aerosol	0.8 mg
	Budesonide	Inhalation powder	0.8 mg
		Inhalation solution	1.5 mg
	Fluticasone propionate	Inhalation aerosol	0.6 mg
		Inhalation powder	0.6 mg
		Inhalation solution	1.5 mg
	Ciclesonide	Inhalation aerosol	0.16 mg
Xanthines	Theophylline	Oral	0.4 g
	Choline theophyllinate	Oral	0.6 g
Leukotriene receptor antagonists	Montelukast	Oral	10 mg
	Zafirlukast	Oral	40 mg
Combination inhaled corticosteroid/ long-acting b2-agonists	Fluticasone/Salmeterol	Inhalation aerosol	0.6mg fluticasone/ 0.1mg salmeterol
		Inhalation powder	0.6mg fluticasone/ 0.1mg salmeterol
	Budesonide/eformoterol	Inhalation powder	0.8mg budesonide/ 24mcg (e)formoterol

DDD= defined daily dose.
Source: WHO Collaborating Centre for Drug Statistics Methodology 2009.

A1.10 Hospital data

The National Hospital Morbidity Database (NHMD) contains data on episodes of care for patients admitted to hospital, including demographic, procedural and length of stay information. Public and private hospitals provide data for hospital separations to state and territory health authorities that are then provided to AIHW for inclusion in the NHMD. The data are organised in financial-year periods. Whilst the dataset contains details of principal and additional diagnoses, in this report data relate to the principal diagnosis only, unless otherwise stated.

When analysing hospital data by state/territory, we have used the state of the establishment (hospital) rather than the state of usual residence.

A1.10.1 Limitations of the National Hospital Morbidity Database

There are a number of issues affecting the reliability and validity of hospitalisations attributed to asthma. In particular, the reliability of coding of hospital separations will be influenced by variation in the propensity of attending medical practitioners to diagnose and label patients as having asthma. There was no recent validation of the coding of diagnosis of asthma during hospital admissions in Australia. International evidence suggests that diagnostic coding of asthma is reasonably accurate in children and younger adults (Krueger et al. 2001; Osborne et al. 1992), but this accuracy decreases with age (Osborne et al. 1992).

A1.10.2 Hospital diagnosis codes

Hospital diagnosis is classified according to the principal diagnosis and was coded using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM), for separations from 1998–99 onwards. A principal diagnosis is the diagnosis chiefly responsible for the episode of hospital care.

A1.10.3 Definitions of comorbid conditions

To examine comorbidities among people hospitalised with a principal diagnosis of asthma (J45, J46), we applied the following definitions.

Respiratory comorbidities were classified as an additional diagnosis of:

- Acute upper respiratory infections (J00–J06)
- Influenza or pneumonia (J09–J18)
- Other acute lower respiratory infections (J20–J22)
- Non-infectious upper respiratory conditions (J30–J39)
- COPD or bronchiectasis (J40–J44, J47).

Other comorbidities were classified as an additional diagnosis of:

- Diabetes Mellitus (E10–E14)
- Heart, stroke or vascular disease (I20–I25, I50, I60–I69, I70–I79)
- Arthritis or osteoporosis (M00–M25, M80–M82)
- Mental or behavioural disorders (F30–F39, F40–F48, F90–F98)
- Any other additional diagnosis except excluded diagnoses (see below).

We excluded the following conditions as additional diagnoses:

- Pregnancy, childbirth and the puerperium (O00–O99)
- Certain conditions originating in the perinatal period (P00–P96)
- Symptoms ,signs and abnormal clinical and laboratory findings, not elsewhere classified (R00–R99)
- Injury, poisoning and certain other consequences of external causes (S00–T98)
- External causes of morbidity and mortality (V01–Y98)
- Factors influencing health statistics and contact with health services (Z00–Z99)
- Codes for special purposes (U00–U99).

In the National Hospital Morbidity Database, conditions are only recorded as additional diagnoses if they impact on the care given to patients.

A1.10.4 Mechanical ventilation

The National Hospital Morbidity Database includes information relating to specific aspects of care, such as the use of mechanical ventilation. Invasive mechanical ventilation is a medical intervention used in situations where patients become unable to breathe by themselves. It involves the use of a positive pressure ventilator to maintain respiration via an endotracheal tube. This intervention is generally administered in hospital intensive care units. The National Hospital Morbidity Database has collected data on the use of invasive mechanical ventilation since 1993–94. However, due to a change in the coding standards for invasive mechanical ventilation in 2000–01, only data for the period 2000–01 onwards have been analysed in this report.

The data presented in the Focus chapter on COPD also include episodes of non-invasive ventilation. A limitation of the data on non-invasive ventilation is that available coding cannot distinguish short-term (≤24 hours), mid-term (>24 hours–<96 hours) or long-term (≥96 hours) ventilatory support.

The procedure codes based on ICD-10-AM that have been included in these analyses are:

- Invasive ventilation:
  - 13882-00—Management of continuous ventilatory support ≤24 hours
  - 13882-01—Management of continuous ventilatory support >24 hours–<96 hours
  - 13882-02—Management of continuous ventilatory support ≥96 hours
  - 13857-00—Continuous ventilatory support, initiation outside of ICU
  - 13879-00—Continuous ventilatory support, initiation in ICU.
- Non-invasive ventilation:
  - 92038-00—Continuous positive airway pressure (CPAP)
  - 92039-00—Bi-level positive airway pressure (BiPAP)
  - 92040-00—Intermittent positive pressure breathing (IPPB).

It should be noted that the data analysed for this section of the report are based on episodes and not individuals and, hence, may include multiple episodes for the same person.

A1.11 Mortality data

Registration of deaths is the responsibility of individual state and territory Registrars of Births, Deaths and Marriages. Information on the cause of death is provided to the Registrar by a medical practitioner certifying a death, or by the Coroner to whom a death is reported. This information is, in turn, supplied to the Australian Bureau of Statistics (ABS) for coding cause of death and compilation into aggregated

statistics. The AIHW National Mortality Database comprises the coded cause of death data sourced from the ABS. As the registration of deaths is a legal requirement in Australia, this dataset is considered nearly complete, although there is no formal validation of completeness. The ABS advises that Aboriginal and Torres Strait Islander Australians are probably under-enumerated in some states/territories.

Although data on multiple causes of death are available, death data throughout this report, relate only to the underlying cause of death reported on each certificate. However, the section on comorbid conditions utilises data on associated causes of death, which are other conditions listed on the death certificate that are not underlying causes of death.

A1.11.1 Limitations in mortality data

There are a number of issues affecting the reliability and validity of certification of deaths. The reliability of death certification can be influenced by variation in the propensity of attending medical practitioners to diagnose and label patients as dying from asthma. Australian and international validation studies of asthma deaths coded on death certificates reveal that adult deaths from asthma can be under-enumerated (Guite & Burney 1996; Smyth et al. 1996; Hunt et al. 1993) or over-enumerated (Sidenius et al. 2000; Jones et al. 1999a; Sears et al. 1986), depending on the awareness of asthma in a particular country. It is generally considered that asthma diagnosis is fairly unambiguous in people aged less than 45 years and data are, therefore, more reliable in these ages. However, under-enumeration of deaths for asthma has also been demonstrated among children and young adults (Jorgensen et al. 2000). Generally, in older people the attribution of death to asthma, or alternatively to one of a range of illnesses with overlapping clinical features, is problematic and, therefore, the death data for asthma are less reliable in older people (Sidenius et al. 2000; Jones et al. 1999a; Smyth et al. 1996). Changes in the classification scheme, or code, have a quantifiable impact on time trends in death data. However, the extent to which changes, over time, in diagnostic fashion affect death data is less well studied.

A1.11.2 Cause of death codes

The classification of asthma as the underlying cause of death was based on the ICD-5 for deaths from 1940 to 1949, ICD-6 for death from 1950 to 1957, ICD-7 for deaths from 1958 to 1967, ICD-8 for deaths from 1968 to 1978, ICD-9 for deaths from 1979 to 1996, and on ICD-10 for deaths from 1997 onwards (see Table A1.12 for ICD-10 codes and description).

Comparability factors were applied to data classified under ICD-5, ICD-6, ICD-7, ICD-8, and ICD-9 to make the data comparable to that coded using ICD-10 (see Section A1.11.3). The classification of chronic obstructive pulmonary disease as the underlying cause of death was based on the ICD-10 for deaths from 1997 to 2007 (Table A1.13).

Table A1.12: Disease codes for asthma

Classification	Codes used	Description
ICD-10	J45.0	Predominantly allergic asthma
Codes J45, J46	J45.1	Non-allergic asthma
	J45.8	Mixed asthma
	J45.9	Asthma, unspecified
	J46	Status asthmaticus

Source: WHO 2007.

Table A1.13: Disease codes for COPD

Classification	Codes used	Description
ICD-10	J40	Bronchitis, not specified as acute or chronic
Codes J40-J44	J41.0	Simple chronic bronchitis
	J41.1	Mucopurulent chronic bronchitis
	J41.8	Mixed simple and mucopurulent chronic bronchitis
	J42	Unspecified chronic bronchitis
	J43.0	MacLeod's syndrome
	J43.1	Panlobular emphysema
	J43.2	Centrilobular emphysema
	J43.8	Other emphysema
	J43.9	Emphysema, unspecified
	J44.0	Chronic obstructive pulmonary disease with acute lower respiratory infection
	J44.1	Chronic obstructive pulmonary disease with acute exacerbation, unspecified
	J44.8	Other specified chronic obstructive pulmonary disease
	J44.9	Chronic obstructive pulmonary disease, unspecified

Source: WHO 2007.

A1.11.3 Comparability factors for mortality data

Table A1.14 shows the age-group specific comparability factors calculated for converting number of asthma deaths from ICD-5, ICD-6, ICD-7, ICD-8, and ICD-9 to ICD-10. The method for calculating these comparability factors was described previously (ACAM 2003, Section A1.3).

Table A1.14: Comparability factors for asthma mortality data

Age group	Conversion factor
<35 years	1.0 (i.e. no conversion)
35–64 years	0.84
65 years and over	0.68

A1.11.4 Definitions of comorbid conditions

To examine comorbidities among people whose underlying cause of death was asthma (J45, J46), the following definitions were applied.

Respiratory comorbidities were classified as an associated cause of death of:

- Acute upper respiratory infections (J00–J06)
- Influenza or pneumonia (J09–J18)
- Other acute lower respiratory infections (J20–J22)
- Non-infectious upper respiratory conditions (J30–J39)
- COPD or bronchiectasis (J40–J44, J47).

Other comorbidities were classified as an associated cause of death of:

- Diabetes Mellitus (E10–E14)
- Heart, stroke or vascular disease (I20–I25, I50, I60–I69, I70–I79)
- Arthritis or osteoporosis (M00–M25, M80–M82)
- Mental or behavioural disorders (F30–F39, F40–F48, F90–F98)
- Malignant neoplasms (i.e. cancer) (C00–C97).

In the section where we have investigated asthma as an associated cause of death when other conditions were listed as the underlying cause of death, the analyses undertaken for this report were confined to seven main causes of death—cancer (C00–C97); diabetes mellitus (E10–E14); mental and behavioural disorders (F30–F39, F40–F48, F90–F98); heart, stroke and vascular disease (I20–I25, I60–I69, I50, I70–I79); influenza, pneumonia and other acute respiratory tract infections (J00–J06, J09–J22); COPD and bronchiectasis (J40–J44, J47); and arthritis and osteoporosis (M00–M25, M80–M82).

