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Mortality from asthma and COPD in Australia

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ACAM
Australian Centre for
Airways disease Monitoring



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**Australian Institute of
Health and Welfare**

*Authoritative information and statistics
to promote better health and wellbeing*

Mortality from asthma and COPD in Australia

Australian Institute of Health and Welfare
Canberra

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Australian Institute of Health and Welfare

Board Chair

Dr Andrew Refshauge

Director

David Kalisch

Any enquiries about or comments on this publication should be directed to:

Digital and Media Communications Unit
Australian Institute of Health and Welfare
GPO Box 570
Canberra ACT 2601
Tel: (02) 6244 1032
Email: info@aihw.gov.au

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Abbreviations

ABS	Australian Bureau of Statistics
ACAM	Australian Centre for Airways disease Monitoring
ACOS	asthma-COPD overlap syndrome
AIHW	Australian Institute of Health and Welfare
ASR	Age-standardised mortality rate
COPD	Chronic obstructive pulmonary disease
DIMIA	Department of Immigration and Multicultural and Indigenous Affairs
ESCoB	English-speaking country of birth
ICD-10	International Statistical Classification of Disease and Related Health Problems 10th revision
NESCoB	Non-English-speaking country of birth
SES	Socioeconomic status
WHO	World Health Organization
YLL	Years of life lost

Summary

Asthma and chronic obstructive pulmonary disease (COPD) are chronic lung diseases; COPD mainly affects older people, while asthma affects people of all ages. Asthma death rates in Australia are high compared with many other countries and COPD is a leading cause of death in Australia (AIHW 2014) and internationally (Lozano et al. 2012). Many deaths due to these conditions are potentially preventable.

This report presents current information about mortality due to asthma and COPD in Australia, examining trends over time, seasonal variation, international comparisons and variation by age, sex, remoteness, Indigenous status, country of birth and socioeconomic disadvantage. To reduce overlap with asthma, COPD mortality data in this report refer only to people aged 55 and over.

Asthma

Since 1911, the mortality rate due to asthma in Australia has fluctuated, with several peaks observed in the late 1950s, mid-1960s and late 1980s. In recent years, the mortality rate due to asthma has declined substantially, but remains relatively high on an international scale.

In Australia in 2011, asthma was certified as the underlying cause of 378 deaths (1.5 per 100,000 people) which represented 0.3% of all deaths in Australia. This included 17 deaths among people aged 5–34 (0.2 per 100,000 people in this age group). The median age at death due to asthma was 80 in 2007–2011.

Deaths due to asthma:

- occur in all age groups but increase with age in both males and females
- are higher in females compared to males aged 35 and over, but similar in males and females aged 5–34
- peak in late winter for those aged 64 and over.

Chronic obstructive pulmonary disease (COPD)

In Australia in 2011, COPD was certified as the underlying cause of 5,767 deaths among people aged 55 and over (102 per 100,000 people aged 55+), representing 4.4% of all deaths in that age group in that year. The median age of death due to COPD was 81 in 2007–2011.

Death rates due to COPD:

- approximately halved between 1979 and 2011 among males
- increased between 1979 and 1997 among females and then declined
- increase with age and are almost double in males compared to females
- are lowest in late summer and usually highest in the late winter months.

Deaths due to asthma and COPD are higher among

- people from English-speaking compared to non-English-speaking countries of birth
- people residing in *Remote* areas of Australia compared to *Major cities*
- Indigenous Australians compared to non-Indigenous Australians
- people residing in areas of greatest socioeconomic disadvantage.

1 Introduction

The purpose of this report is to provide up-to-date information about mortality due to asthma and chronic obstructive pulmonary disease (COPD) in Australia and to place this in a long-term context (see Box 1.1). The report includes data on number of deaths and years of life lost due to premature death, and examines trends over time and variation by age, sex, remoteness of residence, Indigenous status, country of birth and socioeconomic status. Seasonal variation and international comparisons are also presented. The report focuses on analyses up to 2011, the most recent year for which data were available for detailed analysis.

Box 1.1: What are asthma and COPD?

Asthma is a chronic lung disease, which can be controlled but not cured. In clinical practice, asthma is defined by the presence of both of the following: (1) excessive variation in lung function (that is, variation in expiratory airflow that is greater than that seen in healthy people) and (2) respiratory symptoms (for example, wheeze, shortness of breath, cough, chest tightness) that vary over time and may be present or absent at any point in time (National Asthma Council Australia 2014).

COPD is usually acquired after a long period of exposure to inhaled noxious agents, such as cigarette smoke, and is characterised by airflow limitation that is not fully reversible and by associated exertional breathlessness. It mainly affects older people, and is usually progressive over time. COPD may be associated with *emphysema* and/or *chronic bronchitis*. The terms COPD, emphysema and chronic bronchitis tend to be used interchangeably in everyday language.

In older people, there are often difficulties in the attribution of causes of death due to some respiratory conditions, particularly asthma and COPD (Jones et al. 1999; Sears et al. 1986; Smyth et al. 1996). This is because of the complexity of doctor diagnosis of respiratory problems in the elderly, and the considerable overlap between diagnoses of asthma, chronic bronchitis and emphysema (Abramson 2005; Marks et al. 2009).

COPD mainly affects older people, while asthma affects people of all ages. For this reason, and to reduce overlap with asthma due to diagnostic complexities, COPD mortality data in this report refer only to people aged 55 and over.

The report focuses primarily on deaths where asthma or COPD 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 378 deaths in 2011. This corresponds to an asthma mortality rate of 1.5 per 100,000 population and represents 0.3% of all deaths in that year. COPD was certified as the underlying cause of 5,767 deaths among people aged 55 and over in 2011. This corresponds to a COPD mortality rate of 102 per 100,000 population aged 55 and over and represents 4.4% of all deaths among this age group in that year.

Most deaths due to asthma and COPD occur in older people, many of whom have other diseases. Therefore, this report also explores asthma and COPD as *associated causes of death* in people whose deaths are due to other underlying causes (see Box 1.2).

Box 1.2: Terminology for deaths due to or associated with asthma and COPD and mortality rates

The *underlying cause of death* is the disease or injury that initiated the train of events leading directly to death, or the circumstances of the accident or violence that produced the fatal injury.

In this report, in the context of discussion about cause of death, the phrase 'due to' is used to refer to the condition recorded on the death certificate as the *underlying cause of death*.

Associated causes of death are all causes listed on the death certificate, other than the *underlying cause of death*. They include the immediate cause, any intervening causes, and conditions which contributed to the death but were not related to the disease or condition causing the death (ABS 2013).

In this report, the word 'involving' is used to refer to conditions that are recorded on the death certificate as the *underlying* or *associated causes of death*.

A *mortality rate* due to a specific condition is the number of deaths due to that condition divided by the population during a specified time period. Rates are generally multiplied by a number such as 100,000 to create whole numbers. In this report, all the mortality rates presented are age-standardised (see 'age-standardisation' in Glossary).

2 Time trends in deaths due to asthma and COPD

Asthma

All ages

In Australia, deaths due to asthma decreased in the first half of the 20th century before three peaks in asthma mortality occurred in the 1950s, 1960s and late 1980s respectively. Since then, deaths have declined substantially (Figure 2.1).

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 to adjust for these changes, see Appendix) or to other changes in diagnostic or labelling practices.

The peaks in asthma mortality observed in the 1960s and 1980s were probably attributable to the overuse of high potency reliever medications that became available at those times (Abramson et al. 2001; Campbell et al. 1992). See *Asthma in Australia 2011* for more information (ACAM 2011).

After the 1980s peak, the death rate declined by almost 70% to 1.6 per 100,000 population in 2003 and has remained stable, below 2.0 per 100,000 population, since then. In 2011, the mortality rate due to asthma was 1.5 per 100,000 population.

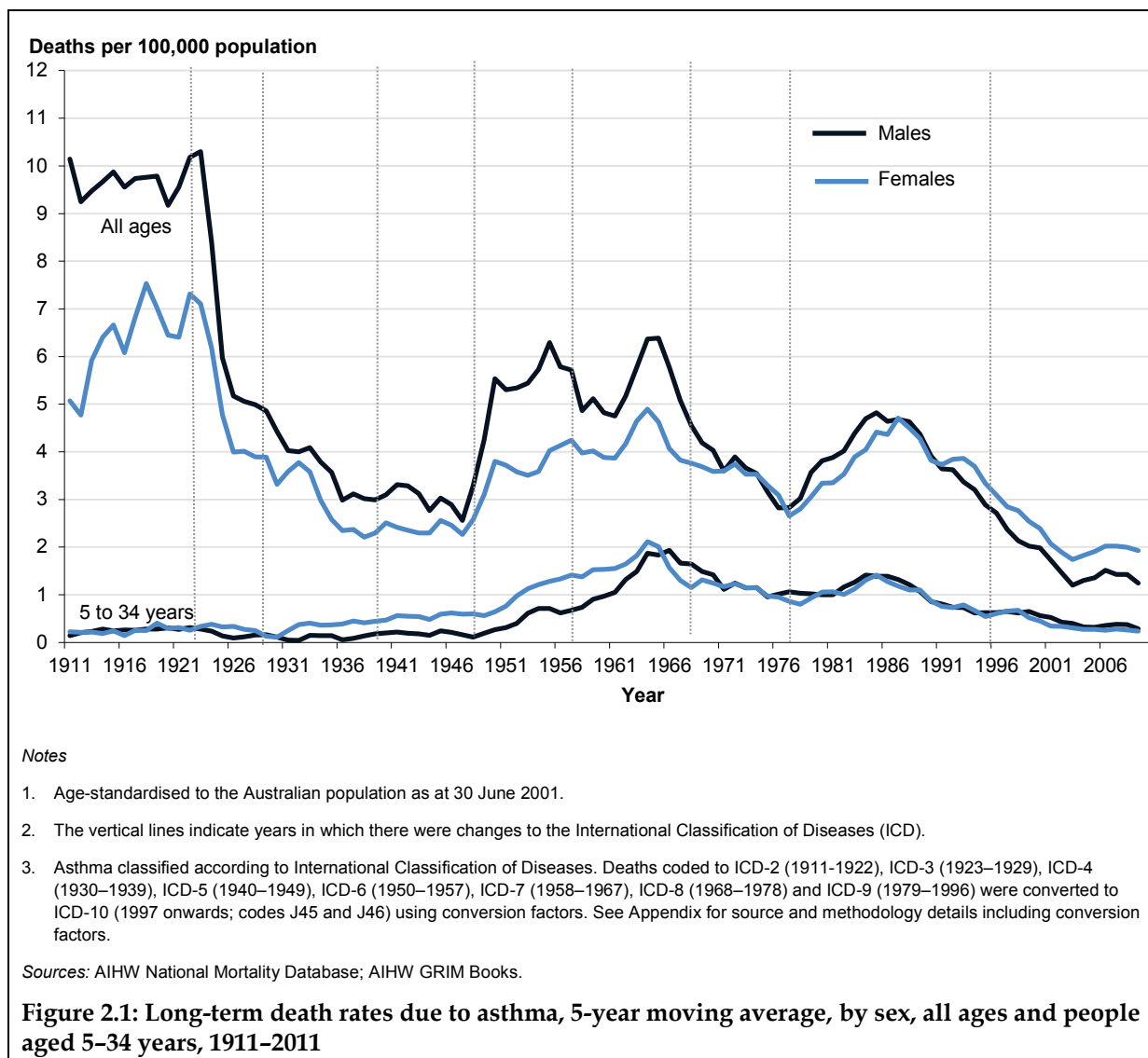
Similar long-term time trends in asthma deaths were observed in England and Wales between 1901 and 2004 (Anderson et al. 2007; Marks & Burney 1997). An increase in all-age deaths due to asthma occurred at the beginning of the 1960s, peaking in the mid-1960s, and was then followed by a decrease. During the late 1970s and early 1980s mortality rates gradually increased again, but have since declined.

People aged 5–34

Attribution of death to asthma is more certain among people aged 5–34 (Campbell et al. 1992; Malmstrom et al. 2007); thus this age group is commonly used for examining time trends and for making international comparisons.

For people aged 5–34, long term fluctuations in the rate of death due to asthma are similar to those for the whole population (Figure 2.1). There has been little change in the rate of mortality due to asthma in this age group over the last 6–7 years. In 2011, there were 17 deaths due to asthma in this age group in Australia, corresponding to a mortality rate of 0.2 per 100,000 population aged 5–34 years.

Among people aged 5–34, 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, there has been little difference between the sexes in the rate of mortality due to asthma in this age range since then (Figure 2.1).



The reason for the recent reduction in the rate of asthma mortality is uncertain. There has been no corresponding decline in the prevalence of asthma among adults (ACAM 2011). Hence, the reduction in deaths due to asthma is likely to be due to a decreased risk of dying from asthma. Factors that may have contributed to this favourable outcome include:

- the introduction of asthma management guidelines in 1989 (Woolcock et al. 1989)
- changes in the availability and use of inhaled corticosteroid treatment for asthma
- policy initiatives at state and national levels, including targeted funding and increased awareness among health professionals and patients with asthma, over this period [for example, the Asthma Cycle of Care (formerly the Asthma 3+ Visit Plan) (Department of Health and Ageing 2010)]
- better diagnosis of asthma and COPD, followed by more accurate cause-of-death certification.