A1.12 Population data

This report uses population data sourced from the AIHW, which, in turn, are sourced from the ABS Demography section and are updated as revised or new estimates become available. All population estimates currently produced by the ABS are referred to as estimated resident populations.

Estimated resident populations are based on the 5-yearly Census of Population and Housing, to which three significant adjustments are made:

- All respondents in the census are placed in their state/territory, SLA, and postcode of usual residence. Overseas visitors counted in the census are *excluded*.
- An adjustment is made for people missed in the census (approximately 2%).
- Australians temporarily overseas on census night (these are not counted in the census) are added to the usual residence census count adjusted for undercount.

Estimated resident populations are then updated each year from the census date using indicators of population change such as births, deaths and net migration. More information is available from <www.abs.gov.au>.

A1.13 Population groups

A1.13.1 Aboriginal and Torres Strait Islander Australians

'Indigenous Australians' refers to people who identify themselves as being of Aboriginal or Torres Strait Islander origin. It is important to identify health disadvantages, with respect to asthma, among Aboriginal and Torres Strait Islander Australians so that those issues can be addressed. It is also important to ensure an acceptable level of reliability and validity of the data that are used for this purpose. Data for Indigenous Australians are currently available via several collections, including the 5-yearly Census, other surveys conducted by the ABS, AIHW, state health departments and other agencies, and administrative datasets such as hospital statistics and mortality collections. However, data quality issues around the identification and enumeration of Indigenous Australians exist across the majority of these collections.

There have been substantial increases in the Indigenous Australian population between census collections that cannot be fully explained by natural increase (Ross 1999). The ABS has introduced an experimental methodology that attempts to account for the changing levels of 'unexplained growth' in estimating and projecting the Indigenous population. Using this methodology, ABS has produced consistent series of estimates of the Indigenous population from 1991 to 2009. For further information refer to *Experimental estimates and projections: Aboriginal and Torres Strait Islander Australians* (ABS cat. no. 3238.0).

Indigenous identification and the quality of Indigenous data have been improving over time in a number of data sets through efforts at all levels. Despite this, deficiencies in health data for Indigenous Australians continue to exist in the National Mortality Collection and the National Hospital Morbidity Dataset (NHMD). In 2000–01, all states and territories adopted a standard definition for use in the NHMD. However, currently for mortality data, only Queensland, Northern Territory, Western Australia and South Australia have relatively complete identification of Indigenous deaths (ABS 2005). For hospital morbidity data, the information provided for Indigenous status from the Northern Territory (public hospitals only), South Australia, Queensland and Western Australia is considered acceptable from 1998–99 onwards; while, from 2004–05, data from New South Wales and Victoria are also considered acceptable (AIHW 2003).

Since 1995, the National Health Survey has over-sampled in Indigenous Australian populations to enable more reliable estimates of their health status. The validity and reliability of other general population surveys (including the state CATI surveys) is less certain. Finally, a voluntary Indigenous identifier was included recently on Medicare forms. This should help improve data about access to health services by Indigenous Australians.

As there is not the same quantity or quality of information about Aboriginal and Torres Strait Islander health as there is for non-Indigenous Australians, it has not been possible in many cases to provide the same level of information on the prevalence of asthma in Australia's Indigenous population or how this is being managed. However, the information about people living in remote regions and people who live in areas of lower socioeconomic status may also be applicable to a large number of Indigenous Australians.

In this report, it was possible to make comparisons between Indigenous and non-Indigenous Australians based on data from the Australian Bureau of Statistics' 2004–05 National Aboriginal and Torres Strait Islander Health Survey. However, for mortality and hospital morbidity data it was only possible to make comparisons between Indigenous and 'Other Australians', where 'Other Australians' included both non-Indigenous people and people for whom Indigenous status was not stated, unknown or inadequately described.

A1.13.2 Country of birth

Factors associated with cultural background may have an impact on health status. People whose first language is not English have been identified as population groups who are likely to experience disadvantage when seeking access to health and related services (ABS 1999). As such, it is necessary to describe the health status of people from different backgrounds. The term 'non-English-speaking background' was used throughout this publication to describe people who have re-settled in Australia but who come from countries where English is not the primary language spoken.

The Department of Immigration and Multicultural and Indigenous Affairs (DIMIA) has developed a classification from 1996 census data, which places every country into one of four groups based on the relative English proficiency of recent arrivals to Australia (DIMIA 2001).

English-speaking background is defined as those people born in Australia, New Zealand, the United Kingdom, Ireland, the United States of America, Canada, Zimbabwe or South Africa, which corresponds to the DIMIA English proficiency countries in group 1. These are the main countries from which Australia receives overseas settlers who are likely to speak English. Non-English-speaking background is defined as those people whose country of birth was somewhere other than one of these seven countries. This corresponds to the DIMIA English proficiency countries in the remaining groups 2–4.

A1.13.3 Socioeconomic status

Findings from all over the globe continue to provide evidence that people living in areas of lower socioeconomic status experience poorer health outcomes compared with people living in areas of higher socioeconomic status. The relationship is consistent for a range of chronic diseases, the list of which includes asthma. Socioeconomic status encompasses a range of contributing factors including education, income and occupation as well as race and/or ethnicity.

The SEIFA Index of Relative Socioeconomic Disadvantage (IRSD) is one of five indexes developed by the ABS to measure socioeconomic characteristics associated with geographic locations (ABS 1998), based on information from the Australian census. Each index summarises information relating to a variety of social and economic characteristics associated with families and households, personal education qualifications and occupation.

This report uses the SEIFA index as it provides a summary score for a range of key socioeconomic variables that are related to health status, including household income and resources, education, occupation, fluency in English, and Indigenous status. The index is constructed so that relatively advantaged areas have high index values (Table A1.15).

Table A1.15: SEIFA quintiles and their corresponding IRSD* score

Quintile	IRSD* score
1st quintile (Lowest socioeconomic status)	<940.5
2nd quintile	940.5–<973.1
3rd quintile	973.1–<1,008.1
4th quintile	1,008.1–<1,064.4
5th quintile (Highest socioeconomic status)	≥1,064.4
NSW average	1,006

*IRSD=Index of Relative Socioeconomic Disadvantage.

Individual records were classified into quintiles of socioeconomic status according to the SEIFA index value associated with the statistical local area (SLA) of usual residence of the individual. Quintile 1 (SES 1) includes households with the lowest socioeconomic status and quintile 5 (SES 5) includes households with the highest socioeconomic status.

It is important to note that the index reflects the relative disadvantage of all people living in an area, not an individual. Therefore, this measure probably underestimates the true inequality in health at the individual level.

A1.13.4 Cities, regional and remote areas

Accessibility to health and education services plays an important role in the successful treatment and management of asthma. For the purposes of this report, urban, rural and remote areas have been identified using the Australian Standard Geographical Classification (ASGC) of remoteness.

ASGC categories of remoteness

The ASGC is based on the Accessibility/Remoteness Index of Australia (ARIA), which measures remoteness solely on the basis of geographical accessibility, and excludes urban/rural, socioeconomic and population size factors. This index can be applied to any location in Australia. It is based on physical geography, whereby locations are classified on the basis of the proximity (that is, the distance people must travel on a road network) to the nearest of 545 service centres, which differ in size and, hence, in the availability of education and health services. The centres with small populations generally have a limited choice of general practitioners, specialists and hospital care.

Values of remoteness for populated localities are calculated by measuring the shortest road distance between a locality and the nearest of each of five different categories of service centres. Each of the populated localities across Australia was assigned an ARIA index score to assess their remoteness from goods, services and opportunities for social interaction (see Table A1.16). For full methodology, see (ABS 2001).

Table A1.16: ABS classes of remoteness, by ASGC and their definition

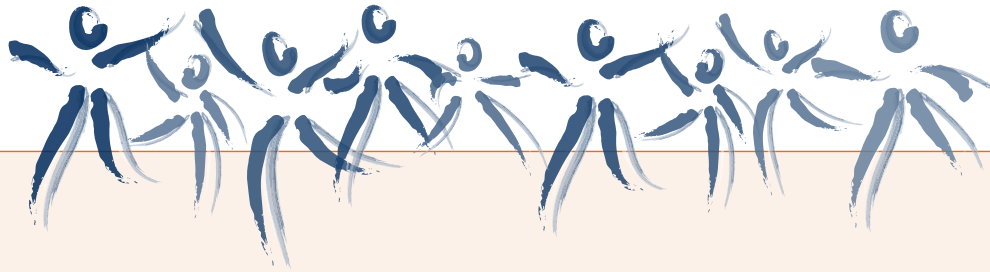
ASGC classification	ARIA index score	Definition
Major cities of Australia	0–0.2	Geographic distance imposes minimal restriction upon accessibility to the widest range of goods, services and opportunities for social interaction
Inner regional Australia	>0.2–2.4	Geographic distance imposes some restriction upon accessibility to the widest range of goods, services and opportunities for social interaction
Outer regional Australia	>2.4–5.92	Geographic distance imposes a moderate restriction upon accessibility to the widest range of goods, services and opportunities for social interaction
Remote Australia	>5.92–10.53	Geographic distance imposes a high restriction upon accessibility to the widest range of goods, services and opportunities for social interaction
Very remote Australia	>10.53–15	Locationally disadvantaged. Geographic distance imposes the highest restriction upon accessibility to the widest range of goods, services and opportunities for social interaction

This report examines data for the five ASGC/ARIA classes where these data are available. However, in some instances the three broader areas of *Major cities*, *Inner regional*, and *Outer regional* or *Remote* areas have been used where cell sizes were too small for accurate estimation in the more detailed classification. The National Health Survey (NHS) does not gather data from *Very remote* areas. *Very remote* areas represent about 1% of the total population. The *Other* areas used in this report from the NHS only covers *Outer regional* and *Remote* areas.

For data from the AIHW National Hospital Morbidity Database, AIHW mapped the supplied area of residence data for each separation to 2008 SLA codes and to remoteness area categories based on the ABS's ASGC Remoteness Structure. This was undertaken on a probabilistic basis as necessary, using ABS concordance information describing the distribution of the population by postcode, remoteness areas and SLAs.

Because of the probabilistic nature of this mapping, the SLA and remoteness area data for individual records may not be accurate; however, the overall distribution of records by geographical areas is considered useful.