Further interpretation of long-term mortality trends is provided in *Asthma in Australia 2011* (ACAM 2011).

COPD

People aged 55 and over

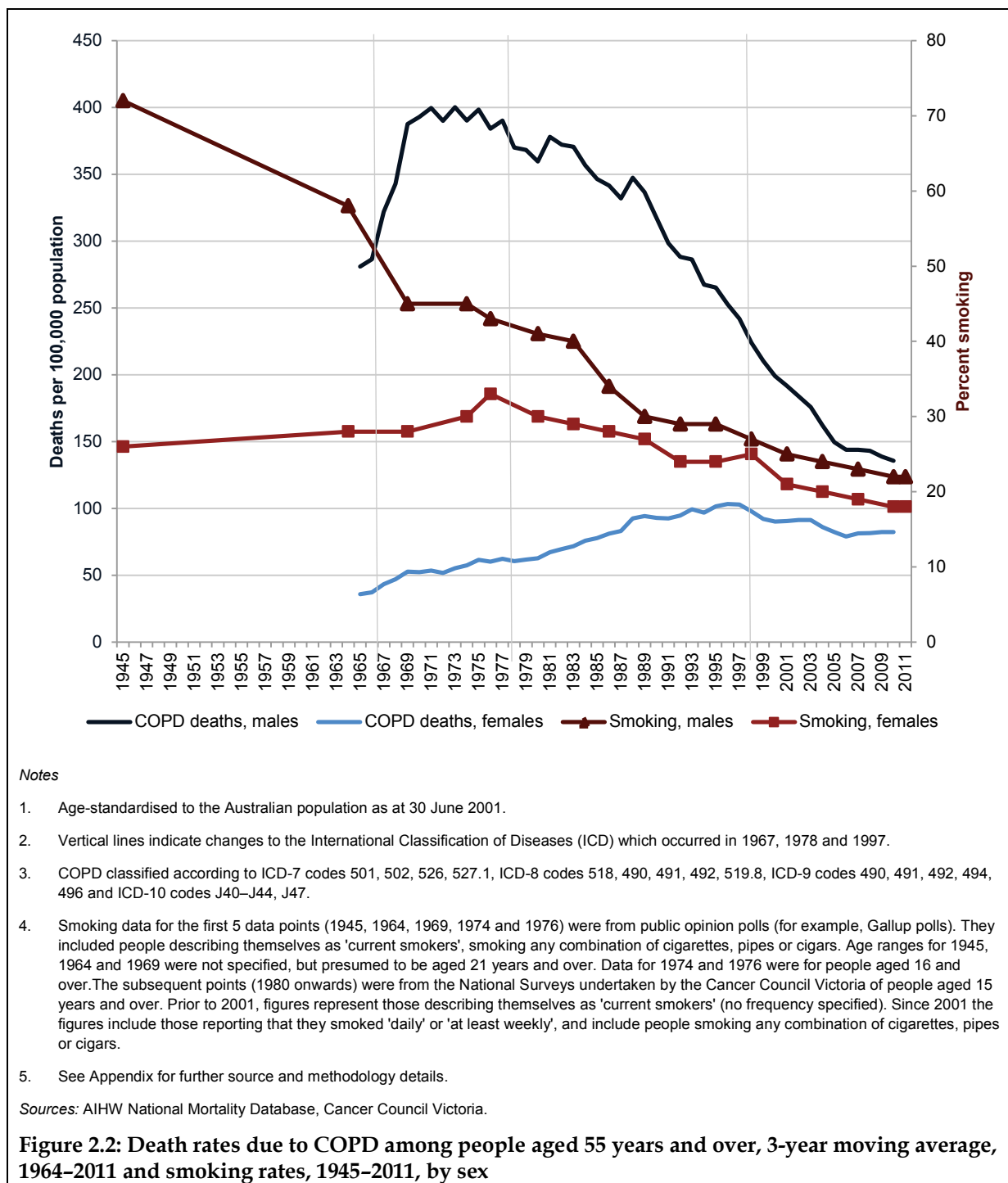
COPD is a serious long-term lung disease that mainly affects older people, while asthma affects people of all ages. For this reason, and to reduce overlap with asthma, COPD mortality data in this report refer only to people aged 55 and over.

Death rates due to COPD in Australia increased among males in the late 1960s then decreased substantially between 1970 and 2011, from 422 to 139 per 100,000 population (Figure 2.2). Among females, death rates due to COPD increased from 35 per 100,000 in 1964 to 108 per 100,000 population in 1996 but have since declined, although rates in 2011 were still higher than those observed in 1964 (86 per 100,000 population).

Tobacco smoking is the predominant cause of COPD (Fletcher & Peto 1977). In Australia, smoking rates among males have historically been higher than those observed among females. In the mid-1940s, the majority of males (72%) in Australia were smokers, compared to only 26% of females. However, smoking rates among males have steadily declined in Australia since 1945. In contrast, smoking rates among females increased until the 1970s and then began to decline.

It remains difficult to interpret the relationship between smoking rates and COPD because of the known long lag time between smoking uptake and death due to COPD. However, the decline in COPD mortality in men since the late 1960s and in women since the mid-1990s probably reflect declines in smoking prevalence that started at least 20 or 30 years earlier.

In contrast to asthma, where pharmacological treatment almost certainly reduced case fatality rates, there is no evidence of a similar benefit for people with COPD. Hence, changes in the use of medications for COPD are unlikely to have influenced the time trends in mortality due to this disease.



Data from England show a similar pattern in deaths due to COPD. Mortality rates for COPD decreased among males aged 55 and over between 1979 and 2007; however, unlike asthma deaths, COPD mortality among females aged 55 and over in England increased slightly over the same period (Goldacre et al. 2012).

Comparison with trends in all-cause deaths

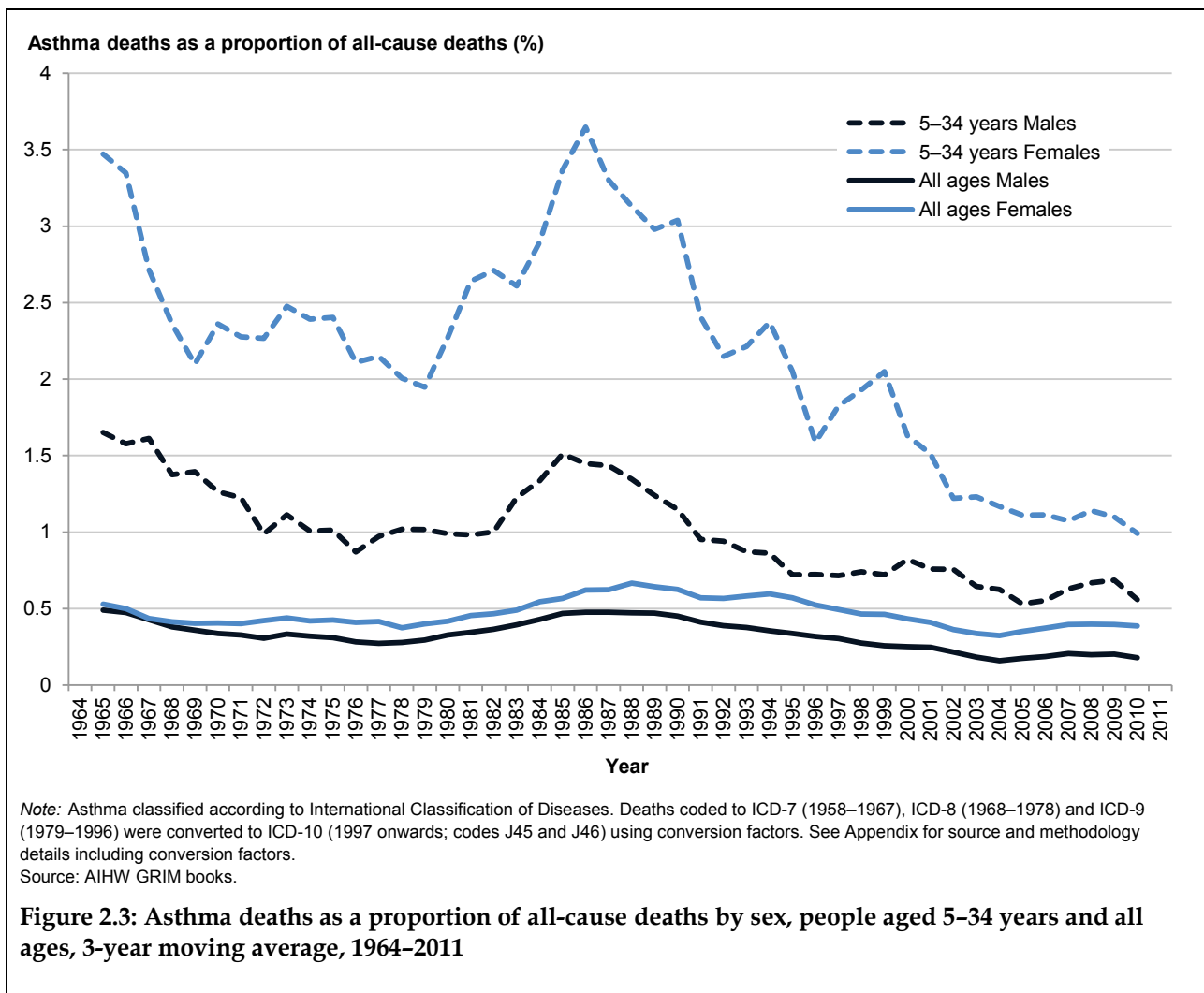
Asthma deaths as a proportion of all-cause deaths

Asthma deaths represent a larger proportion of deaths due to all causes (referred to here as 'all-cause deaths') among people aged 5 to 34 than among all ages.

Among people of all ages, the proportion of all-cause deaths due to asthma peaked in the late 1980s. This confirms that the peak in the rate of asthma deaths observed at that time (Figure 2.3) was over and above any change in the total number of deaths in Australia over the same period. This pattern was observed among both males and females.

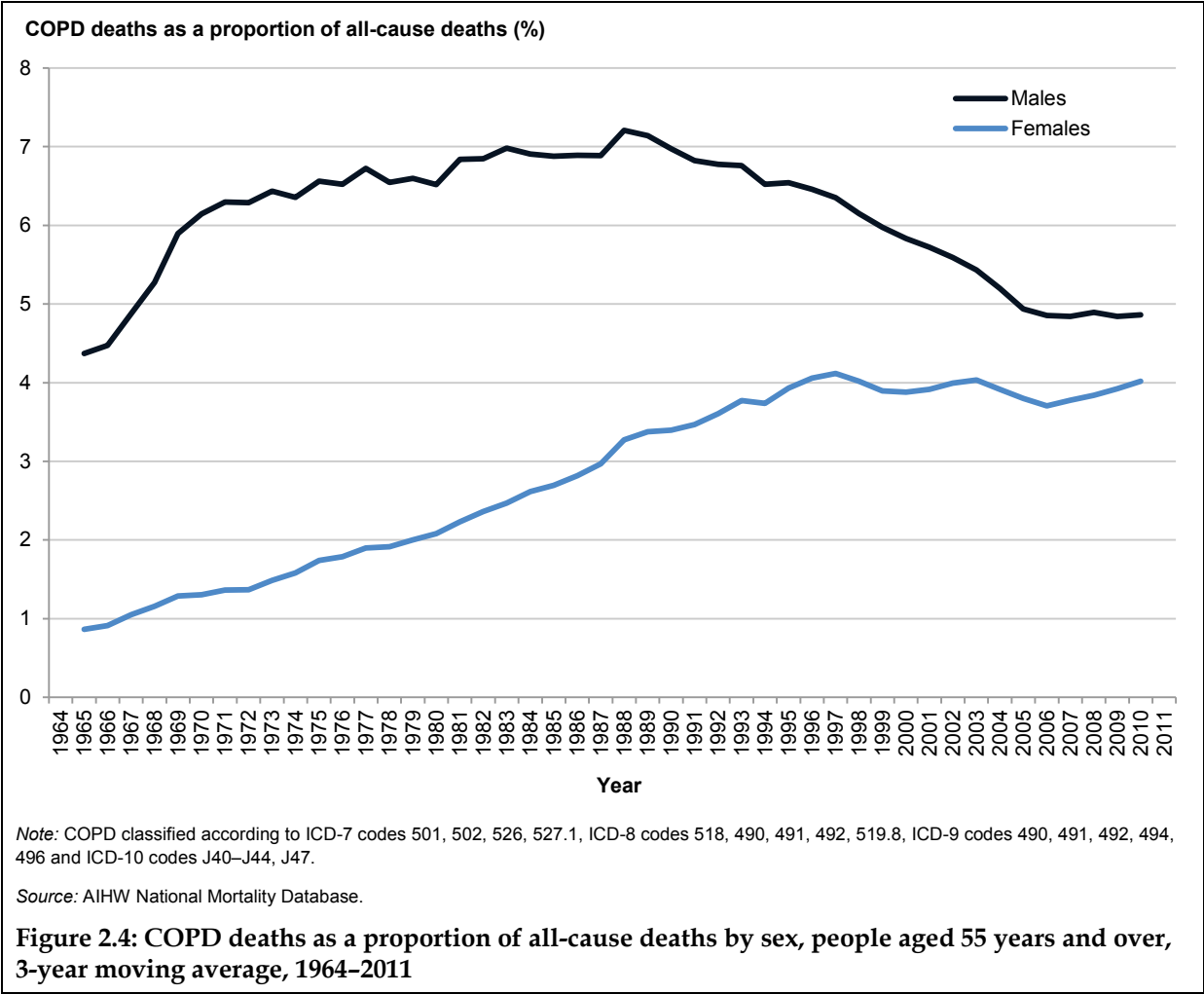
A marked peak in the proportion of all-cause deaths due to asthma was observed among people aged 5–34 over the same period, particularly among females, for whom the proportion of asthma deaths peaked at 3.7% in 1987.

Since the peak in the late 1980s there has been a decline in the proportion of all deaths due to asthma, which has been observed in both males and females. This indicates that the observed improvements in asthma mortality are additional to the overall increase in longevity during this time.



COPD deaths as a proportion of all-cause deaths among people aged 55 and over

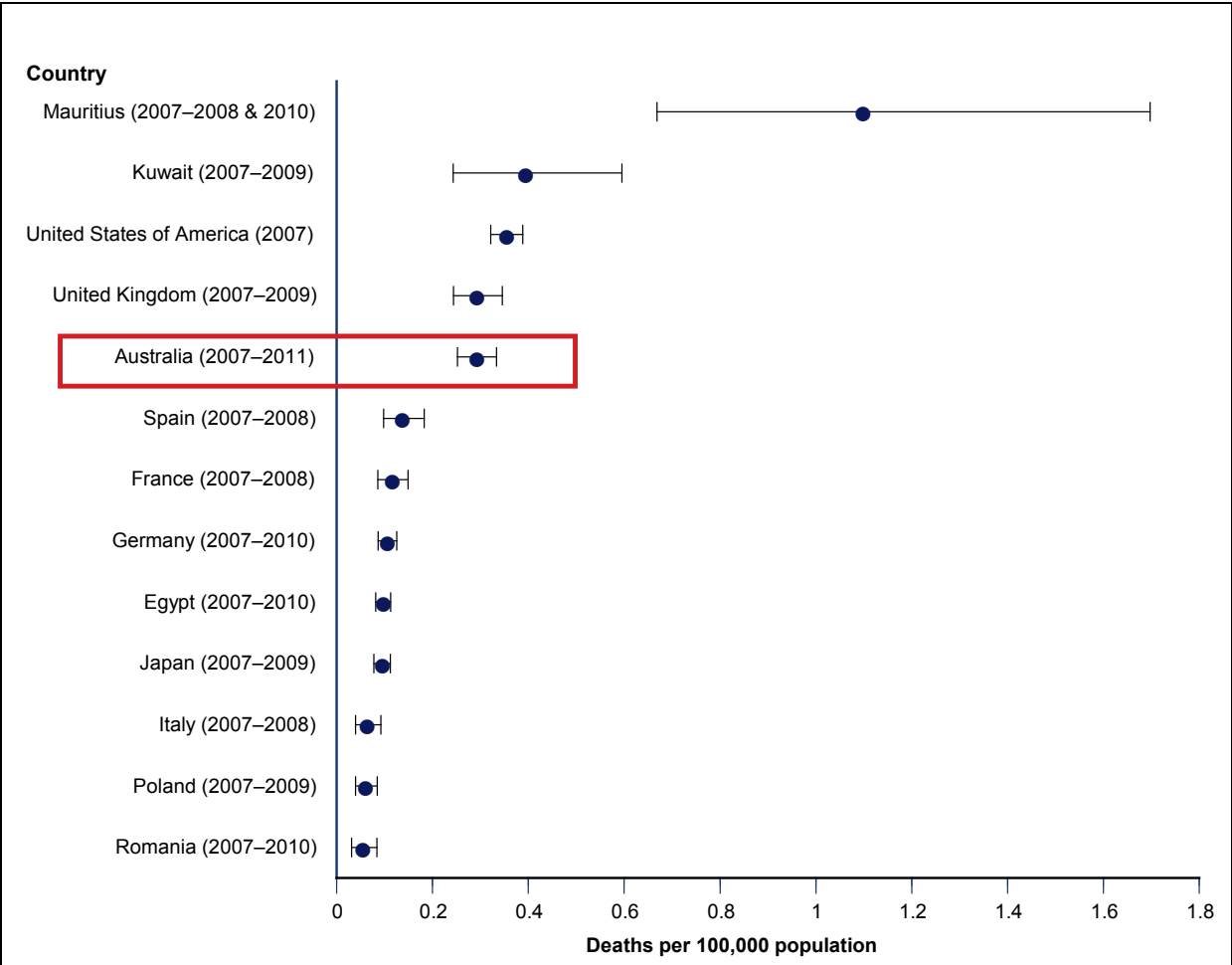
The proportion of all-cause deaths due to COPD among those aged 55 and over has stabilised in recent years (Figure 2.4). Among females, the proportion of all deaths due to COPD increased steadily from 1964 to 1996 and has remained relatively constant since 1997. In contrast, among males the proportion of all deaths due to COPD peaked in 1989 after which time there was a decline in the proportion of all deaths due to COPD until 2006, after which the proportion has been relatively constant.



International comparisons

Asthma

Mortality rates due to asthma in Australia are relatively high in comparison with many other countries. Although similar rates are reported for the United States and the United Kingdom (Figure 2.5), other countries such as Poland, Italy, Japan, Germany, and France have lower rates of mortality due to asthma than Australia. (See also the section on *Country of birth* in this report.)



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 Airways disease Monitoring (ACAM) and all interpretations and conclusions published here are those of ACAM and not 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 2007–2011 (years of coverage for each country are shown in brackets). The horizontal bar on each point estimate represents the 95% confidence interval (i.e. the true estimate for each country has a 95% probability of being between the left and right limit of this horizontal line).
4. Rates are age-standardised to the WHO World Standard Population (Ahmad et al. 2001).
5. Data are included only for those countries for which age-standardised data were available for the period 2007–2011 and for which the relative standard error for the average asthma mortality rate was less than 25%.

Sources: Data were obtained from the WHO Mortality Database for all countries, except Australia. Data for Australia for 2007–2011 were obtained from the AIHW National Mortality Database.

Figure 2.5: World ranking of asthma mortality rates, people aged 5–34 years, 2007–2011

A study involving 20 developed countries reported an overall pattern of higher asthma mortality rates in the late 1960s and mid-1980s among people aged 5–34 (Wijesinghe et al. 2009). After the late 1980s, there was a reduction in asthma mortality rates in many of these countries 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, the Netherlands and Spain.

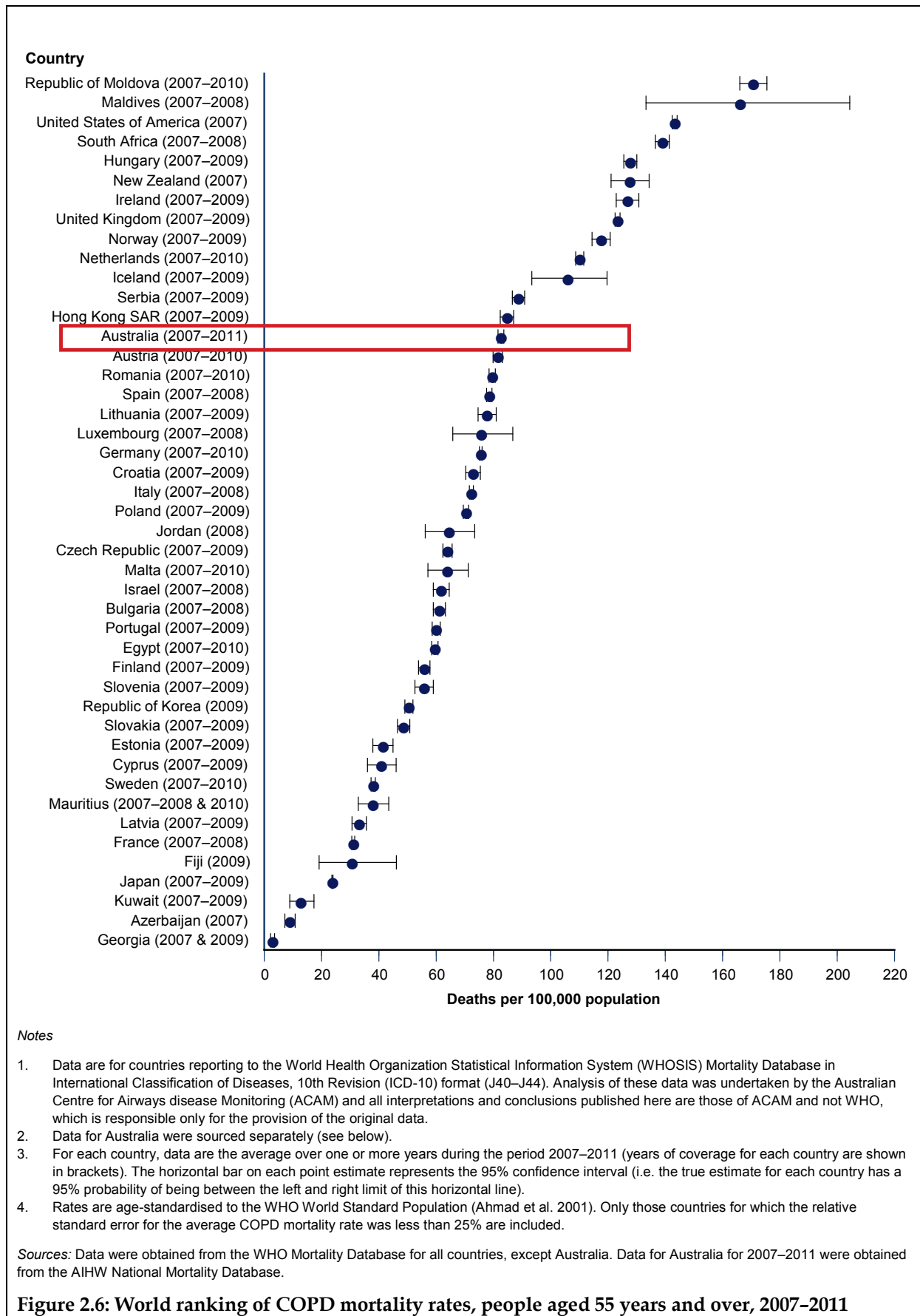
It is important to note that there are insufficient data to determine the likely causes of the variations in asthma mortality among countries. The global mortality rates due to asthma do not appear to correlate with the prevalence of the condition (GINA 2012).

COPD

COPD was the 3rd leading cause of death worldwide in 2010 (Lozano et al. 2012).

The rate of mortality due to COPD in Australia is lower than in several other developed countries, including the United States, New Zealand and the United Kingdom (Figure 2.6). However, the Australian rates are higher than those reported for Japan, France, Sweden and Finland. (See also the section on *Country of birth* in this report.)

In the United States, the COPD mortality rate among adults aged 25 years and over was reported at 63.1 per 100,000 population in 2010 (Ford et al. 2013). In the Asia-Pacific region between 1991 and 2004, reported mortality rates due to COPD among people aged 40 and over ranged from 30.0 per 100,000 population in South Korea to 73.0 per 100,000 population in Hong Kong. In this same period, the reported rate for Australia (56.0 per 100,000 population) was within this range (Tan et al. 2009).