Appendix 2: Statistical tables



Asthma

Prevalence

Table A2.1: Prevalence of ever having doctor-diagnosed asthma, by age group and sex, all ages, Australia, 2007–08

Sex/age (years)	Estimated number of people with ever doctor-diagnosed asthma	Estimated total people	Age-standardised per cent of people with ever doctor-diagnosed asthma	95% confidence interval
Males				
0–4	68,100	688,907	10.5	7.3–13.7
5–9	148,700	681,293	21.9	17.2–26.5
10–14	188,022	703,384	26.2	20.8–31.6
15–24	385,998	1,435,081	27.2	23.8–30.5
25–34	330,292	1,447,107	23.0	19.8–26.2
35–44	243,781	1,502,571	16.4	14.0–18.7
45–54	176,089	1,422,129	12.3	10.2–14.5
55–64	156,169	1,171,535	13.5	10.9–16.2
65–74	95,176	705,095	13.2	9.8–16.6
75 and over	53,358	504,257	10.0	7.1–12.8
All ages	**1,845,685**	**10,261,359**	**18.1**	**17.1–19.1**
Females				
0–4	60,702	650,088	9.3	6.6–12.1
5–9	103,087	625,326	16.5	12.6–20.5
10–14	135,240	693,518	19.3	15.6–23.1
15–24	351,536	1,415,584	24.6	21.5–27.7
25–34	335,314	1,429,494	23.3	20.8–25.9
35–44	322,606	1,542,851	20.9	18.5–23.4
45–54	272,457	1,462,317	18.6	16.1–21.1
55–64	199,772	1,170,831	16.9	14.0–19.8
65–74	135,414	738,492	18.5	14.9–22.1
75 and over	127,138	653,269	19.6	16.3–23.0
All ages	**2,043,267**	**10,381,770**	**19.7**	**18.7–20.6**

Notes

1. 'Ever asthma' based on a positive response to 'Have you ever been told by a doctor that you have asthma?'
2. Prevalence rates were age-standardised to the 2001 Australian population.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Table A2.2: Prevalence of current asthma, by age group and sex, all ages, Australia, 2007–08

Sex/age (years)	Estimated number of people with current asthma	Estimated total people	Age-standardised per cent of people with current asthma	95% confidence interval
Males				
0–4	64,315	688,907	9.9	6.8–13.0
5–9	105,726	681,293	15.1	11.0–19.3
10–14	81,856	703,384	11.5	7.8–15.2
15–24	158,473	1,435,081	11.0	8.7–13.4
25–34	107,767	1,447,107	7.3	5.5–9.1
35–44	123,280	1,502,571	8.4	6.7–10.1
45–54	91,263	1,422,129	6.4	4.8–8.1
55–64	79,371	1,171,535	7.0	5.1–8.8
65–74	60,224	705,095	8.5	5.5–11.5
75 and over	37,006	504,257	6.9	4.4–9.4
All ages	**909,282**	**10,261,359**	**8.9**	**8.1–9.7**
Females				
0–4	49,414	650,088	7.6	5.2–10.0
5–9	63,849	625,326	10.2	7.1–13.3
10–14	49,378	693,518	7.0	4.9–9.0
15–24	160,357	1,415,584	11.1	9.0–13.3
25–34	166,504	1,429,494	11.7	9.9–13.6
35–44	186,990	1,542,851	12.1	10.0–14.2
45–54	164,860	1,462,317	11.2	9.2–13.3
55–64	134,651	1,170,831	11.3	9.0–13.7
65–74	76,200	738,492	10.3	7.7–12.8
75 and over	87,601	653,269	13.4	10.3–16.5
All ages	**1,139,804**	**10,381,770**	**10.9**	**10.1–11.6**

Notes

1. Current asthma based on a positive response to 'Have you ever been told by a doctor that you have asthma?' and 'Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?'
2. Prevalence rates were age-standardised to the 2001 Australian population.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Mortality

Table A2.3: Deaths due to asthma, by sex, all ages, Australia, 1979–2007

	Males				Females			
Year	Deaths due to asthma	Population	Age standardised rate per 100,000	95% confidence interval	Deaths due to asthma	Population	Age standardised rate per 100,000	95% confidence interval
1979	177	7,253,762	3.21	2.69–3.77	164	7,261,967	2.60	2.20–3.03
1980	201	7,338,060	3.75	3.19–4.37	225	7,357,296	3.49	3.04–3.98
1981	213	7,448,267	3.75	3.21–4.33	213	7,474,993	3.07	2.67–3.52
1982	224	7,580,914	3.94	3.39–4.54	234	7,603,333	3.46	3.02–3.94
1983	236	7,686,346	3.96	3.43–4.53	249	7,707,126	3.52	3.08–3.98
1984	264	7,778,212	4.15	3.63–4.71	257	7,801,179	3.61	3.17–4.08
1985	295	7,882,728	5.05	4.42–5.72	337	7,905,584	4.55	4.07–5.07
1986	315	8,000,187	4.88	4.31–5.49	301	8,018,163	3.97	3.53–4.45
1987	296	8,118,255	4.53	3.99–5.11	363	8,145,619	4.72	4.24–5.23
1988	297	8,248,945	4.51	3.98–5.10	341	8,283,219	4.40	3.94–4.89
1989	334	8,387,589	5.01	4.45–5.60	402	8,426,827	5.01	4.52–5.52
1990	294	8,511,269	4.36	3.84–4.92	335	8,553,859	4.10	3.67–4.57
1991	255	8,615,409	3.73	3.25–4.24	314	8,668,627	3.72	3.31–4.16
1992	253	8,716,147	3.65	3.19–4.14	310	8,778,517	3.63	3.23–4.06
1993	250	8,797,915	3.54	3.09–4.03	336	8,869,178	3.83	3.43–4.27
1994	245	8,888,066	3.66	3.19–4.17	365	8,966,672	4.04	3.64–4.48
1995	212	8,993,604	2.86	2.47–3.29	341	9,078,154	3.68	3.30–4.09
1996	223	9,108,055	3.05	2.64–3.49	314	9,202,659	3.32	2.96–3.71
1997	207	9,203,171	2.71	2.34–3.12	292	9,314,393	2.97	2.64–3.33
1998	187	9,294,674	2.34	2.01–2.71	294	9,416,597	2.94	2.62–3.30
1999	160	9,396,548	2.02	1.71–2.37	264	9,529,307	2.58	2.28–2.92
2000	169	9,505,331	2.00	1.71–2.33	285	9,648,049	2.71	2.40–3.05
2001	175	9,630,652	2.00	1.71–2.32	247	9,782,588	2.27	1.99–2.57
2002	158	9,753,065	1.90	1.61–2.23	239	9,898,373	2.14	1.88–2.43
2003	108	9,874,412	1.23	1.00–1.49	206	10,021,023	1.76	1.53–2.02
2004	108	9,992,728	1.20	0.98–1.45	205	10,134,635	1.71	1.48–1.97
2005	108	10,128,064	1.15	0.94–1.39	210	10,266,727	1.69	1.46–1.93
2006	139	10,282,433	1.52	1.27–1.79	263	10,415,447	2.03	1.79–2.30
2007	132	10,475,527	1.34	1.12–1.59	253	10,596,925	1.89	1.66–2.14

Sources: AIHW National Mortality Database; ABS.

Table A2.4: Deaths due to asthma, by sex, people aged 5–34 years, Australia, 1979–2007

	Males				Females			
Year	Deaths due to asthma	Population	Age standardised rate per 100,000	95% confidence interval	Deaths due to asthma	Population	Age standardised rate per 100,000	95% confidence interval
1979	39	3,801,424	1.04	0.74–1.42	26	3,666,212	0.71	0.46–1.04
1980	40	3,838,662	1.04	0.75–1.42	31	3,707,242	0.84	0.57–1.19
1981	37	3,886,621	0.97	0.68–1.33	47	3,755,136	1.25	0.92–1.66
1982	39	3,913,365	0.98	0.70–1.34	40	3,780,951	1.08	0.77–1.48
1983	41	3,925,054	1.06	0.76–1.44	32	3,794,433	0.85	0.58–1.20
1984	58	3,929,234	1.45	1.10–1.88	41	3,799,641	1.08	0.77–1.46
1985	50	3,941,760	1.27	0.94–1.67	56	3,810,544	1.44	1.09–1.87
1986	62	3,963,505	1.52	1.16–1.95	55	3,829,133	1.41	1.06–1.84
1987	55	3,993,308	1.37	1.03–1.79	55	3,862,446	1.40	1.05–1.82
1988	52	4,031,302	1.27	0.95–1.67	40	3,900,786	1.01	0.72–1.38
1989	54	4,071,700	1.31	0.98–1.70	46	3,941,204	1.14	0.83–1.52
1990	44	4,102,245	1.06	0.77–1.43	47	3,971,569	1.16	0.85–1.54
1991	35	4,113,138	0.85	0.59–1.18	41	3,986,925	1.01	0.73–1.37
1992	27	4,121,361	0.66	0.43–0.95	17	3,997,413	0.43	0.25–0.69
1993	38	4,115,544	0.91	0.64–1.25	33	3,993,033	0.83	0.57–1.16
1994	26	4,115,954	0.64	0.41–0.93	37	3,993,799	0.93	0.65–1.28
1995	26	4,124,616	0.63	0.41–0.93	24	4,003,108	0.60	0.39–0.90
1996	24	4,134,908	0.58	0.37–0.86	19	4,017,879	0.47	0.28–0.73
1997	27	4,127,183	0.65	0.43–0.95	22	4,017,855	0.55	0.34–0.83
1998	26	4,120,055	0.63	0.41–0.93	32	4,014,573	0.79	0.54–1.11
1999	27	4,124,427	0.66	0.43–0.95	25	4,022,006	0.62	0.40–0.92
2000	23	4,141,012	0.56	0.35–0.84	25	4,040,411	0.61	0.40–0.90
2001	30	4,166,146	0.73	0.49–1.04	13	4,067,548	0.32	0.17–0.54
2002	16	4,200,803	0.38	0.22–0.62	17	4,092,712	0.41	0.24–0.66
2003	19	4,233,923	0.45	0.27–0.71	12	4,121,341	0.28	0.15–0.49
2004	18	4,261,950	0.43	0.25–0.68	13	4,139,807	0.31	0.16–0.52
2005	13	4,293,994	0.30	0.16–0.52	13	4,165,565	0.31	0.17–0.54
2006	10	4,329,650	0.22	0.11–0.41	8	4,191,510	0.19	0.08–0.37
2007	18	4,394,137	0.41	0.24–0.65	11	4,238,555	0.25	0.12–0.45

Sources: AIHW National Mortality Database; ABS.

General practice

Table A2.5: General practice encounters for asthma, by age group, Australia, April 2000 to March 2010

Age group/ year	GP encounters for asthma per 100 GP encounters	95% confidence interval	Total annual GP attendances	Population	GP encounters for asthma per 100 population	95% confidence interval
0 to 4 years						
2007–08	3.2	2.6–3.8	7,289,890	1,359,383	17.3	14.1–20.6
2008–09	3.6	3.1–4.2	7,617,767	1,405,215	19.6	16.6–22.6
2009–10	3.5	2.7–4.4	7,817,446	1,445,832	19.2	14.4–23.9
5 to 14 years						
2007–08	6.7	5.8–7.5	6,377,906	2,746,319	15.5	13.5–17.4
2008–09	6.4	5.6–7.2	6,618,508	2,755,686	15.4	13.5–17.4
2009–10	6.3	5.4–7.2	7,071,627	2,766,720	16.0	13.7–18.3
15 to 34 years						
2007–08	2.2	1.9–2.5	20,295,643	5,924,920	7.6	6.7–8.5
2008–09	2.2	1.9–2.5	20,778,730	6,056,806	7.5	6.6–8.5
2009–10	2.0	1.7–2.3	21,414,646	6,287,210	6.9	6.0–7.8
35 to 64 years						
2007–08	1.8	1.6–2.0	38,712,210	8,409,801	8.3	7.6–9.1
2008–09	1.9	1.7–2.0	40,315,047	8,553,315	8.9	8.1–9.7
2009–10	1.8	1.6–2.0	41,657,337	8,694,078	8.7	7.6–9.8
65 years and over						
2007–08	1.5	1.3–1.7	24,658,672	2,797,481	13.5	11.8–15.2
2008–09	1.6	1.4–1.7	25,915,653	2,872,965	14.1	12.5–15.7
2009–10	1.3	1.1–1.6	26,756,030	2,961,589	12.2	10.2–14.1
0 to 14 years						
2000–01	5.8	5.2–6.4	15,890,422	3,977,640	23.2	20.9–25.5
2001–02	6.0	5.0–6.2	15,298,258	3,991,444	21.4	19.1–23.8
2002–03	5.2	4.6–5.7	15,052,658	3,998,663	19.5	17.5–21.6
2003–04	5.5	4.9–6.0	14,081,346	4,005,663	19.2	17.2–21.2
2004–05	4.9	4.4–5.4	13,524,047	4,012,173	16.5	14.8–18.3
2005–06	5.1	4.5–5.7	13,452,251	4,036,944	17.0	15.1–18.9
2006–07	4.6	4.1–5.2	13,003,306	4,065,519	14.8	13.0–16.6
2007–08	4.8	4.3–5.4	15,832,193	4,105,702	18.6	16.5–20.7
2008–09	4.9	4.4–5.4	14,236,275	4,160,901	16.8	15.2–18.5
2009–10	4.8	4.1–5.5	14,889,073	4,212,552	16.9	14.4–19.4