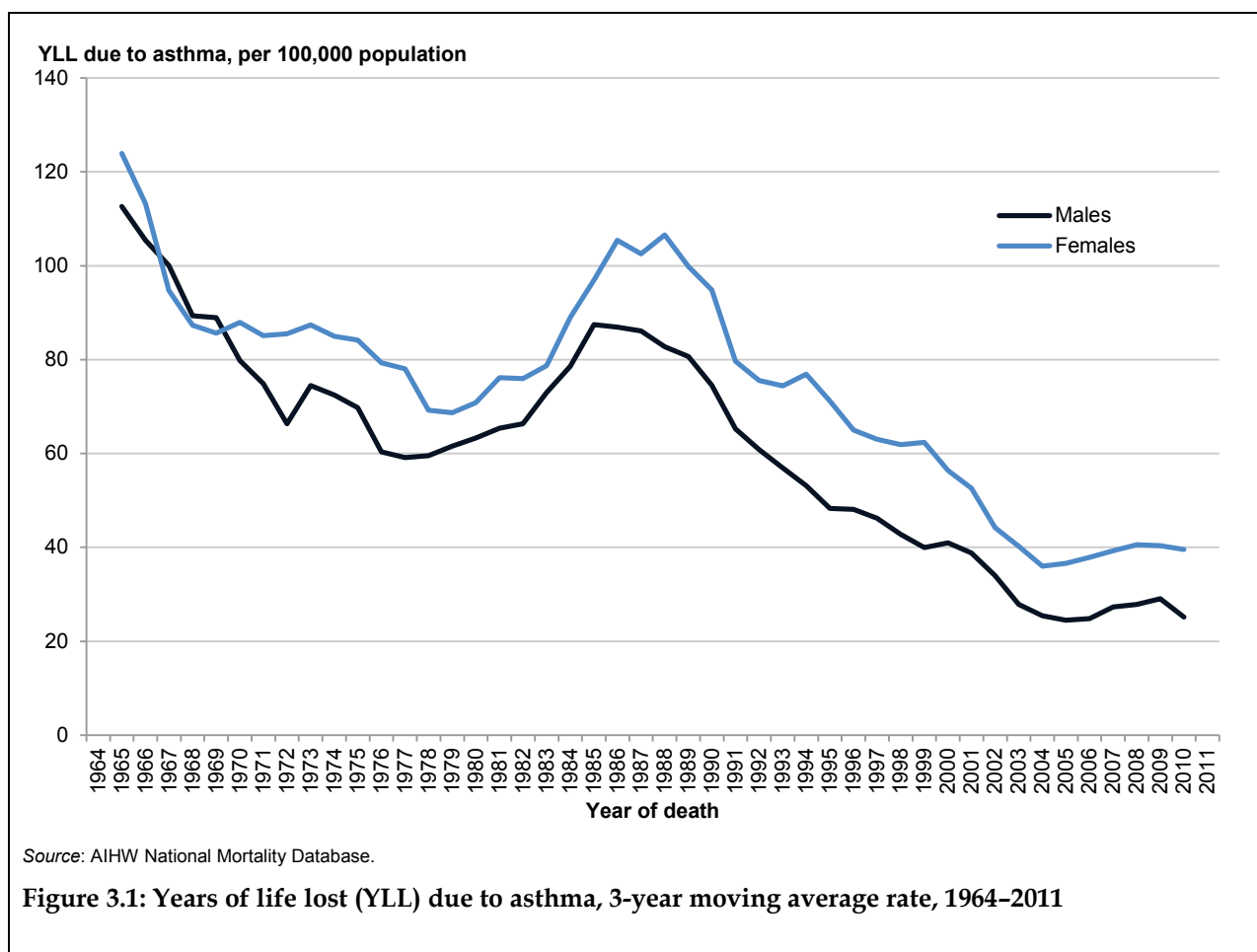


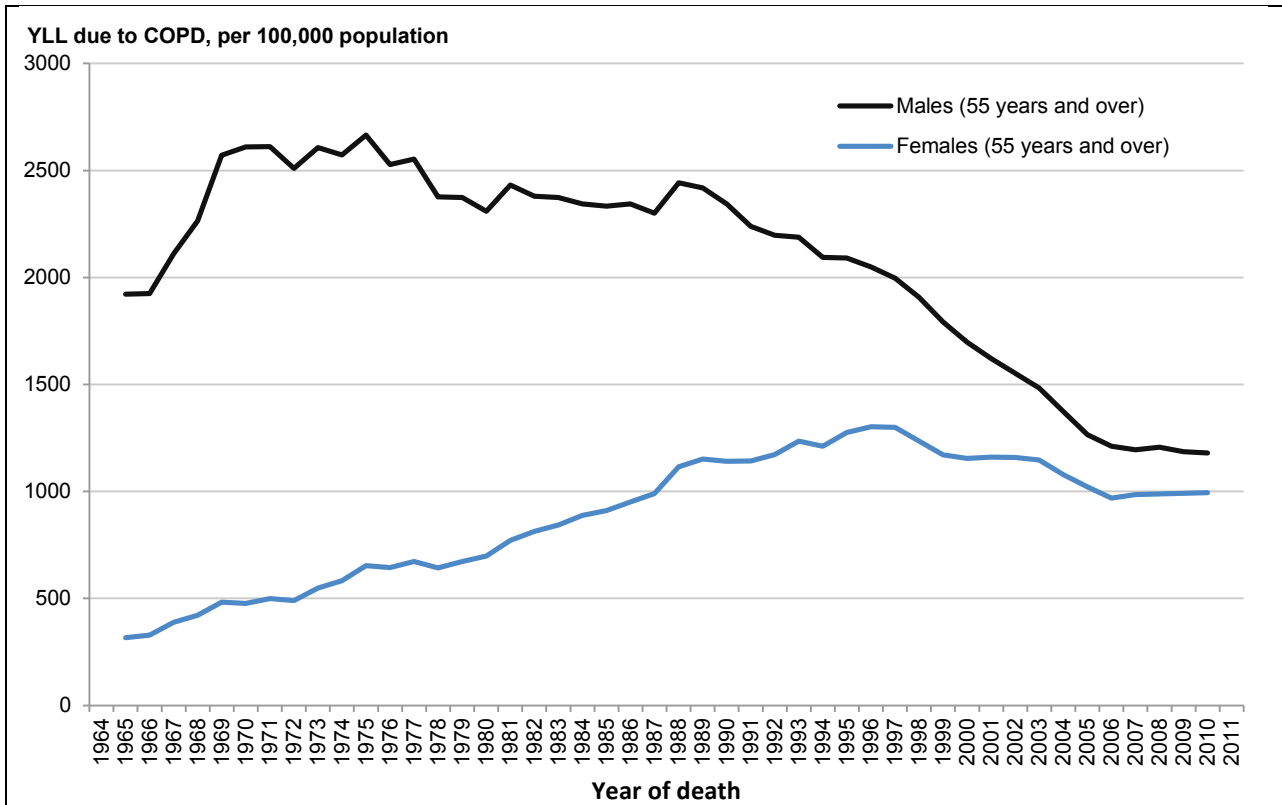
3 Years of life lost

The burden of mortality due to asthma and COPD can be expressed as the years of life lost (YLL) due to these diseases. This represents the life expectancy at the time of death, summed over all deaths due to these diseases. The result can be expressed as years of life lost per 100,000 population. YLLs take into account both the number of deaths and the age at which they occur by giving greater weight to deaths at a younger age and lower weight to deaths at an older age (WHO 2011). Therefore, YLL is more sensitive than mortality counts or rates to the effects of interventions that prevent premature deaths.

Between 1964 and the mid-1980s, YLL due to asthma declined before a large peak in the late 1980s (Figure 3.1). The decline and peak over this time was evident among males and females and mirrored the pattern seen in long term trends in the age-standardised rate of asthma deaths (Figure 2.1).

YLL due to COPD declined among males between the 1970s and 2005 and has since remained steady (Figure 3.2). In contrast, among females, YLL due to COPD steadily rose from 1964 to the late 1990s. Since this time, the YLL due to COPD among females has declined, but is still much higher than the rate observed in the 1960s and 1970s. This may be related to the different pattern of smoking uptake between males and females whereby the prevalence of smoking increased in women up to the mid-1970s but has been decreasing in men since the 1940s (Adair et al. 2012).



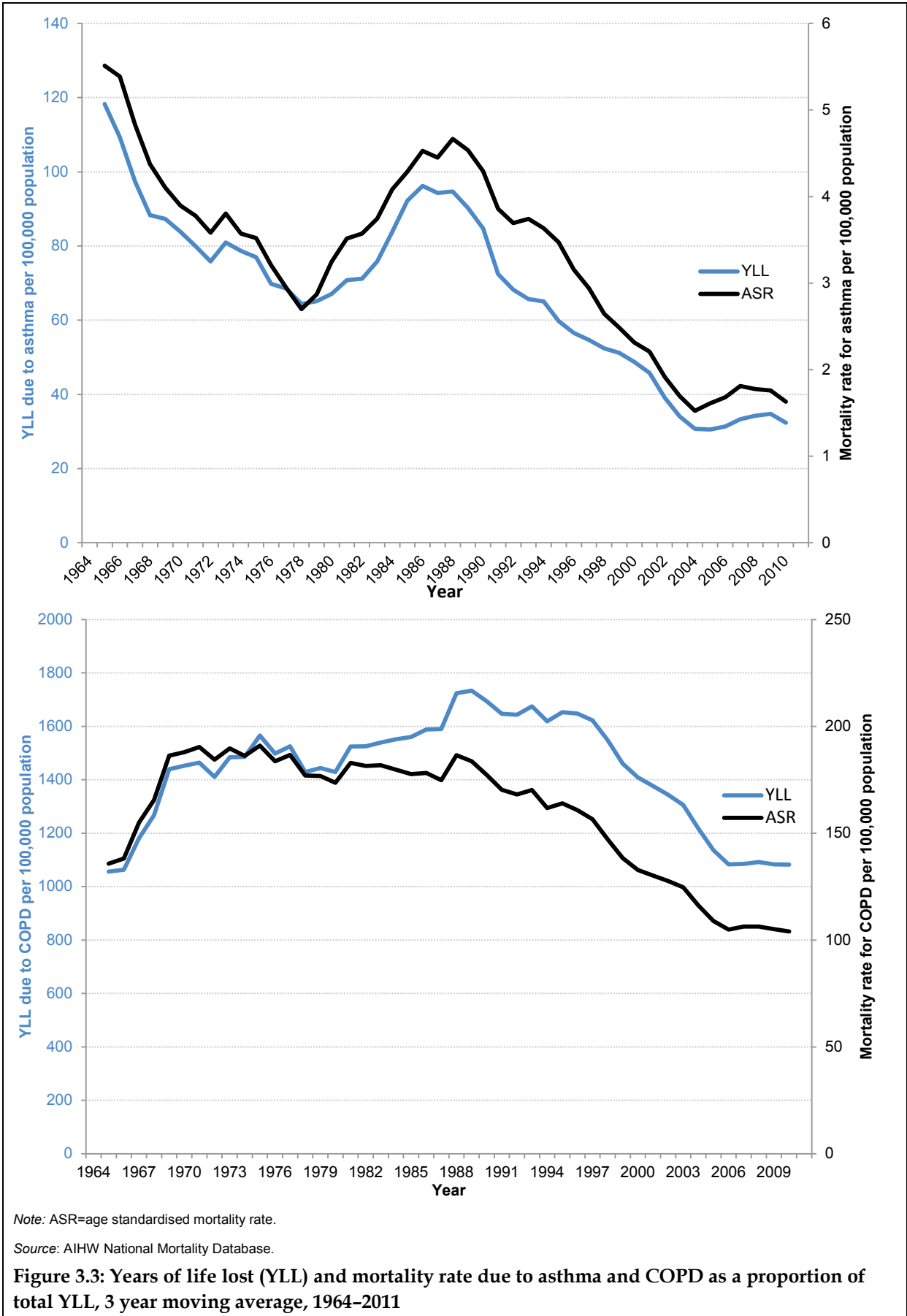


Source: AIHW National Mortality Database.

Figure 3.2: Years of life lost (YLL) due to COPD, 3-year moving average rate, 1964–2011

For deaths due to asthma, mortality rates and YLL from 1964 to 2011 have shown remarkably similar trends (Figure 3.3). This indicates that, over this period, there has been no change in the age distribution of deaths due to asthma except what is attributable to overall increase in life expectancy over this period.

In contrast, YLL due to COPD declined less than mortality rates due to COPD between 1980 and 2000, which indicates that, relative to the increase in life expectancy over this period, the age at death of people dying due to COPD has not increased to the same extent. In other words, prevention of premature death due to other causes, such as heart disease, was more effective than prevention of premature death due to COPD during the last two decades of the 20th century.



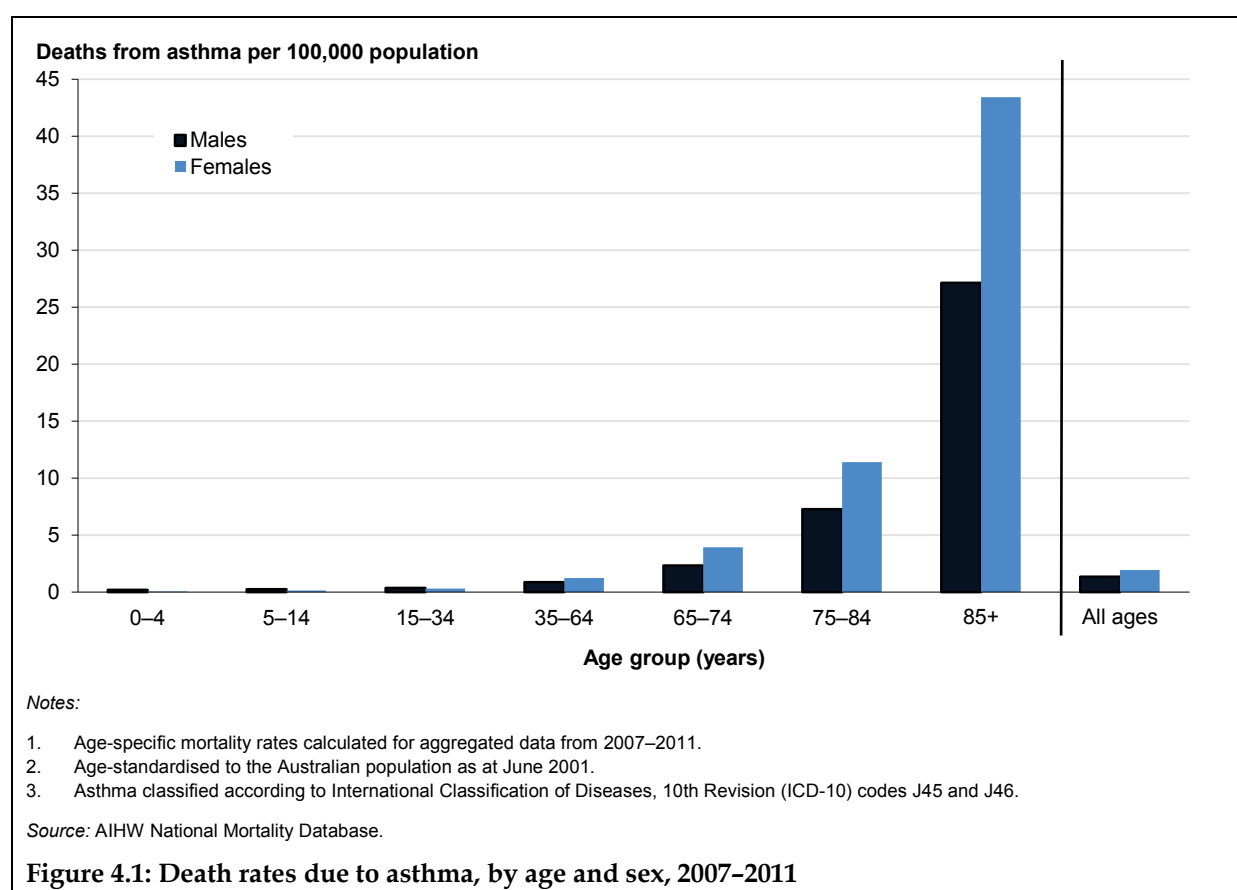
4 Population subgroups

Age and sex

Asthma

While deaths due to asthma occur in all age groups, the risk of dying from asthma increases with age in both males and females (Figure 4.1). The median age at death due to asthma was 80 years between 2007 and 2011. COPD deaths are also most common in older people (median age at death 81 years from 2007–2011). 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 in older people is not reliable in clinical practice or in mortality statistics. [See *Asthma in Australia 2011* for more information (ACAM 2011).]

Death rates due to asthma among children aged 0–4 and 5–14 were less than or equal to 0.2 per 100,000 population during the period 2007–2011, while rates in people aged 15–34 and 35–64 were 0.4 and 1.1 per 100,000 population, respectively (Figure 4.1).



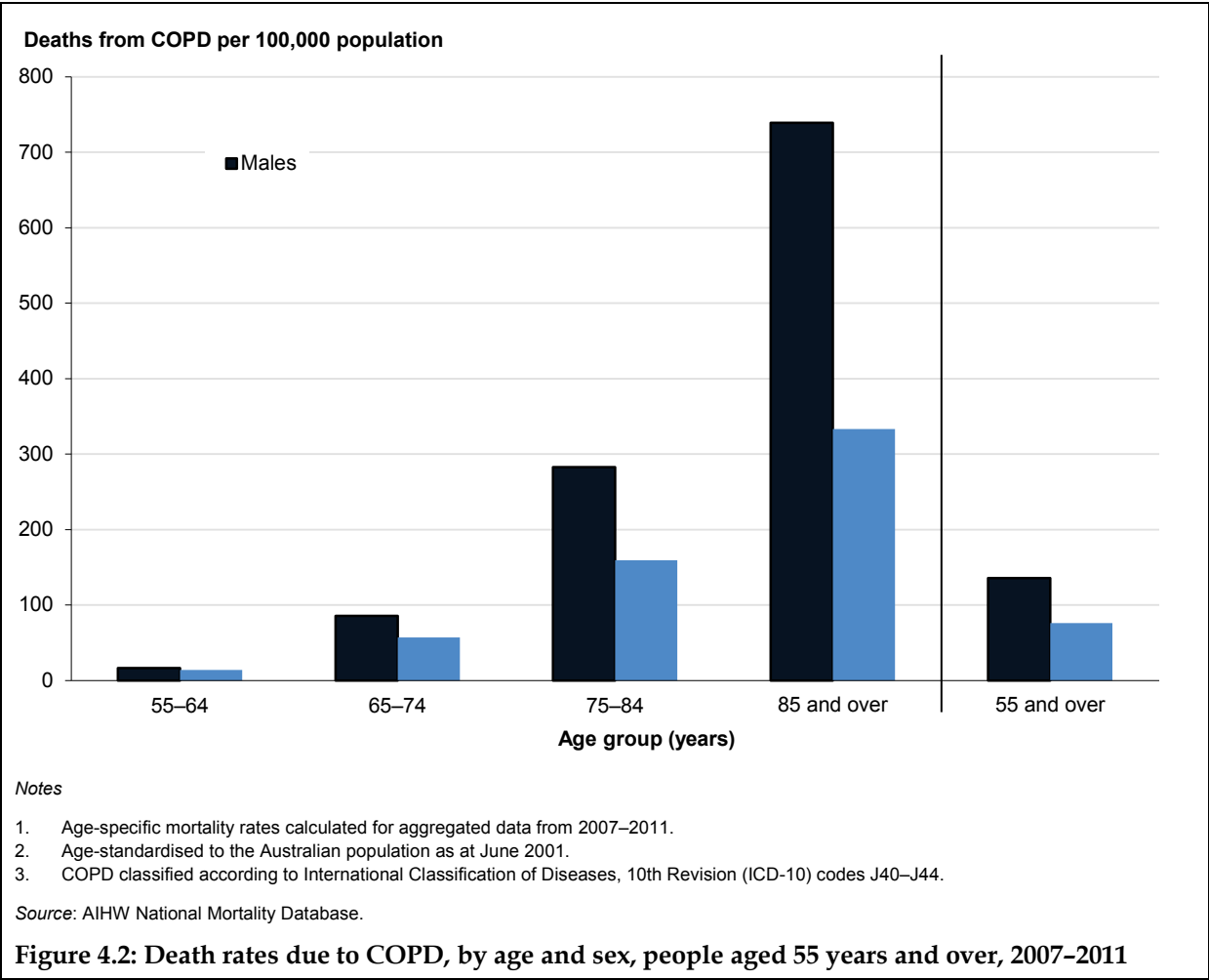
Among people aged 5–34, the rate of mortality due to asthma is higher among males than females. However, among people aged 35 and over the rate of death due to asthma is higher in females than males (Figure 4.1). This could be due to several reasons, for example, asthma is much more prevalent in women than in men and there is evidence of diagnostic bias by

gender, with GPs more likely to assign the diagnosis of COPD to male rather than female patients (Han et al. 2007).

COPD

Between 2007 and 2011, the median age of death from COPD was 81 years. Among people aged 55 and over, the risk of dying from COPD increased with age (Figure 4.2) and was 1.8 times higher in males (136 per 100,000 population) than in females (76.0 per 100,000 population). The disparity between males and females also increased with age. Among people aged 55–64, the mortality rate due to COPD among males was 1.2 times that of females, while among people aged 85 and over, the mortality rate among males was 2.2 times that of females.

This may reflect a higher prevalence of smoking or smoking history among males in this cohort. Rates of smoking have steadily declined in males in Australia since the mid-1940s (see Figure 2.2).