(continued)

Table A2.5: General practice encounters for asthma, by age group, Australia, April 1998 to March 2010 *(continued)*

Age group/ year	GP encounters for asthma per 100 GP encounters	95% confidence interval	Total annual GP attendances	Population	GP encounters for asthma per 100 population	95% confidence interval
15 years and over						
2000–01	2.3	2.2–2.5	83,896,643	15,295,004	12.8	12.0–13.6
2001–02	2.4	2.2–2.6	82,918,902	15,542,528	12.9	12.0–13.8
2002–03	2.3	2.2–2.5	82,249,382	15,772,300	12.2	11.4–13.1
2003–04	2.2	2.0–2.3	80,823,032	16,006,219	10.9	10.1–11.6
2004–05	2.0	1.8–2.1	80,796,672	16,239,959	9.8	9.2–10.5
2005–06	1.9	1.7–2.0	81,567,817	16,507,120	9.2	8.6–9.8
2006–07	1.9	1.8–2.1	81,959,183	16,808,144	9.5	8.8–10.2
2007–08	1.8	1.7–1.9	98,775,280	17,132,202	10.5	9.8–11.2
2008–09	1.8	1.7–2.0	87,009,430	17,483,086	9.1	8.5–9.8
2009–10	1.7	1.5–1.9	89,828,013	17,942,877	8.6	7.7–9.4
All ages						
2000–01	2.8	2.7–3.0	89,814,608	19,272,644	13.3	12.5–14.1
2001–02	2.8	2.7–3.0	90,767,006	19,533,972	13.3	12.4–14.1
2002–03	2.7	2.6–2.9	90,661,663	19,770,963	12.6	11.8–13.3
2003–04	2.6	2.4–2.7	89,176,063	20,011,882	11.5	10.7–12.2
2004–05	2.3	2.2–2.5	89,671,484	20,252,132	10.4	9.7–11.1
2005–06	2.3	2.1–2.4	90,532,408	20,544,064	10.1	9.4–10.7
2006–07	2.3	2.1–2.4	90,678,610	20,873,663	9.9	9.2–10.6
2007–08	2.2	2.0–2.3	97,334,326	21,237,904	10.0	9.3–10.6
2008–09	2.2	2.1–2.3	101,245,705	21,643,987	10.2	9.6–10.9
2009–10	2.1	1.9–2.3	104,717,086	22,155,429	9.8	9.0–10.7

Note: Data are presented in 'Bettering the Evaluation and Care of Health (BEACH)' years, which extend from April to March.
Sources: BEACH Survey of General Practice; Medicare Australia online statistics.

Hospitalisations

Table A2.6: Hospital separations for asthma, by age group and sex, Australia, 1998–2009

	Males			Females		
Age group/year	Hospital separations	Population	Hospital separations per 100,000	Hospital separations	Population	Hospital separations per 100,000
0 to 4 years						
1998–99	11,238	660,834	1,701	5,980	626,963	954
1999–2000	8,734	658,172	1,327	4,733	625,275	757
2000–01	9,735	657,699	1,480	5,233	625,012	837
2001–02	8,416	656,135	1,283	4,504	623,932	722
2002–03	7,935	654,732	1,212	4,206	622,581	676
2003–04	8,335	655,030	1,273	4,266	622,051	686
2004–05	8,438	656,154	1,286	4,598	622,434	739
2005–06	9,097	666,940	1,364	4,938	632,579	781
2006–07	8,600	679,342	1,266	4,722	643,608	734
2007–08	9,279	698,012	1,329	4,901	661,371	741
2008–09	9,525	721,570	1,320	5,325	683,645	779
5 to 14 years						
1998–99	7,232	1,360,322	530	4,813	1,295,501	371
1999–2000	5,662	1,371,673	411	3,853	1,305,170	295
2000–01	6,655	1,381,575	480	4,336	1,313,354	330
2001–02	4,984	1,390,303	358	3,032	1,321,074	230
2002–03	4,322	1,396,244	311	2,702	1,325,106	204
2003–04	4,420	1,400,258	317	2,952	1,328,324	223
2004–05	4,605	1,402,807	331	2,965	1,330,778	224
2005–06	4,497	1,404,565	323	2,831	1,332,860	214
2006–07	4,676	1,406,890	336	3,126	1,335,679	236
2007–08	4,427	1,408,535	317	2,849	1,337,784	214
2008–09	3,979	1,413,206	284	2,720	1,342,480	204
15 to 34 years						
1998–99	3,442	2,759,034	125	6,214	2,721,878	229
1999–2000	3,314	2,758,367	120	5,798	2,725,773	213
2000–01	3,349	2,767,140	121	5,790	2,737,189	212
2001–02	2,628	2,792,525	94	4,475	2,760,498	162
2002–03	2,133	2,818,938	76	4,093	2,781,839	147
2003–04	2,170	2,846,912	76	4,176	2,802,433	149
2004–05	1,942	2,872,470	68	3,641	2,820,371	129
2005–06	1,785	2,903,909	61	3,533	2,844,303	124
2006–07	1,769	2,948,515	60	3,197	2,876,753	111
2007–08	1,669	3,006,488	56	3,347	2,918,432	115
2008–09	1,500	3,077,572	48	3,061	2,979,234	103

(continued)

Table A2.6: Hospital separations for asthma, by age group and sex, Australia, 1998–2009 *(continued)*

Age group/year	Males			Females		
	Hospital separations	Population	Hospital separations per 100,000	Hospital separations	Population	Hospital separations per 100,000
35 to 64 years						
1998–99	2,903	3,548,475	82	7,117	3,530,008	203
1999–2000	2,953	3,625,130	82	7,049	3,613,603	196
2000–01	2,824	3,694,790	76	6,770	3,691,197	184
2001–02	2,563	3,763,807	68	6,205	3,767,856	165
2002–03	2,249	3,827,936	59	5,609	3,838,885	146
2003–04	2,260	3,891,292	58	5,610	3,910,487	143
2004–05	2,194	3,955,843	55	5,481	3,983,595	137
2005–06	2,298	4,029,650	57	5,416	4,064,905	133
2006–07	2,061	4,105,279	50	5,118	4,150,078	123
2007–08	2,149	4,178,821	52	5,461	4,230,980	129
2008–09	2,034	4,249,601	48	5,213	4,303,714	120
65 years and over						
1998–99	1,457	1,013,748	146	3,511	1,297,513	271
1999–2000	1,353	1,035,905	133	3,557	1,319,270	270
2000–01	1,181	1,061,095	113	3,159	1,343,593	235
2001–02	1,171	1,088,919	109	3,040	1,368,923	221
2002–03	1,047	1,113,597	95	2,933	1,391,105	210
2003–04	937	1,140,361	84	2,864	1,414,734	201
2004–05	923	1,167,918	79	2,674	1,439,762	184
2005–06	918	1,198,105	78	2,616	1,466,248	177
2006–07	883	1,231,436	72	2,436	1,496,083	161
2007–08	897	1,268,006	71	2,662	1,529,475	172
2008–09	829	1,307,327	63	2,517	1,565,638	159
0 to 14 years						
1998–99	18,470	2,021,156	905.2	10,793	1,922,464	557.8
1999–2000	14,396	2,029,845	705.0	8,586	1,930,445	442.9
2000–01	16,390	2,039,274	801.0	9,569	1,938,366	492.4
2001–02	13,400	2,046,438	654.8	7,536	1,945,006	387.5
2002–03	12,257	2,050,976	599.6	6,908	1,947,687	355.5
2003–04	12,755	2,055,288	623.7	7,218	1,950,375	371.5
2004–05	13,043	2,058,961	637.4	7,563	1,953,212	389.2
2005–06	13,594	2,071,505	657.1	7,769	1,965,439	395.6
2006–07	13,276	2,086,232	633.9	7,848	1,979,287	395.4
2007–08	13,706	2,106,547	641.8	7,750	1,999,155	383.3
2008–09	13,504	2,134,776	616.1	8,045	2,026,125	388.3

(continued)

Table A2.6: Hospital separations for asthma, by age group and sex, Australia, 1998–2009 *(continued)*

	Males			Females		
Age group/year	Hospital separations	Population	Hospital separations per 100,000	Hospital separations	Population	Hospital separations per 100,000
15 years and over						
1998–99	7,802	7,321,257	107.6	16,842	7,549,399	223.1
1999–2000	7,620	7,419,402	103.5	16,404	7,658,646	213.9
2000–01	7,354	7,523,025	98.0	15,719	7,771,979	201.9
2001–02	6,362	7,645,251	83.8	13,720	7,897,277	172.8
2002–03	5,429	7,760,471	70.5	12,635	8,011,829	156.5
2003–04	5,367	7,878,565	68.4	12,650	8,127,654	154.4
2004–05	5,059	7,996,231	63.4	11,796	8,243,728	141.7
2005–06	5,001	8,131,664	61.8	11,565	8,375,456	136.5
2006–07	4,713	8,285,230	57.0	10,751	8,522,914	124.6
2007–08	4,715	8,453,315	56.0	11,470	8,678,887	130.6
2008–09	4,363	8,634,500	50.6	10,791	8,848,586	120.3
All ages						
1998–99	26,272	9,342,413	270.6	27,635	9,471,863	291.5
1999–2000	22,016	9,449,247	226.4	24,990	9,589,091	260.7
2000–01	23,744	9,562,299	241.7	25,288	9,710,345	261.3
2001–02	19,762	9,691,689	200.4	21,256	9,842,283	216.7
2002–03	17,686	9,811,447	178.6	19,543	9,959,516	197.2
2003–04	18,122	9,933,853	181.9	19,868	10,078,029	198.8
2004–05	18,102	10,055,192	180.7	19,359	10,196,940	192.3
2005–06	18,595	10,203,169	183.4	19,334	10,340,895	189.5
2006–07	17,989	10,371,462	174.9	18,599	10,502,201	180.0
2007–08	18,421	10,559,862	175.7	19,220	10,678,042	182.2
2008–09	17,867	10,769,276	166.1	18,836	10,874,711	175.1

Notes

1. Asthma is classified according to ICD-10 codes J45 and J46.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

Source: AIHW National Hospital Morbidity Database.