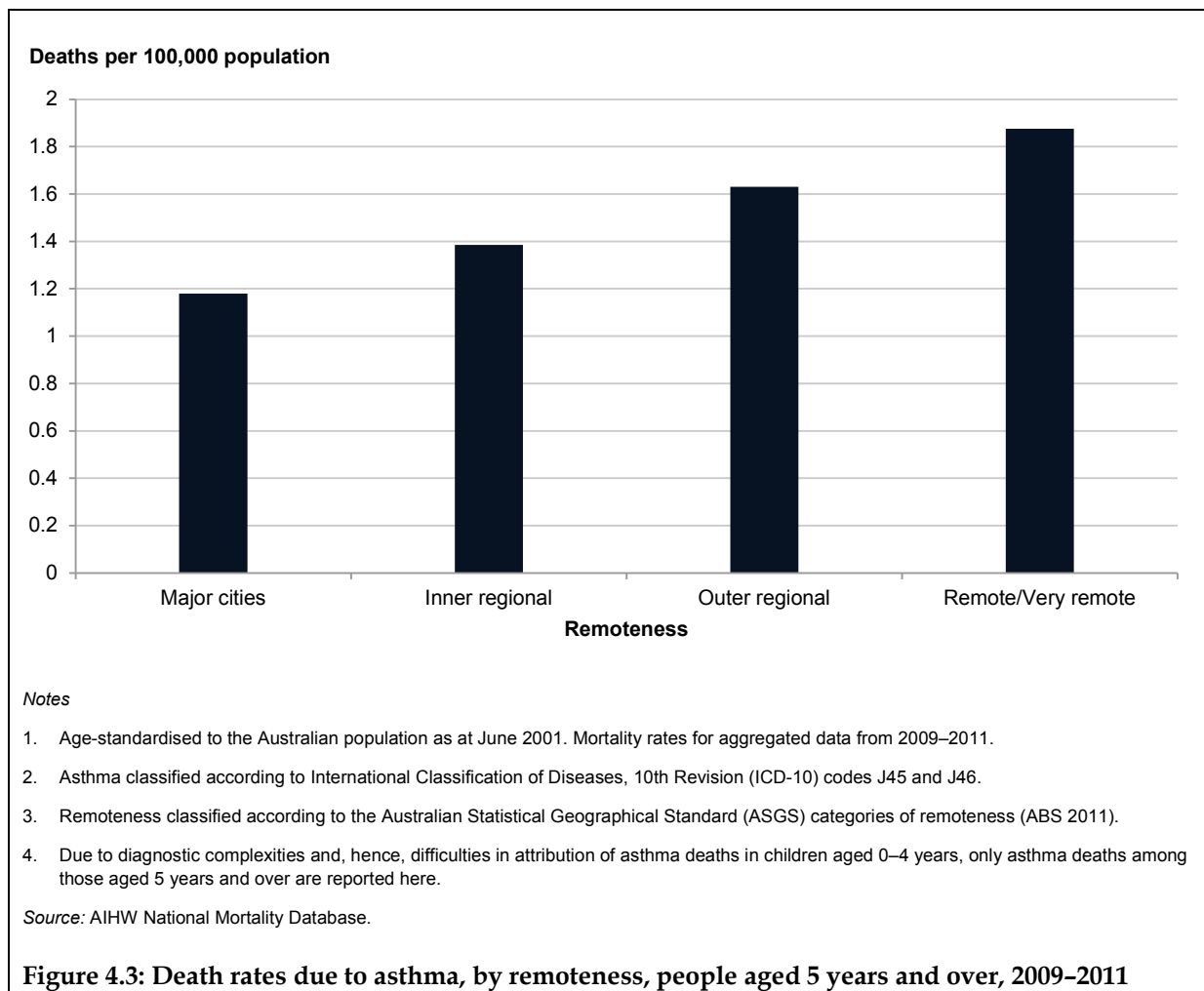


Remoteness

Asthma

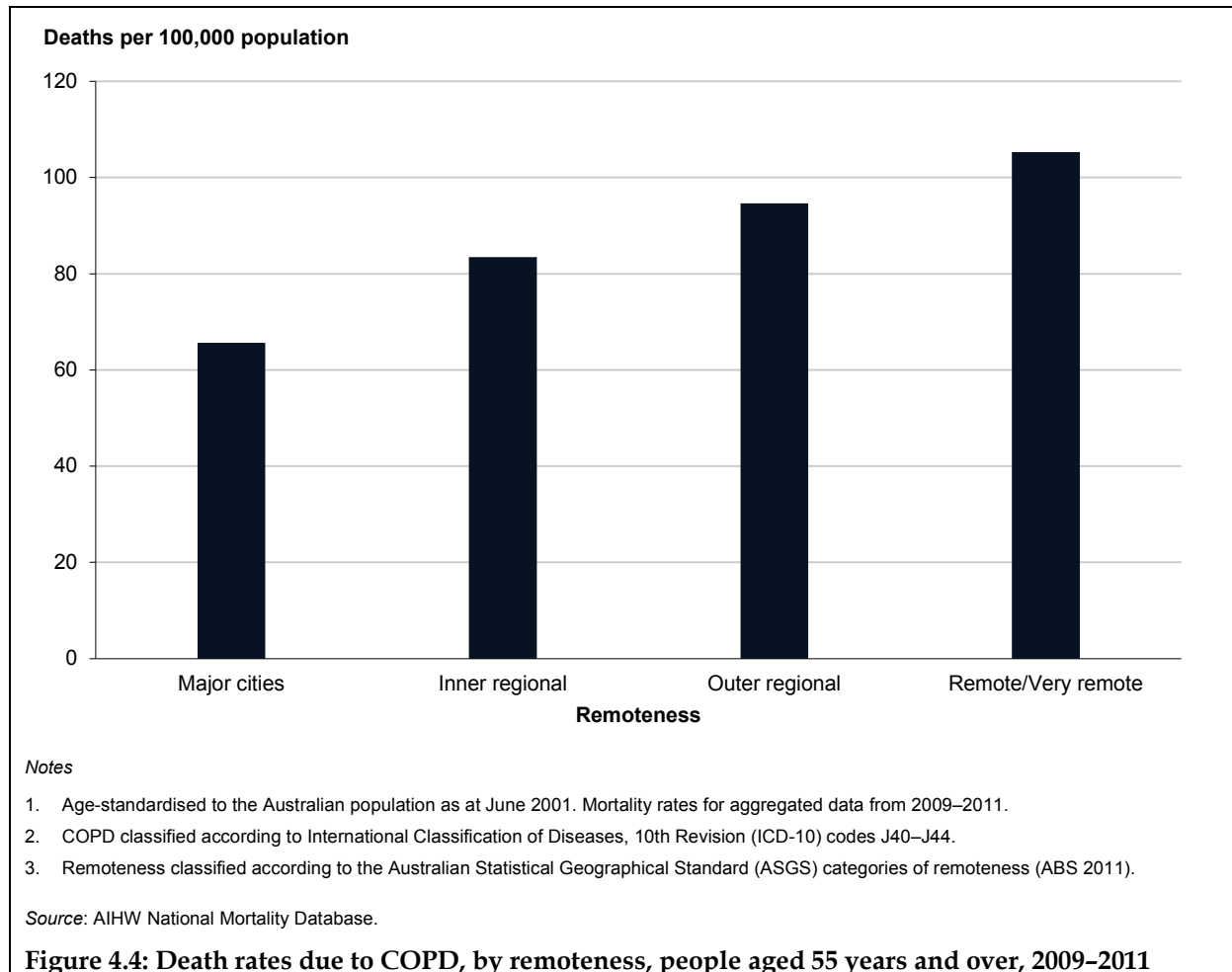
Mortality rates due to asthma increased with increasing remoteness of residence. Mortality rates due to asthma were higher among people residing in *Outer regional* and *Remote/Very remote* areas than in *Major cities* and *Inner Regional* areas (Figure 4.3). This pattern applied across all age groups. This finding is consistent with the observation that a high proportion of deaths due to asthma that were reported to the coroner were for people living in rural or remote areas (45%) despite only 32% of the overall Australian population residing in these areas (Goeman et al. 2013).

This pattern is consistent with the regional variation observed for hospital separations for asthma (ACAM 2011) and all-cause hospital separations (AIHW 2013) among adults. These results may reflect regional variation in access to health care.



COPD

Among people aged 55 and over, mortality rates due to COPD increased with remoteness of residence (Figure 4.4). The highest death rate due to COPD occurred in *Remote/Very remote* areas. This pattern was seen in all age groups.

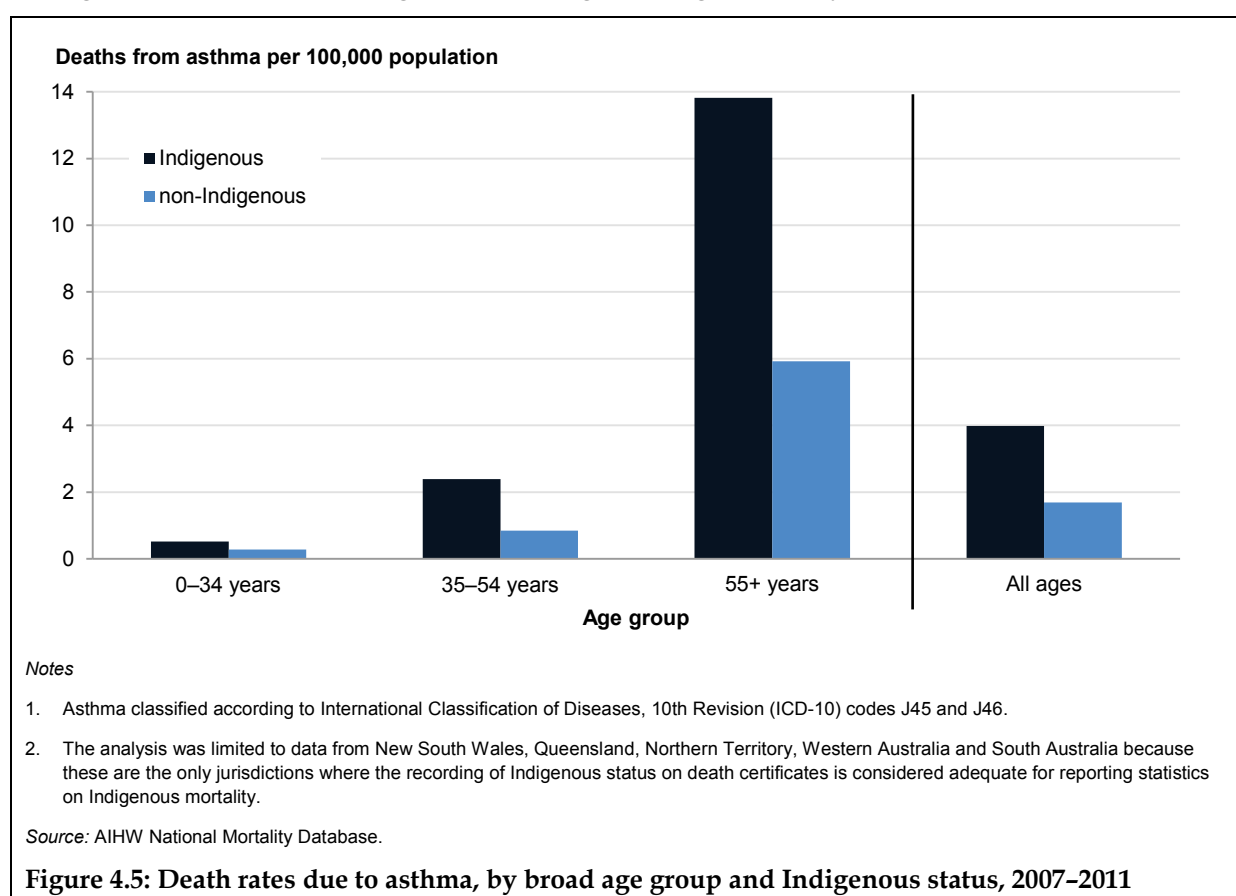


There was no difference in mortality rates due to asthma or COPD according to state/territory of death (data not shown).

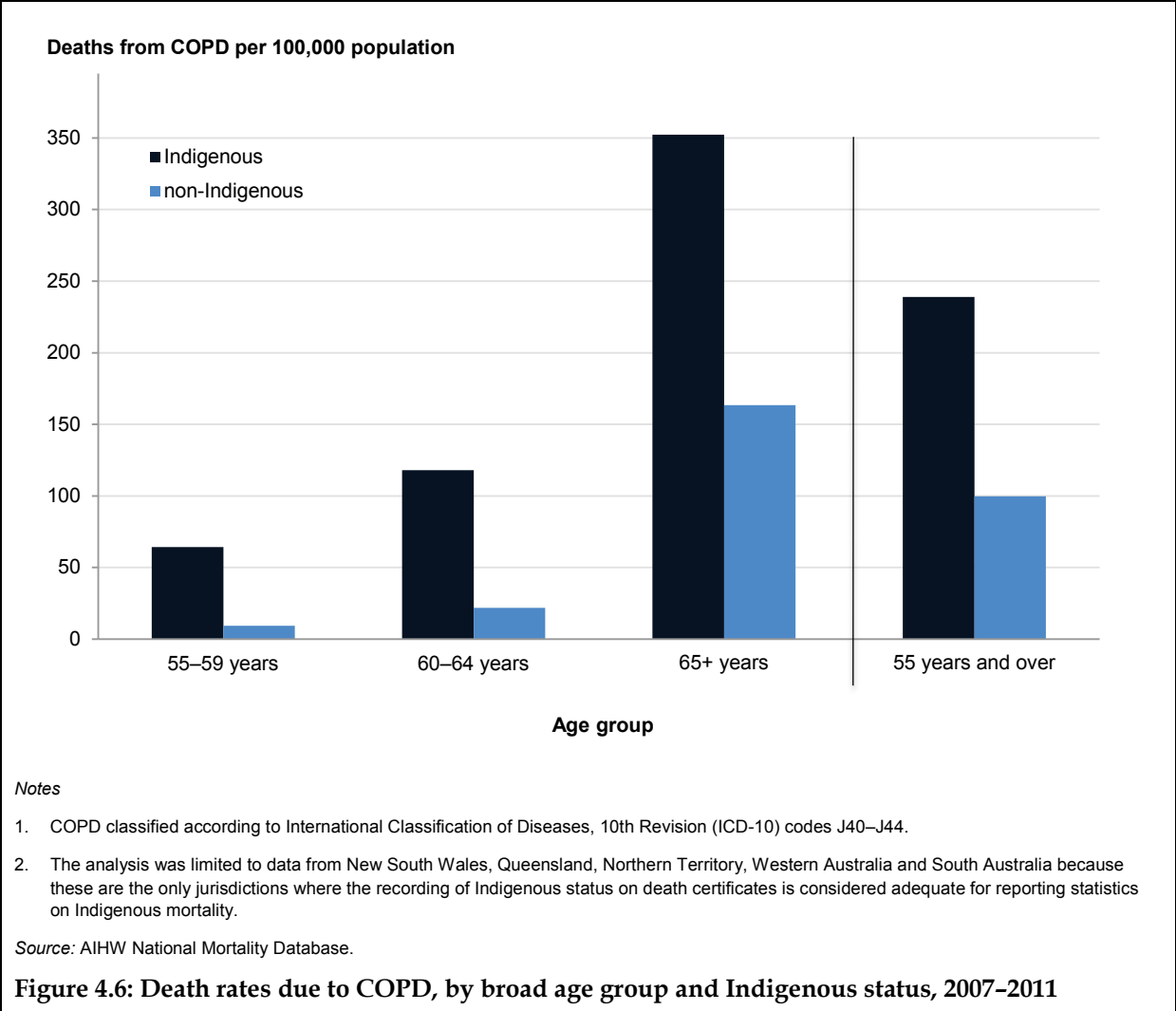
Aboriginal and Torres Strait Islander people

Aboriginal and Torres Strait Islander people (referred to in this report as Indigenous Australians) experience higher overall mortality rates than non-Indigenous Australians (ABS 2012). Furthermore, the Indigenous Australian population (median age 21.8 in 2011) has a younger age structure than the non-Indigenous population (median age 37.6 in 2011) (ABS 2013).

During the period from 2007 to 2011, the mortality rate for asthma among Indigenous Australians of all ages was 4.0 per 100,000 population, which was 2.3 times that of non-Indigenous Australians (1.7 per 100,000 population; Figure 4.5). The mortality rate due to asthma increased with age among Indigenous Australians and non-Indigenous Australians (Figure 4.5) and the disparity in the mortality rate between Indigenous Australians and non-Indigenous Australians was greatest among those aged 35–54 years.



During the period from 2007 to 2011, the mortality rate for COPD among Indigenous Australians aged 55 and over was 263 per 100,000 population, 2.6 times that of non-Indigenous Australians (101 per 100,000 population; Figure 4.6). The disparity in the mortality rate for COPD between Indigenous and non-Indigenous Australians was greatest among those aged 55–59 years. In this age group, the mortality rate for COPD among Indigenous Australians was 7 times that of non-Indigenous Australians. Deaths due to COPD among Indigenous Australians and non-Indigenous Australians aged 55 and over increased with age (Figure 4.6).