Patient days

Table A2.7: Hospital patient days for asthma per 100,000 population, by age group, Australia, 1998–2009

	Age group (years)					
	0 to 4	5 to 14	15 to 34	35 to 64	65 and over	All ages
Year						
1998–99	2,149.4	864.9	399.5	525.1	1,309.5	741.7
1999–2000	1,642.8	647.8	344.1	493.1	1,223.2	639.4
2000–01	1,691.7	718.3	333.9	433.9	1,022.9	601.5
2001–02	1,426.4	490.9	251.4	386.0	882.7	493.0
2002–03	1,280.0	409.4	210.8	324.1	814.3	428.0
2003–04	1,314.2	417.3	210.2	314.1	723.7	416.0
2004–05	1,300.5	423.2	188.8	297.9	692.6	399.6
2005–06	1,356.9	394.5	175.1	281.0	657.5	384.5
2006–07	1,257.2	409.8	154.4	247.0	575.5	350.8
2007–08	1,292.9	380.0	156.5	252.4	605.7	355.5
2008–09	1,281.4	349.6	131.3	236.5	530.3	327.7
Remoteness (data for 2008–09)						
Major cities	1,516.7	388.6	142.9	227.8	561.5	352.4
Inner regional	1,582.9	400.8	172.1	268.7	437.3	366.9
Outer regional	1,315.6	449.4	192.0	342.6	720.1	425.9
Remote	1,496.2	497.8	258.0	512.9	889.3	550.1
Very remote	1,815.5	447.1	208.3	638.2	584.1	559.8

Notes

1. Asthma is classified according to ICD-10 codes J45 and J46.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

Source: AIHW National Hospital Morbidity Database.

Chronic obstructive pulmonary disease

Prevalence

Table A2.8: Prevalence of COPD, by age group and sex, 55 years and over, Australia, 2007–08

Sex/age (years)	Estimated number of people with COPD	Estimated total people	Per cent of people with COPD	95% confidence interval
Males				
55–59	15,298	617,440	2.5	0.8–4.2
60–64	22,248	554,095	4.0	2.4–5.7
65–69	27,654	398,297	6.9	4.2–9.7
70–74	28,045	306,797	9.1	3.5–14.8
75–79	21,506	246,511	8.7	4.9–12.5
80–84	10,838	183,203	5.9	0.6–11.2
85 and over	4,058	74,543	5.4	0.4–10.45
55 and over	**129,646**	**2,380,887**	**5.4**	**4.4–6.4**
Females				
55–59	26,594	632,596	4.2	2.3–6.1
60–64	19,487	538,235	3.6	2.1–5.1
65–69	16,073	408,073	3.9	2.1–5.8
70–74	6,618	330,419	2.0	0.7–3.3
75–79	21,708	281,065	7.7	3.2–12.3
80–84	16,640	225,716	7.4	2.3–12.4
85 and over	15,985	146,488	10.9	3.8–18.0
55 and over	**123,104**	**2,562,592**	**4.8**	**3.7–5.9**

Notes

1. 'COPD' is based on a positive response to 'Which of these (long-term conditions) do you/does [proxy name] have?' for bronchitis or emphysema.
2. Prevalence rates for 55 years and over were age-standardised to the 2001 Australian population. Crude rates presented for each 5-year age groups.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Table A2.9: Prevalence of current asthma, by age group and sex, 55 years and over, Australia, 2007–08

Sex/age (years)	Estimated number of people with current asthma	Estimated total people	Per cent of people with current asthma	95% confidence interval
Males				
55–59	40,084	617,440	6.5	4.0–9.0
60–64	39,287	554,095	7.1	4.7–9.5
65–69	39,817	398,297	10.0	5.3–14.7
70–74	20,407	306,797	6.7	3.2–10.1
75–79	21,629	246,511	8.8	4.7–12.8
80–84	13,224	183,203	7.2	2.5–11.9
85 and over	2,153	74,543	2.9	–0.2–6.0
55 and over	**176,601**	**2,380,887**	**7.4**	**6.1–8.8**
Females				
55–59	77,078	632,596	12.2	8.4–16.0
60–64	57,573	538,235	10.7	7.1–14.3
65–69	48,084	408,073	11.8	8.0–15.6
70–74	28,116	330,419	8.5	4.9–12.1
75–79	41,516	281,065	14.8	10.4–19.1
80–84	29,540	225,716	13.1	8.3–17.9
85 and over	16,546	146,488	11.3	5.3–17.3
55 and over	**298,452**	**2,562,592**	**11.6**	**10.0–13.3**

Notes

1. Current asthma based on a positive response to 'Have you ever been told by a doctor that you have asthma?' and 'Have you had any symptoms of asthma or taken treatment for asthma in the last 12 months?'
2. Prevalence rates were age-standardised to the 2001 Australian population.

Source: ACAM analysis of ABS National Health Survey 2007–08.

Mortality

Table A2.10: Deaths due to COPD, by sex, 55 years and over, Australia, 1997–2007

	Males				Females			
Year	Deaths due to COPD	Population	Age standardised rate per 100,000	95% confidence interval	Deaths due to COPD	Population	Age standardised rate per 100,000	95% confidence interval
1997	3,576	1,778,329	234.7	226.8–242.7	2,219	2,051,397	100.8	96.6–105.1
1998	3,358	1,824,586	213.8	206.5–221.4	2,035	2,093,645	90.2	86.4–94.3
1999	3,334	1,880,053	204.6	197.5–211.8	2,082	2,146,390	89.1	85.3–93.1
2000	3,247	1,938,697	194.4	187.6–201.3	2,010	2,201,955	83.8	80.2–87.6
2001	3,143	2,003,542	181.0	174.6–187.5	2,053	2,262,815	83.7	80.1–87.4
2002	3,289	2,078,976	183.5	177.2–189.9	2,249	2,336,918	88.4	84.7–92.1
2003	3,124	2,148,187	170.1	164.1–176.2	2,203	2,405,752	84.0	80.5–87.6
2004	2,958	2,211,964	156.0	150.3–161.8	2,205	2,471,111	83.1	79.6–86.6
2005	2,799	2,279,365	142.9	137.6–148.3	2,027	2,541,292	74.1	70.8–77.4
2006	2,686	2,344,746	133.0	128.0–138.2	2,052	2,608,749	72.9	69.8–76.2
2007	2,908	2,416,344	138.9	133.8–144.0	2,143	2,682,169	73.6	70.5–76.9

Sources: AIHW National Mortality Database; ABS.

Table A2.11: Deaths due to asthma, by sex, 55 years and over, Australia, 1997–2007

	Males				Females			
Year	Deaths due to asthma	Population	Age standardised rate per 100,000	95% confidence interval	Deaths due to asthma	Population	Age standardised rate per 100,000	95% confidence interval
1997	141	1,778,329	9.1	7.6–10.8	234	2,051,397	10.7	9.3–12.1
1998	139	1,824,586	8.2	6.9–9.7	220	2,093,645	9.8	8.5–11.2
1999	111	1,880,053	6.8	5.6–8.3	201	2,146,390	8.7	7.5–10.0
2000	109	1,938,697	6.2	5.1–7.5	214	2,201,955	9.0	7.8–10.3
2001	111	2,003,542	6.1	5.0–7.3	201	2,262,815	8.2	7.1–9.4
2002	115	2,078,976	6.6	5.4–8.0	181	2,336,918	7.1	6.1–8.2
2003	75	2,148,187	4.0	3.2–5.1	171	2,405,752	6.5	5.5–7.5
2004	68	2,211,964	3.6	2.8–4.6	170	2,471,111	6.2	5.3–7.2
2005	71	2,279,365	3.5	2.8–4.5	169	2,541,292	5.9	5.0–6.8
2006	112	2,344,746	5.7	4.7–6.9	233	2,608,749	8.0	7.0–9.2
2007	92	2,416,344	4.4	3.5–5.4	216	2,682,169	7.1	6.1–8.1

Sources: AIHW National Mortality Database; ABS.

General practice

Table A2.12: General practice encounters for COPD, 55 years and over, Australia, April 2000 to March 2010

Age group/year	GP encounters for COPD per 100 GP encounters	95% confidence interval	Total annual GP attendances	Population	GP encounters for COPD per 100 population	95% confidence interval
55 years and over						
2000–01	2.0	1.8–2.2	33,777,348	4,200,565	15.7	14.2–17.3
2001–02	1.9	1.7–2.0	34,073,184	4,339,239	14.6	13.1–16.0
2002–03	1.9	1.6–2.1	34,826,350	4,481,628	14.4	12.8–16.0
2003–04	1.7	1.6–1.9	35,030,365	4,617,212	13.2	12.0–14.5
2004–05	1.8	1.6–2.0	35,926,368	4,750,147	13.8	12.2–15.4
2005–06	1.7	1.5–1.9	36,633,762	4,887,073	12.9	11.6–14.3
2006–07	2.0	1.8–2.1	37,250,864	5,025,287	14.5	13.1–15.8
2007–08	1.7	1.6–1.9	38,167,618	5,171,258	12.9	11.6–14.2
2008–09	1.8	1.6–1.9	40,099,090	5,316,787	13.3	12.1–14.6
2009–10	1.8	1.7–2.0	41,364,952	5,468,495	13.9	12.6–15.3

Note: Data are presented in 'Bettering the Evaluation and Care of Health (BEACH)' years, which extend from April to March.
Sources: BEACH Survey of General Practice; Medicare Australia online statistics.

Table A2.13: General practice encounters for asthma, 55 years and over, Australia, April 2000 to March 2010

Age group/year	GP encounters for asthma per 100 GP encounters	95% confidence interval	Total annual GP attendances	Population	GP encounters for asthma per 100 population	95% confidence interval
55 years and over						
2000–01	2.1	1.9–2.3	33,777,348	4,200,565	17.1	15.6–18.6
2001–02	2.2	2.0–2.4	34,073,184	4,339,239	17.6	16.1–19.2
2002–03	2.1	1.9–2.3	34,826,350	4,481,628	16.7	15.1–18.2
2003–04	2.0	1.8–2.2	35,030,365	4,617,212	15.1	13.7–16.6
2004–05	1.8	1.6–1.9	35,926,368	4,750,147	13.4	12.1–14.7
2005–06	1.7	1.5–1.9	36,633,762	4,887,073	12.7	11.4–14.0
2006–07	1.7	1.5–1.9	37,250,864	5,025,287	12.5	11.2–13.8
2007–08	1.6	1.5–1.8	38,167,618	5,171,258	12.1	11.0–13.3
2008–09	1.7	1.5–1.9	40,099,090	5,316,787	12.8	11.6–14.0
2009–10	1.5	1.3–1.7	41,364,952	5,468,495	11.2	9.8–12.6

Note: Data are presented in 'Bettering the Evaluation and Care of Health (BEACH)' years, which extend from April to March.
Sources: BEACH Survey of General Practice; Medicare Australia online statistics.

Hospitalisations

Table A2.14: Hospital separations for COPD, by age group (55 years and over) and sex, Australia, 1998–2009

	Males			Females		
Age group/year	Hospital separations	Population	Hospital separations per 100,000	Hospital separations	Population	Hospital separations per 100,000
55 to 69 years						
1998–99	8,589	1,172,248	717.4	6,357	1,169,220	529.7
1999–2000	8,539	1,205,455	700.7	6,613	1,199,334	541.4
2000–01	8,604	1,242,349	691.3	6,818	1,232,725	546.1
2001–02	8,490	1,291,305	661.8	6,965	1,280,586	541.2
2002–03	8,636	1,347,250	650.7	7,118	1,337,778	533.8
2003–04	8,459	1,398,408	616.8	7,464	1,392,165	540.0
2004–05	8,390	1,447,383	590.3	7,407	1,445,977	516.5
2005–06	8,310	1,495,572	565.8	7,400	1,499,066	498.5
2006–07	7,996	1,541,966	525.2	7,525	1,550,512	489.0
2007–08	8,855	1,590,501	560.8	7,987	1,603,387	500.0
2008–09	8,847	1,638,256	541.9	8,676	1,656,125	523.4
70 to 84 years						
1998–99	15,984	608,814	2,690.0	10,289	788,755	1,303.2
1999–2000	16,699	628,126	2,720.4	10,485	803,520	1,302.0
2000–01	17,269	648,015	2,724.2	11,445	819,351	1,391.2
2001–02	17,305	665,541	2,646.9	11,625	832,095	1,388.6
2002–03	18,110	678,594	2,699.8	12,355	840,814	1,456.6
2003–04	18,165	692,192	2,642.6	12,468	849,941	1,448.4
2004–05	17,511	703,518	2,494.2	11,849	856,962	1,365.0
2005–06	17,283	715,473	2,410.9	12,227	863,159	1,390.1
2006–07	16,319	729,768	2,227.4	11,723	871,148	1,320.6
2007–08	17,241	744,468	2,305.7	12,696	880,696	1,415.8
2008–09	17,034	759,191	2,236.5	13,353	890,476	1,472.3
85 years and over						
1998–99	2,169	70,375	3,082.1	1,854	161,161	1,150.4
1999–2000	2,427	74,997	3,236.1	2,207	170,218	1,296.6
2000–01	2,678	79,559	3,366.1	2,354	178,566	1,318.3
2001–02	2,897	83,577	3,466.3	2,412	186,135	1,295.8
2002–03	3,084	86,210	3,577.3	2,706	190,982	1,416.9
2003–04	3,231	89,118	3,625.5	2,895	195,388	1,481.7
2004–05	3,357	93,856	3,576.8	2,811	202,451	1,388.5
2005–06	3,381	101,132	3,343.2	3,152	212,671	1,482.1
2006–07	3,801	108,607	3,499.8	3,017	223,286	1,351.2
2007–08	4,183	117,493	3,560.2	3,585	234,713	1,527.4
2008–09	4,451	126,868	3,508.4	3,840	245,871	1,561.8

(continued)

Table A2.14: Hospital separations for COPD, by age group (55 years and over) and sex, Australia, 1998–2009 *(continued)*

Age group/year	Males			Females		
	Hospital separations	Population	Hospital separations per 100,000	Hospital separations	Population	Hospital separations per 100,000
70 years and over						
1998–99	18,153	679,189	2,749.8	12,143	949,916	1,279.9
1999–2000	19,126	703,123	2,799.1	12,692	973,738	1,301.1
2000–01	19,947	727,574	2,822.1	13,799	997,917	1,380.0
2001–02	20,202	749,118	2,771.9	14,037	1,018,230	1,374.4
2002–03	21,194	764,804	2,833.7	15,061	1,031,796	1,450.5
2003–04	21,396	781,310	2,792.6	15,363	1,045,329	1,453.5
2004–05	20,868	797,374	2,659.4	14,660	1,059,413	1,368.8
2005–06	20,664	816,605	2,553.2	15,379	1,075,830	1,404.1
2006–07	20,120	838,375	2,421.6	14,740	1,094,434	1,325.3
2007–08	21,424	861,961	2,497.2	16,281	1,115,409	1,432.8
2008–09	21,485	886,059	2,430.6	17,193	1,136,347	1,485.9
55 years and over						
1998–99	26,742	1,851,437	1,545.2	18,500	2,119,136	835.2
1999–2000	27,665	1,908,578	1,555.4	19,305	2,173,072	850.8
2000–01	28,551	1,969,923	1,559.2	20,617	2,230,642	885.8
2001–02	28,692	2,040,423	1,521.2	21,002	2,298,816	880.6
2002–03	29,830	2,112,054	1,539.8	22,179	2,369,574	907.2
2003–04	29,855	2,179,718	1,503.0	22,827	2,437,494	912.0
2004–05	29,258	2,244,757	1,433.0	22,067	2,505,390	863.5
2005–06	28,974	2,312,177	1,375.2	22,779	2,574,896	867.4
2006–07	28,116	2,380,341	1,297.6	22,265	2,644,946	829.6
2007–08	30,279	2,452,462	1,349.5	24,268	2,718,796	879.9
2008–09	30,332	2,524,315	1,311.2	25,869	2,792,472	915.4

Notes

1. COPD is classified according to ICD, 10th Revision ICD-10 codes J40 to J44.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

Source: AIHW National Hospital Morbidity Database.

Table A2.15: Hospital separations for asthma, by age group (55 years and over) and sex, Australia, 1998–2009

	Males			Females		
Age group/year	Hospital separations	Population	Hospital separations per 100,000	Hospital separations	Population	Hospital separations per 100,000
55 to 69 years						
1998–99	1,333	1,172,248	113.2	2,945	1,169,220	251.4
1999–2000	1,280	1,205,455	106.0	2,865	1,199,334	238.4
2000–01	1,123	1,242,349	90.4	2,673	1,232,725	216.7
2001–02	1,095	1,291,305	85.0	2,538	1,280,586	198.1
2002–03	1,004	1,347,250	74.7	2,317	1,337,778	173.2
2003–04	973	1,398,408	69.6	2,301	1,392,165	165.2
2004–05	977	1,447,383	67.7	2,268	1,445,977	156.9
2005–06	933	1,495,572	62.4	2,266	1,499,066	151.3
2006–07	902	1,541,966	58.7	2,178	1,550,512	140.5
2007–08	879	1,590,501	55.4	2,226	1,603,387	139.1
2008–09	840	1,638,256	51.2	2,172	1,656,125	131.1
70 to 84 years						
1998–99	897	608,814	148.3	2,190	788,755	277.4
1999–2000	877	628,126	140.9	2,235	803,520	278.1
2000–01	769	648,015	119.6	1,971	819,351	240.2
2001–02	696	665,541	105.7	1,885	832,095	226.0
2002–03	640	678,594	94.8	1,800	840,814	213.8
2003–04	582	692,192	84.2	1,797	849,941	210.8
2004–05	571	703,518	81.2	1,732	856,962	200.0
2005–06	575	715,473	80.3	1,577	863,159	181.4
2006–07	518	729,768	70.9	1,462	871,148	165.8
2007–08	542	744,468	72.8	1,594	880,696	179.3
2008–09	465	759,191	61.3	1,538	890,476	170.9
85 years and over						
1998–99	125	70,375	177.6	390	161,161	242.0
1999–2000	115	74,997	153.3	436	170,218	256.1
2000–01	98	79,559	123.2	423	178,566	236.9
2001–02	109	83,577	130.4	434	186,135	233.2
2002–03	100	86,210	116.0	431	190,982	225.7
2003–04	100	89,118	112.2	418	195,388	213.9
2004–05	74	93,856	78.8	358	202,451	176.8
2005–06	101	101,132	99.9	420	212,671	197.5
2006–07	86	108,607	79.2	399	223,286	178.7
2007–08	94	117,493	80.0	466	234,713	198.5
2008–09	89	126,868	70.2	446	245,871	181.4

(continued)

Table A2.15: Hospital separations for asthma, by age group (55 years and over) and sex, Australia, 1998–2009 *(continued)*

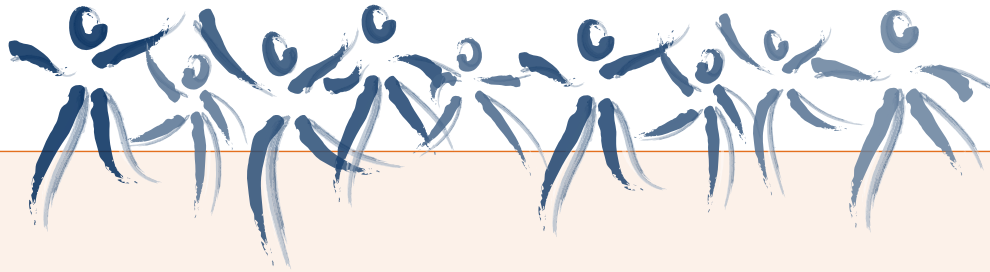
	Males			Females		
Age group/year	Hospital separations	Population	Hospital separations per 100,000	Hospital separations	Population	Hospital separations per 100,000
70 years and over						
1998–99	1,022	679,189	152.8	2,580	949,916	272.0
1999–2000	992	703,123	142.8	2,671	973,738	274.7
2000–01	867	727,574	120.1	2,394	997,917	239.7
2001–02	805	749,118	109.5	2,319	1,018,230	227.1
2002–03	740	764,804	98.1	2,231	1,031,796	215.6
2003–04	682	781,310	88.5	2,215	1,045,329	211.3
2004–05	645	797,374	80.9	2,090	1,059,413	196.4
2005–06	676	816,605	83.3	1,997	1,075,830	183.8
2006–07	604	838,375	72.2	1,861	1,094,434	167.8
2007–08	636	861,961	73.9	2,060	1,115,409	182.2
2008–09	554	886,059	62.7	1,984	1,136,347	172.5
55 years and over						
1998–99	2,355	1,851,437	129.3	5,525	2,119,136	259.8
1999–2000	2,272	1,908,578	121.0	5,536	2,173,072	253.2
2000–01	1,990	1,969,923	102.5	5,067	2,230,642	226.1
2001–02	1,900	2,040,423	95.0	4,857	2,298,816	209.9
2002–03	1,744	2,112,054	84.2	4,548	2,369,574	190.5
2003–04	1,655	2,179,718	77.3	4,516	2,437,494	184.0
2004–05	1,622	2,244,757	73.1	4,358	2,505,390	173.0
2005–06	1,609	2,312,177	70.9	4,263	2,574,896	164.5
2006–07	1,506	2,380,341	64.2	4,039	2,644,946	151.6
2007–08	1,515	2,452,462	62.9	4,286	2,718,796	156.6
2008–09	1,394	2,524,315	55.9	4,156	2,792,472	147.9

Notes

1. Asthma is classified according to ICD, 10th Revision ICD-10 codes J45 and J46.
2. Separations for which the care type was reported as *Newborn* with no qualified days, and records for *Hospital boarders* and *Posthumous organ procurement* have been excluded.

Source: AIHW National Hospital Morbidity Database.