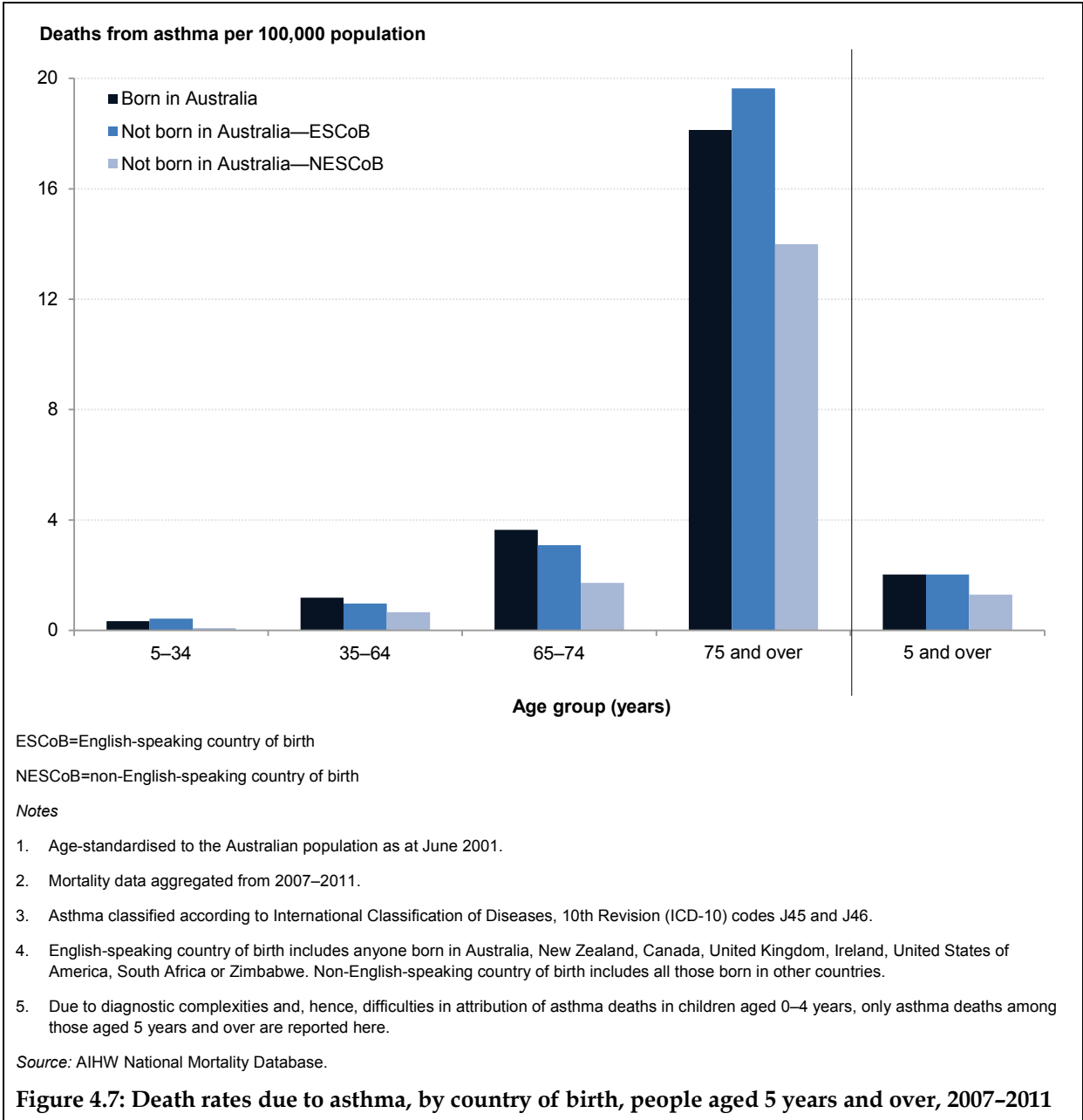


Country of birth

Asthma

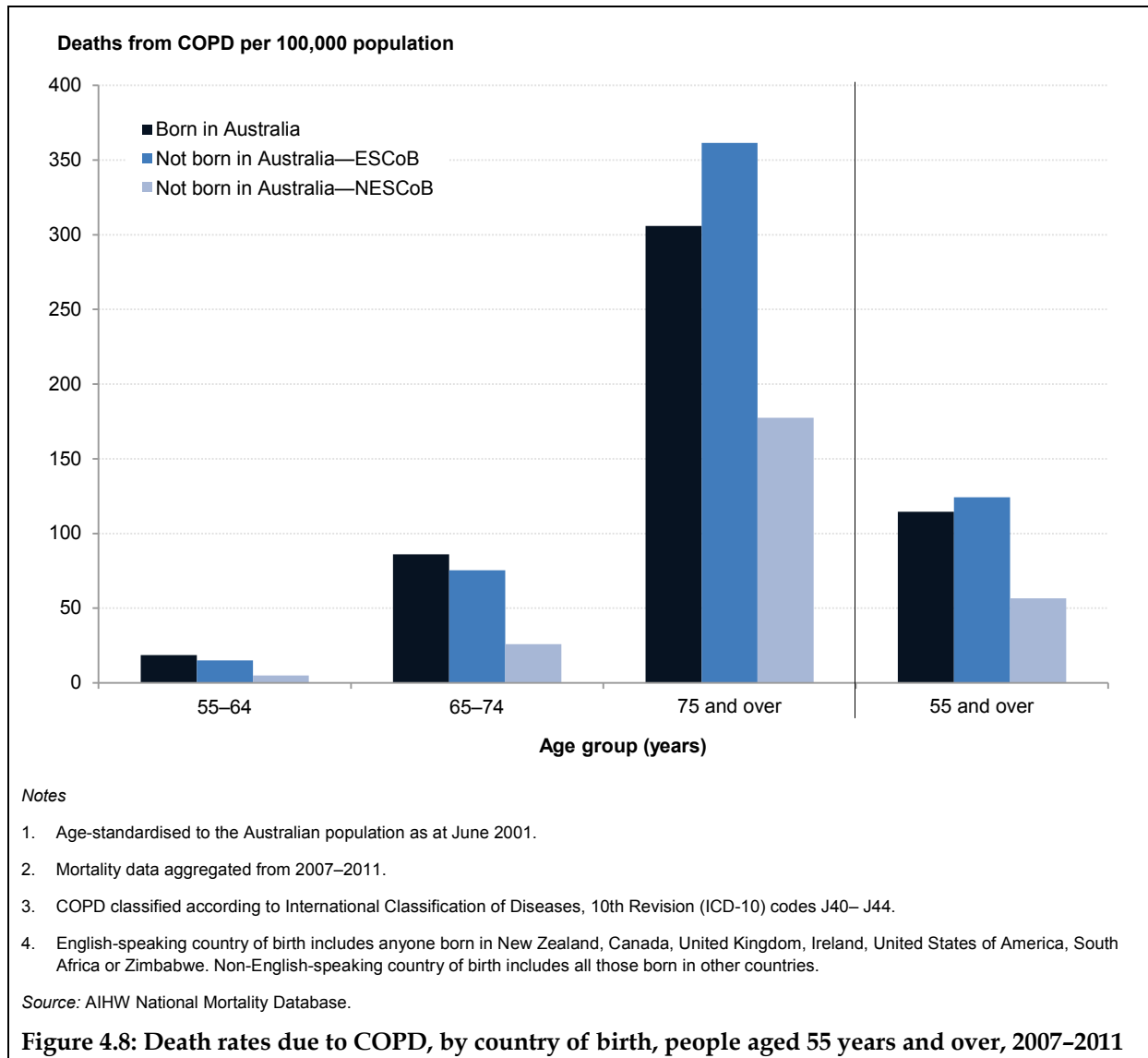
Among people aged 5 and over, the mortality rate due to asthma was higher among people born in Australia or in other English-speaking countries (2.0 per 100,000 population) compared with those from a non-English-speaking country of birth (1.3 per 100,000 population). The disparity was largest among those aged 5–34 years. In this age group, people from an English-speaking country of birth were 4 times as likely to die from asthma as those from a non-English-speaking country of birth (Figure 4.7).

The mortality rate due to asthma was similar among people born in Australia and people born in other English-speaking nations who subsequently migrated to Australia (Figure 4.7).



COPD

Among people aged 55 and over, the mortality rate due to COPD was twice as high among people born in Australia or in other English-speaking countries (115 and 124 per 100,000 population, respectively) compared with those from a non-English-speaking country of birth (56.5 per 100,000 population). The disparity was largest among people aged 55 to 64, where the mortality rate for those born in Australia was 3.8 times the rate for those from a non-English-speaking country of birth (Figure 4.8). There was no difference in the mortality rate due to COPD between people born in Australia and people born in other English-speaking countries who subsequently migrated to Australia.

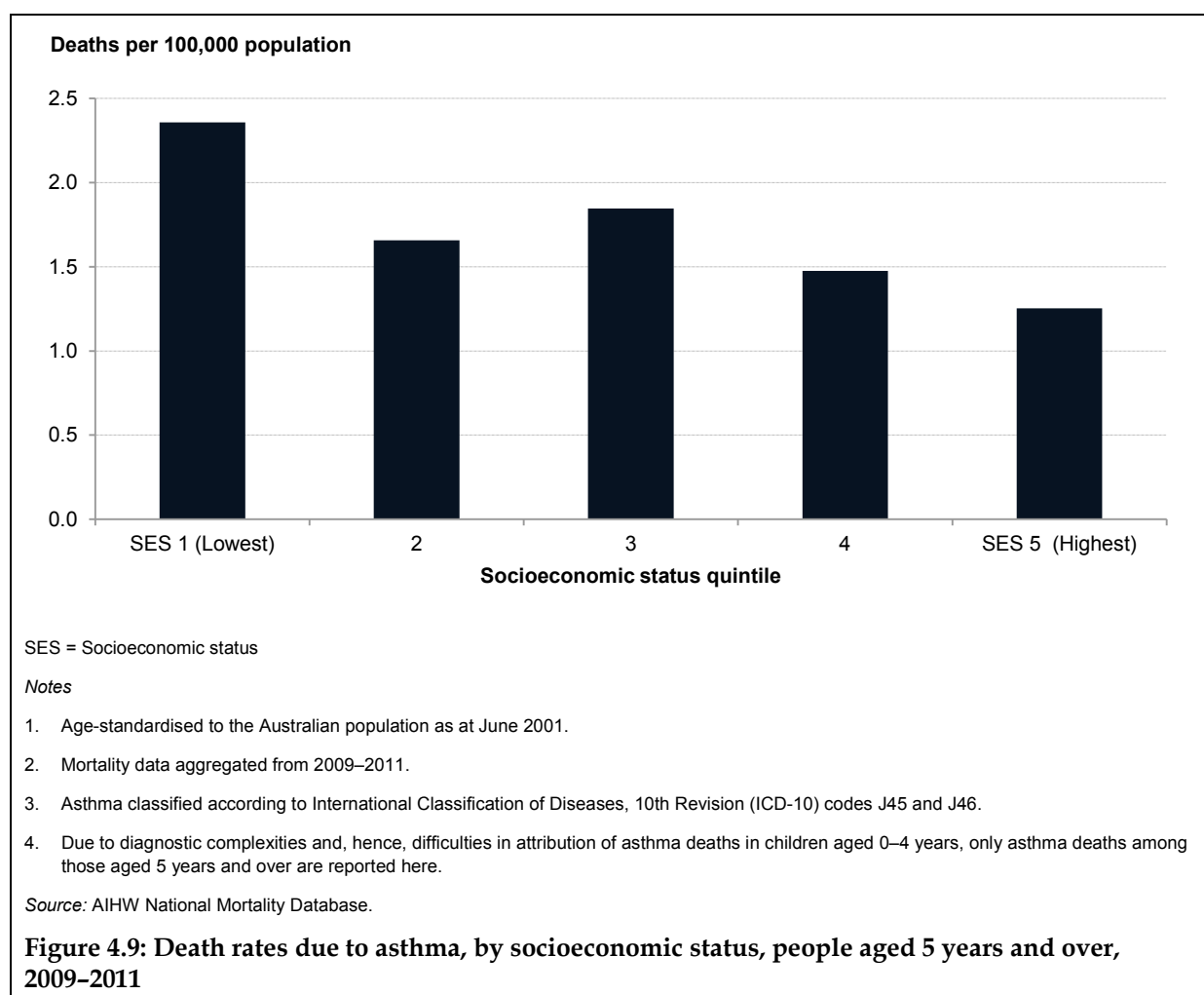


Since differences in mortality rates are observed between people from an English-speaking country of birth (including Australia) and people from a non-English-speaking country of birth for asthma and COPD, the disparity observed cannot simply be due to misattribution of COPD or asthma. The more likely explanation is that this represents a real difference in the risk of mortality from obstructive lung disease between these population subgroups. The cause of this difference is unknown.

Areas of socioeconomic disadvantage

Asthma

Socioeconomic factors may influence asthma control and health-seeking behaviours. In children, various studies have shown that severe asthma is associated with lower socioeconomic status and poverty (Babin et al. 2007; Mielck et al. 1996). Studies from Australia and the United States of America also show a higher risk of asthma mortality related to lower socioeconomic status (Castro et al. 2001; Goeman et al. 2013; Grant et al. 2000). This is reflected in data from the AIHW National Mortality Database, which show higher asthma mortality rates among those residing in areas of lowest socioeconomic status (2.4 per 100,000 population) compared to those residing in areas of highest socioeconomic status (1.3 per 100,000 population; Figure 4.9).