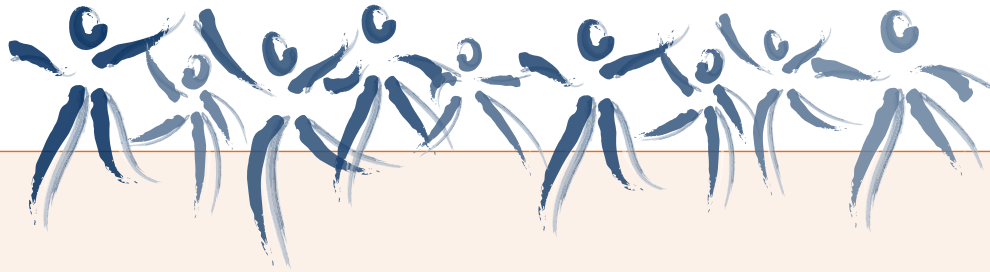
Abbreviations



ABS	Australian Bureau of Statistics
ACAM	Australian Centre for Asthma Monitoring
ACT	Australian Capital Territory
AGPSCC	Australian General Practice Statistics and Classification Centre
AIHW	Australian Institute of Health and Welfare
ARIA	Accessibility/Remoteness Index of Australia
ASGC	Australian Standard Geographical Classification
ASR	age-standardised rate
ATC	Anatomical Therapeutic Chemical
BEACH	Bettering the Evaluation and Care of Health
BOLD	Burden of Obstructive Lung Disease
CAPS	Coding Atlas for Pharmaceutical Substances
CATI	computer-assisted telephone interview
CI	confidence interval
COPD	chronic obstructive pulmonary disease
CURF	confidentialised unit record file
DALY	disability-adjusted life years
DDD	defined daily dose
DRG	Diagnostic Related Groups
ED	emergency department
EDDC	Emergency Department Data Collection
ETS	environmental tobacco smoke
FaCSIA	Australian Government Department of Families, Community Services and Indigenous Affairs
GINA	Global Initiative for Asthma
GP	general practitioner
HIC	Health Insurance Commission
HRQoL	health-related quality of life
ICD-9	International Classification of Diseases, 9th Revision
ICD-9-CM	International Classification of Diseases, 9th Revision, Clinical Modification
ICD-10	International Classification of Diseases, 10th Revision
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification

ICPC	International Classification of Primary Care
ICPC-2	International Classification of Primary Care, 2nd edition
ICS	inhaled corticosteroids
ICU	intensive care unit
IRSD	Index of Relative Socioeconomic Disadvantage
ISAAC	International Study of Asthma and Allergies in Childhood
LABA	long-acting beta-agonists
LSAC	Longitudinal Study of Australian Children
LTRA	Leukotriene Receptor Antagonist
MBS	Medicare Benefits Schedule
NAC	National Asthma Council
NATSIHS	National Aboriginal and Torres Strait Islander Health Survey
NHMD	National Hospital Morbidity Database
NHS	National Health Survey
NSW	New South Wales
NT	Northern Territory
PBS	Pharmaceutical Benefits Scheme
PIP	Practice Incentives Program
Qld	Queensland
RADL	Remote Access Data Laboratory
RHINE	Respiratory Health in Northern Europe
RPBS	Repatriation Pharmaceutical Benefits Scheme
SA	South Australia
SABA	short-acting beta-agonists
SABRE	Surveillance of Australian workplace Based Respiratory Events
SAMSS	South Australian Monitoring and Surveillance System
SAND	Supplementary Analysis of Nominated Data
SEIFA	Socio-Economic Indexes for Areas
SLA	statistical local area
SMART	budesonide/formoterol maintenance and reliever therapy
Tas	Tasmania
Vic	Victoria
WA	Western Australia

Glossary



See Appendices for definitions of additional statistical terms.

Aboriginal	A person who identifies themselves as an Aboriginal person.
Additional diagnosis	An additional diagnosis is a condition or complaint that either coexists with the principal diagnosis or arises during the episode of care. Additional diagnoses were only coded where they had an impact on the care given to patients.
Admission	Admission to hospital. In this report, the number of separations was taken as the number of admissions. Hence, admission rate is the same as separation rate.
Adult	In some data sources for this document, a person may be classified as an adult from the age of 15 years, rather than strictly according to the legal age of 18 years.
Age-specific rate	A rate for a specific age group. The numerator and denominator relate to the same age group. See Appendix 1 (Section A1.1) for full description.
Age-standardisation	A method of removing the influence of age when comparing populations with different age structures. This is usually necessary because the rates of many diseases vary strongly (usually increasing) with age. The age structures of the different populations are converted to the same 'standard' structure, then the disease rates that would have occurred with that structure are calculated and compared. See Appendix 1 (Section A1.1) for full description.
Airway hyperresponsiveness	Excessive twitchiness or narrowing of the airways in response to certain stimuli. This is a characteristic feature of asthma.
ARIA/ASGC classification	The Accessibility/Remoteness Index of Australia and Australian Standard Geographical Classification provide classification of the level of accessibility to goods and services (such as general practitioners, hospitals and specialist care) based on the proximity to these services (measured by road distance).
Arthritis	A group of disorders in which there is inflammation of the joints, which can become stiff, painful, swollen or deformed. The two main types of arthritis are osteoarthritis and rheumatoid arthritis.
Associated cause of death	Any condition(s), diseases and injuries—other than the underlying cause—considered to contribute to a death. See also Cause of death.
Asthma	Asthma is a chronic inflammatory disorder of the airways. Chronically inflamed airways are hyperresponsive; they become obstructed and airflow is limited (by bronchoconstriction, mucus plugs, and increased inflammation) when airways are exposed to various risk factors (GINA 2010).
Asthma control	Is the extent to which the manifestations of asthma have been reduced or removed by treatment. The aim is to achieve good asthma control. The assessment of asthma control includes assessment of the patient's current status (symptoms, reliever use, lung function), and their risk of future adverse outcomes (exacerbations, decreasing lung function, medication side-effects) (Reddel et al. 2009).

Asthma severity	Is now defined by the intensity of treatment required to achieve good asthma control. Mild asthma is asthma that can be well-controlled with reliever medications alone or with low dose inhaled corticosteroids. Severe asthma is asthma which requires high intensity treatment with inhaled corticosteroids and long-acting b2-agonists to maintain good control, or which is not well controlled despite such treatment. Several different definitions of asthma severity have been used in the past (Reddel et al. 2009).
Asthma action plan	A plan that provides instructions on how to recognise and respond to worsening asthma. It is recommended that these instructions be given in writing ('written asthma action plan'). The action plan is based on symptoms and/or peak expiratory flow measurements and is individualised according to the pattern of the person's asthma and their usual treatment. Some data sources refer to written asthma action plans as 'asthma management plans', 'asthma plans', 'self-management plans', 'asthma care plans' or 'personal asthma plans'.
Asthma expenditure	The component of total health expenditure that is attributable to asthma. Compare with Total health expenditure.
Asthma management plan	A comprehensive individualised plan of management for patients with asthma, often formulated in accordance with the Australian 'Six Step Asthma Management Plan'. (The asthma action plan forms one part of this.)
Asthma Cycle of Care	A component of the Practice Incentives Program Asthma Incentive funded by the Australian Government aimed at people with moderate to severe asthma. The Asthma Cycle of Care must include at least two visits to the general practitioner at which the patient's asthma is assessed, an individualised asthma action plan is developed and reviewed, and the patient receives appropriate education about asthma.
Average length of stay	The average length of stay for admitted patient episodes. Calculated by dividing total patient days in a given period by the total number of hospital separations in that period. See Patient days, Hospital separation and Length of stay.
BEACH (Bettering the Evaluation and Care of Health) survey	A continuous cross-sectional paper-based data collection that collects information for individual patient visits about the reasons for seeking medical care, the type of patients seen, the types of problems managed and treatment provided in general practice across Australia.
Bronchial challenge tests	Tests designed to detect the presence of airway hyperresponsiveness; include the bronchial provocation challenge test and methacholine challenge. See Airway hyperresponsiveness.
Bronchitis	Inflammation of the main air passages (the bronchi). May be acute (because of infection) or chronic (most often because of tobacco smoking).
Cancer	A large range of diseases, in which some of the body's cells become defective, begin to multiply out of control, can invade and damage the area around them, and can also spread to other parts of the body to cause further damage.

Cardiovascular disease	Any disease of the circulatory system, namely the heart (cardio) or blood vessels (vascular). Includes heart attack, angina, stroke and peripheral vascular disease. Also known as circulatory disease.
Cause of death	The disease or factor contributing to a death. When used technically, this term is usually applied to the 'underlying cause' listed on the medical certificate issued at death. From information reported on the medical certificate of cause of death, each death is classified by the underlying cause of death according to rules and conventions of the International Classification of Diseases of the day (currently ICD, 10th Revision). The underlying cause is defined as the disease that initiated the train of events leading directly to death. Deaths from injury or poisoning are classified according to the circumstances of the violence that produced the fatal injury, rather than to the nature of the injury. See Underlying cause of death and Associated cause of death.
Cerebrovascular disease	Any disorder of the blood vessels supplying the brain or its covering membranes. A notable and major form of cerebrovascular disease is stroke.
Chronic bronchitis	A condition with the presence of cough and sputum production for at least 3 months in each of two consecutive years (GOLD 2010).
Chronic obstructive pulmonary disease	A preventable and treatable disease with some significant extra-pulmonary effects that may contribute to the severity in individual patients. Its pulmonary component is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases (GOLD 2010). It may be characterised by Emphysema and/or Chronic bronchitis. By far the greatest cause is cigarette smoking.
Comorbidity	When a person has two or more health problems at the same time.
Confidence interval (CI)	A statistical term describing a range (interval) of values within which we can be 'confident' that the true value lies. For this report, confidence intervals are calculated using the 95% confidence level. A 95% confidence interval implies that there is 95% confidence that the true value will be included in this interval.
Country of birth	This term is used to describe the multicultural nature of the Australian population, including those from English-speaking countries and those from countries where English is not spoken as the first language. See also English-speaking background and Non-English-speaking background.
Cromones	Cromones (which include nedocromil sodium and sodium cromoglycate) are administered by inhalation and used as prophylactic treatment of asthma. Cromones must be taken regularly to produce optimal effect but they will not relieve acute symptoms. Although the mechanism of action of these drugs is not fully understood, they are thought to block allergen-induced bronchoconstriction, and may be useful in asthma associated with allergic factors. They may also be used to prevent exercise-induced bronchoconstriction.

Current asthma	Reported ever being diagnosed with asthma by a doctor or nurse, and reporting having any symptoms of asthma or taking treatment for asthma in the previous 12 months. Other definitions have been used in some surveys however this is the definition recommended by ACAM. See also Asthma.
Defined daily dose	The assumed average maintenance dose per day for a drug used for its main indication in adults.
Diabetes (diabetes mellitus)	A chronic condition in which the body cannot properly use its main energy source, the sugar glucose. This is due to a relative or absolute deficiency in insulin, a hormone produced by the pancreas. Insulin helps glucose enter the body's cells from the bloodstream and then be processed by them. Diabetes is marked by an abnormal build-up of glucose in the blood and it can have serious short- and long-term effects. The three main types of diabetes are type I diabetes, type II diabetes and gestational diabetes.
Disability-adjusted life year	Years of healthy life lost through premature death or living with disability due to illness or injury.
Emphysema	A chronic lung disease where over-expansion or destruction of the lung tissue limits oxygen uptake, leading to shortness of breath and other problems.
English-speaking background	Includes anyone born in Australia, New Zealand, United Kingdom, Ireland, United States of America, Canada, Zimbabwe or South Africa (Department of Immigration and Multicultural and Indigenous Affairs (DIMIA) English proficiency group 1).
Epigenetic mechanism	Inherited changes in gene expression affecting a cell, organ or individual without directly affecting its DNA sequence.
Estimated resident population	An estimate of the resident population derived from the 5-yearly census counts. It is based on the usual residence of the person.
Health-related quality of life	A term used to describe the impact that a disease has on an individual's health status and everyday functioning. It is most often used when referring to chronic diseases.
Health risk factor	Any factor that represents a greater risk of a health disorder or other unwanted condition or event. Some risk factors are regarded as causes of disease, others are not necessarily so.
Health service use	Use of the available health-care services within the population, including hospitals, emergency departments and general practitioners.
Health survey	A research method in which health information is collected from participants at a point in time. In population health monitoring, this typically involves selecting a representative sample of the population and administering questionnaires to the participants. This can be done in person, over the phone or by post. Some surveys have additionally included physiological measurements.
Heterogeneity	Is a state consisting of dissimilar parts.

Hospital separation	The formal process by which a hospital records the completion of treatment or care for an admitted patient. The episode of care can be completed by the total hospital stay of the admitted patient (from admission to discharge, transfer or death) or a portion of a hospital stay, beginning or ending in a change of type of care (for example, from acute to rehabilitation).
Incidence	The number of new cases (of a disease, condition or event) occurring during a given period. Compare with Prevalence.
Indicator	A key statistical measure selected to help describe (indicate) a situation concisely, track progress and performance, and act as a guide to decision-making. It may have an indirect meaning as well as a direct one; for example, Australia's overall mortality rate is a direct measure of mortality but is often used as a major indicator of population health.
Indigenous	A person who identifies themselves as an Aboriginal and/or Torres Strait Islander person.
Indigenous Australians	Refers to people who identify themselves as being of Aboriginal or Torres Strait Islander origin.
Inhaled corticosteroids (ICS)	Inhaled corticosteroids are widely used in the treatment of airways disease (including asthma and COPD) to reduce bronchial inflammation and hyperresponsiveness. They reduce symptoms, improve lung function, and reduce the risk of exacerbations. Inhaled corticosteroids are most effective when used on a regular basis, either daily or twice daily. In Australian asthma guidelines, inhaled corticosteroids are termed 'preventers'. See also Preventer medication.
International Classification of Diseases (ICD)	International Statistical Classification of Diseases and Related Health Problems. The World Health Organization's internationally accepted statistical classification of death and disease. The 10th Revision (ICD-10) is currently in use. In this report, hospital separations before 1998–99 and causes of death before 1997 under previous revisions have been reclassified to ICD-10. ICD-10-AM is the Australian modification of ICD-10, used for diagnoses and procedures recorded for patients admitted to hospitals.
kappa statistic	A statistical measure of agreement between categorical items that is corrected for chance. A value of 1 indicates perfect agreement.
Length of stay	Duration of hospital stay, calculated by subtracting the date the patient is admitted from the day of separation. All leave days, including the day the patient went on leave, are excluded. A same-day patient is allocated a length of stay of one day. See also Average length of stay.
Leukotriene receptor antagonists	The leukotriene receptor antagonist (available as montelukast sodium) is orally administered resulting in relaxation of smooth muscle and some reduction of the inflammation mediated by leukotrienes. This type of treatment may have a place in prevention or treatment of exacerbations of asthma in children but should not be used for acute relief of symptoms. It may also have a role in the management of aspirin-sensitive asthma and exercise-induced bronchoconstriction.

Life expectancy	An indication of how long a person can expect to live. Technically it is the number of years of life remaining to a person at a particular age if mortality rates do not change.
Long-acting anti-cholinergics	Inhaled anti-cholinergic drugs work by relaxing the muscles that surround the airways. This tends to open the airways and relieve breathlessness. The duration of action is more than 24 hours and the onset of action is around 30 minutes. The only long-acting anti-cholinergic drug that is currently available in Australia is tiotropium bromide; it only needs to be taken once per day.
Long-acting beta-agonists (LABA)	Long-acting beta-agonists (available as eformoterol and salmeterol) relax the muscles that surround the airways and allows for easier breathing. In asthma management, long-acting beta-agonists are only recommended for use in combination with inhaled corticosteroid therapy, after a trial of inhaled corticosteroids alone. In COPD, these medications may be used on their own. Eformoterol has an onset of action of 1–3 minutes and salmeterol 10–20 minutes. The action of long-acting beta agonists lasts at least 12 hours.
Mechanical ventilation, invasive	A medical intervention used in situations where patients become unable to breathe by themselves. It involves the use of a positive pressure ventilator to maintain respiration via an endotracheal tube. This intervention is generally administered in hospital intensive care units.
Mechanical ventilation, non-invasive	A medical intervention used in situations where patients become unable to breathe by themselves. It involves the use of a positive pressure ventilator to maintain respiration via face or nasal mask. This intervention is generally administered in hospital intensive care units.
Median	The midpoint of a list of observations ranked from the smallest to the largest.
Medicare Benefits Schedule	A national, government-funded scheme that subsidises the cost of personal medical services for all Australians and aims to help them afford medical care.
Morbidity	Refers to ill health in an individual and to levels of ill health in a population or group.
Mortality	Death.
Neoplasm	An abnormal ('neo', new) growth of tissue. Can be 'benign' (not a cancer) or 'malignant' (a cancer).
Non-English-speaking background	This term is used to describe people who have settled in Australia but who come from countries where English is not the primary language spoken. Includes people born in all countries not identified as English-speaking-background countries (equivalent to DIMIA English proficiency groups 2 to 4). See also English-speaking-background.
Non-Indigenous	People who have declared they are not of Aboriginal or Torres Strait Islander descent.
Outcome (health outcome)	A health-related change due to a preventive or clinical intervention or service. (The intervention may be single or multiple and the outcome may relate to a person, group or population or be partly or wholly due to the intervention.)

Other Australians	People who have declared they are not of Aboriginal or Torres Strait Islander descent, or whose status is not known.
p value	The probability that the observed difference or association could have occurred by chance. If that probability is less than 5% (i.e. $p<0.05$), it is conventionally held that it would be unlikely to have occurred by chance and is a true difference or association.
Patient days	The number of full or partial days of stay for patients who were admitted for an episode of care and who underwent separation during the reporting period. A patient who is admitted and separated on the same day is allocated one patient day. Compare with Length of stay and Average length of stay.
Percentage	A percentage is a proportion multiplied by 100. See Proportion. Compare with Rate.
Pharmaceutical Benefits Scheme (PBS)	A national, government-funded scheme that subsidises the cost of a wide range of pharmaceutical drugs, and that covers all permanent residents and citizens of Australia to help them afford standard medications.
Phenotypic	Related to an observable characteristic or trait.
Prescription drugs	Pharmaceutical drugs available only on the prescription of a registered medical practitioner and available only from pharmacies.
Prevalence	The number or proportion (of cases, instances, and so forth) present in a population at a given time. Compare with Incidence.
Preventer medication	A type of medication used to treat asthma or COPD to control the disease in order to minimise symptoms and exacerbations.
Principal diagnosis	The diagnosis describing the problem that was chiefly responsible for the patient's episode of care in hospital.
Proportion	A proportion is a fraction in which the numerator contains a subset of the individuals contained in the denominator. Its value ranges between 0 and 1. For example, the proportion of males in the population is calculated as the number of males divided by the number of persons (i.e. males + females). Compare with Rate.
Pulmonary rehabilitation	Pulmonary rehabilitation is a system of care that includes education, exercise training, nutrition counselling, and psychosocial support. Exercise training includes aerobic training of upper and lower limbs and trunk muscles, flexibility and muscle strength as well as teaching breathing control. Education improves the patient's knowledge about breathing and assists smokers to quit and sustain quitting. Patients are trained to optimise activities and nutrition, gain control over anxiety, panic or depression, and use appropriate medications and therapeutic devices effectively (Frith 2008).
Quintile	A group derived by ranking the population according to specified criteria and dividing it into five equal parts.

Rate	A rate is one number (the numerator) divided by another number (the denominator). The numerator is commonly the number of events in a specified time period. The denominator is the population 'at risk' of the event. Rates (crude, age-specific and age-standardised) are generally multiplied by a number such as 100,000 to create whole numbers. Compare with Proportion and Percentage.
Reliever medication	A type of medication used in the treatment of asthma to relieve symptoms when they occur.
Risk factor	See Health risk factor.
Same-day patients	Admitted patients who are admitted to hospital and separated on the same day.
SAND data	Additional questions asked of patients in subsamples of general practice encounters, as part of the BEACH survey.
SEIFA Index of Relative Socioeconomic Disadvantage	An index of socioeconomic status which provides a summary score for a range of key socioeconomic variables that are related to health status, including household income and resources, education, occupation, fluency in English, and Indigenous status.
Separation	See Hospital separation.
Short-acting anti-cholinergics	Short-acting anticholinergics (which includes ipratropium bromide) are bronchodilators; their peak effect is not reached for 1.5–2 hours and the duration of action is approximately 6 hours. This type of medication is not normally used for immediate relief of symptoms. It is mainly used in acute exacerbations of chronic obstructive pulmonary disease (COPD) and sometimes in the emergency situation for acute severe asthma.
Short-acting beta-agonists (SABA)	These are fast-acting bronchodilators; their effects are evident within 5 minutes and last for about 3 hours. They are used to relieve bronchoconstriction and are known in Australia as 'reliever' medications. Short-acting beta-agonists should only be used for intermittent symptom relief. Frequent use indicates poorly controlled asthma.
Six Step Asthma Management Plan	An Australian consensus-based programme for the management of asthma. The six steps are: (1) assess asthma severity; (2) achieve best lung function; (3) maintain best lung function: identify and avoid trigger factors; (4) maintain best lung function: optimise medication program; (5) develop an action plan; and (6) educate and review regularly.
Spirometer/spirometry	Spirometry is a measure of lung function performed by a spirometer. Spirometry is used to establish the presence of airflow limitation and its reversibility in response to bronchodilator, which is an important feature in the diagnosis of asthma.
Statistical significance	An indication from a statistical test that an observed difference or association may be significant, or 'real', because it is unlikely to be due just to chance. A statistical result is often said to be 'significant' if it would occur by chance only once in twenty times or less often. See also P value.

Torres Strait Islander	A person who identifies themselves as a Torres Strait Islander.
Total health expenditure	The sum of health expenditure for all health conditions (i.e. allocated recurrent health expenditure). This excludes expenditure that cannot be allocated to a specific disease (e.g. ambulance services) and capital expenditure (non-recurrent).
Underlying cause of death	The condition, disease or injury initiating the sequence of events leading directly to death; that is, the primary, chief, main or principal cause. Compare with Associated cause of death.
Wheeze	Breathing difficulty accompanied by an audible whistling sound.
Xanthines	Xanthines (which include theophylline) are bronchodilators that are administered orally and have a highly variable half-life of approximately 8 hours in adults and 4 hours in children.

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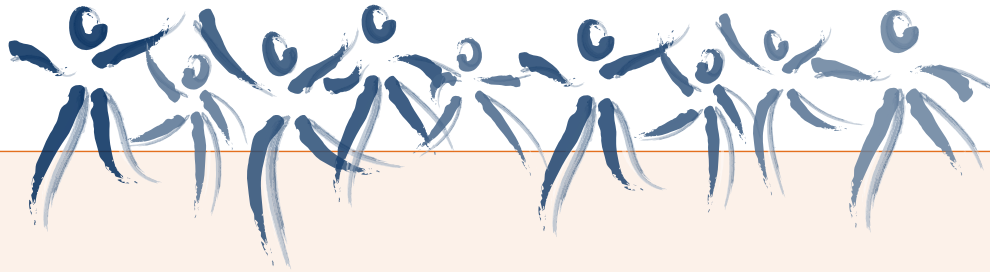

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Asthma is an important health problem in Australia. This report brings together data from a wide range of sources to describe the current status of asthma in Australia. It includes information on the number of people who have asthma and who visit their general practitioner, are hospitalised or die due to asthma. Time trends and profiles of people who receive various treatments for asthma are also presented, along with information on those who have written asthma action plans. In addition, comorbidities and quality of life among people with asthma are also investigated. This report also includes a chapter that focuses on chronic obstructive pulmonary disease in Australians aged 55 years and over.