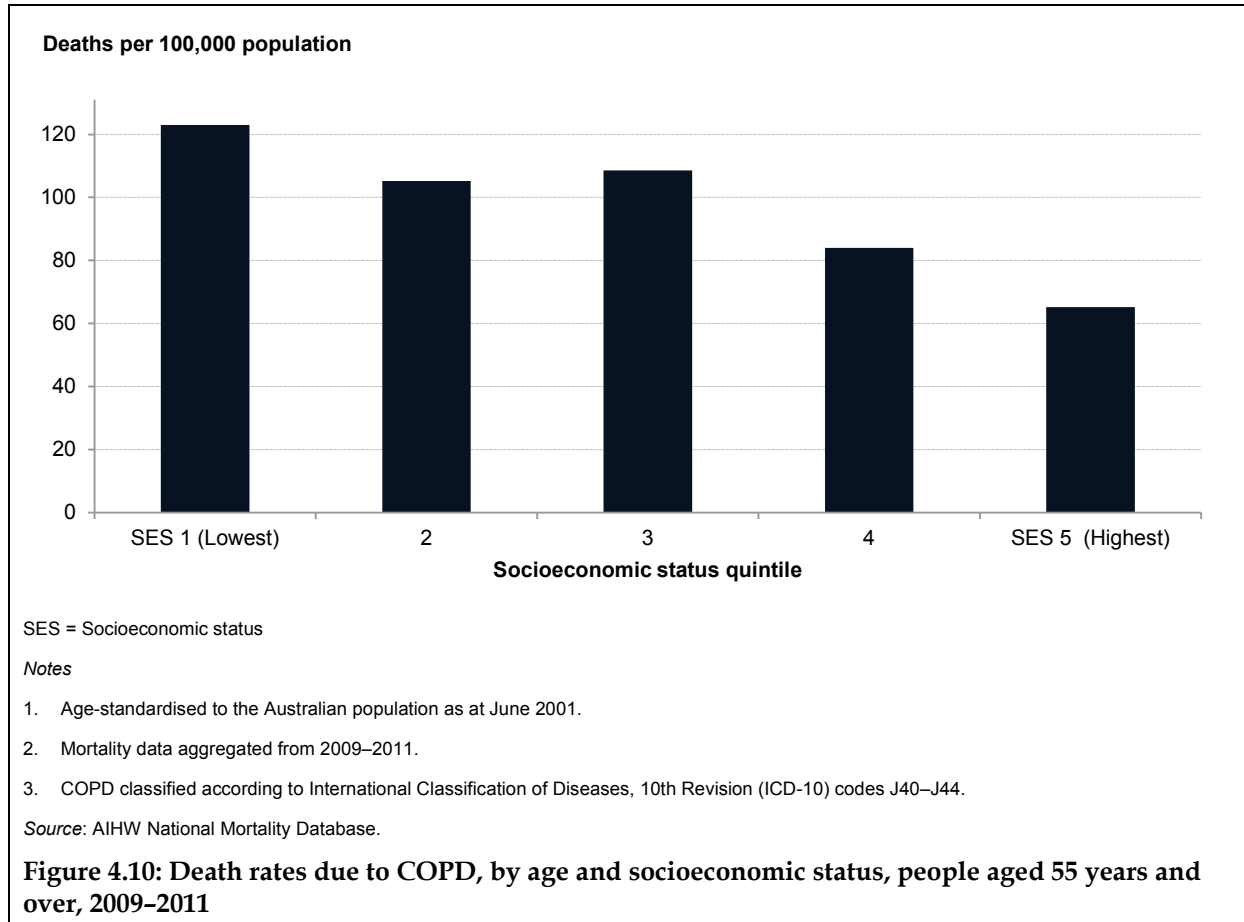


The disparity is particularly evident among people aged 5–34 in whom asthma mortality rates are four times as high among those living in areas of lowest socioeconomic status (0.4 per 100,000 population) compared with those residing in areas of highest socioeconomic status (0.1 per 100,000 population; data not shown).

It should be noted that for the data presented here, socioeconomic status is based on the area of usual residence and, hence, reflects the relative disadvantage of all people living in an area, not necessarily that of an individual.

COPD

Mortality due to COPD among people aged 55 and over is almost double among those residing in areas of lowest socioeconomic status (123 per 100,000 population) compared with those residing in areas of highest socioeconomic status (65.2 per 100,000 population; Figure 4.10).



5 Seasonal variation in mortality risk

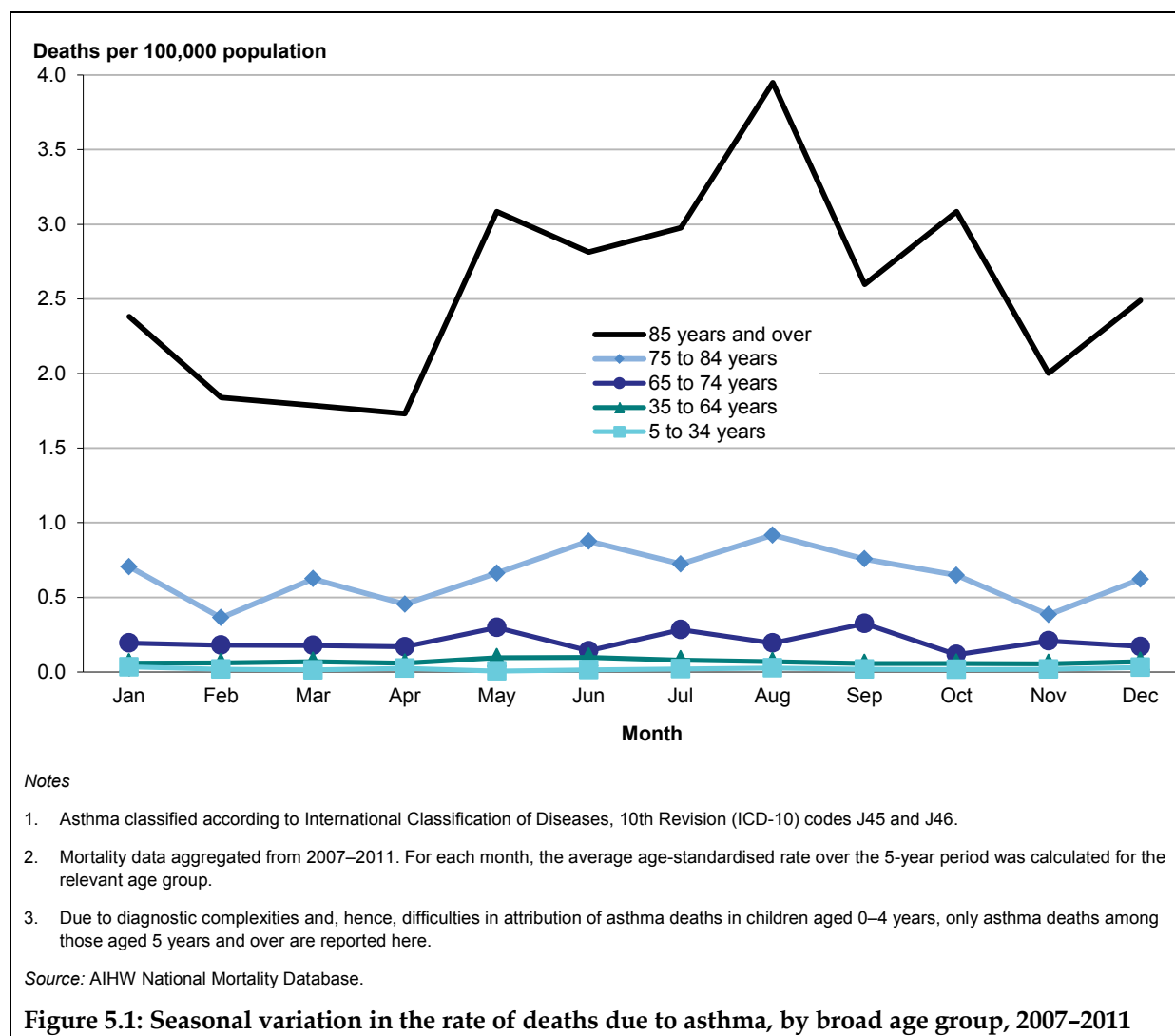
There are more deaths due to all causes in the colder months and fewer deaths in the warmer months in Australia (AIHW: De Looper 2002). The winter peak is more pronounced in infants and older Australians. In younger people, a peak in overall deaths is seen in warmer months, reflecting the seasonality of the major causes of death in these age groups including motor vehicle accidents, suicide and drowning (AIHW: De Looper 2002).

Similarly, the risk of death due to asthma and COPD varies with the time of year and is different between age groups (Figures 5.1 and 5.2).

Asthma

Deaths due to respiratory conditions overall are higher between May and September, which corresponds to the winter months in the southern part of Australia (AIHW: De Looper 2002).

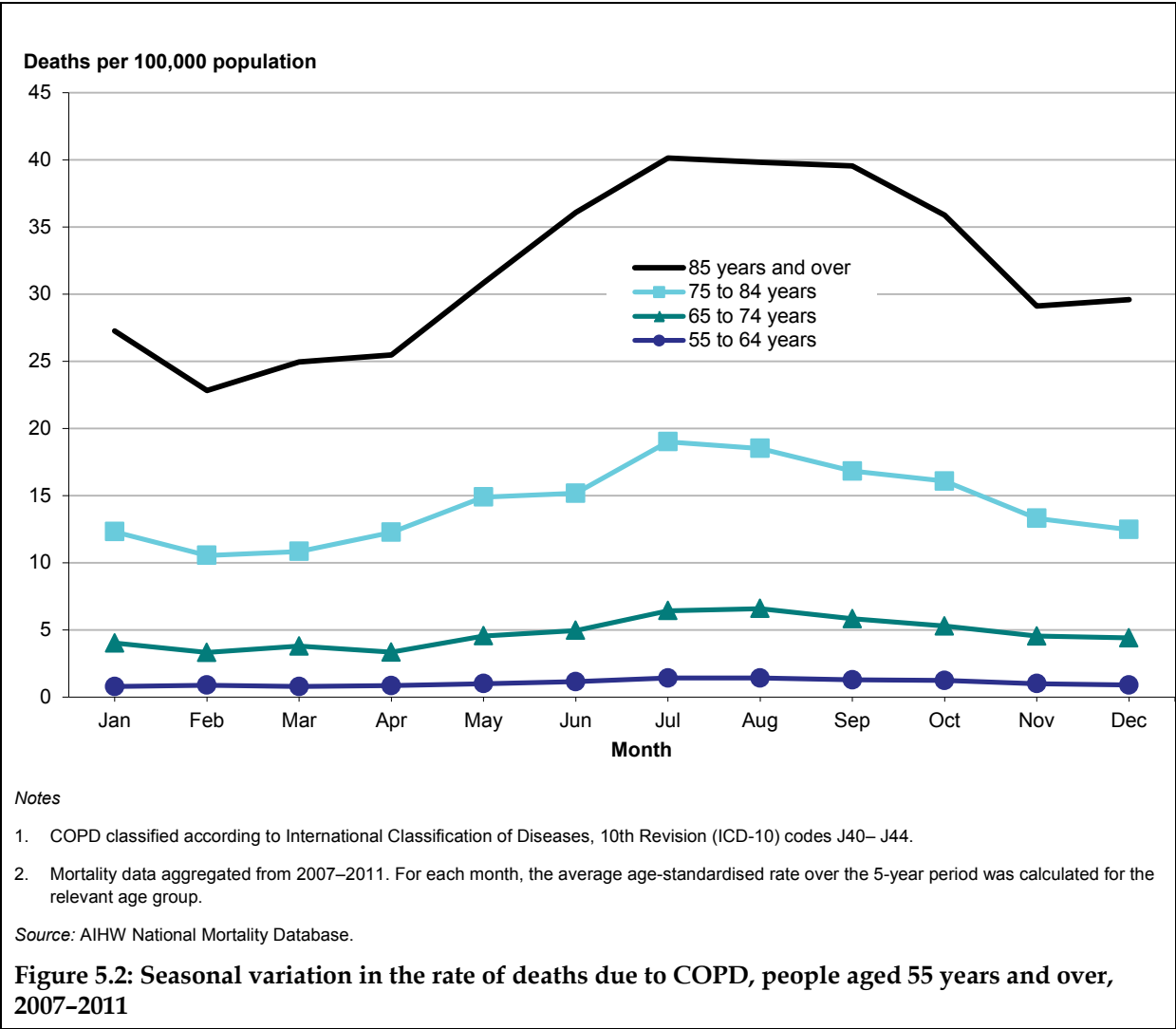
Recent data for Australia in the period 2007–2011 (Figure 5.1) show no seasonal differences in asthma deaths among people aged 5–34 and 35–64, contrasting with the peak in warmer months for all-cause mortality in these two age groups.



In contrast with younger age groups, there was higher mortality due to asthma in people aged 85 and over in late winter (August) over the period 2007–2011. This pattern could reflect the impact of winter rises in influenza and pneumonia, which contribute to acute exacerbations leading to increased risk of hospitalisations and death. A similar peak is seen in winter months for older patients in other countries. Studies from the United States of America (Weiss 1990) and the United Kingdom (Fleming et al. 2000; Marks & Burney 1997) demonstrated higher rates of asthma deaths during winter months among older people.

COPD

Australian data show that COPD deaths tend to be highest in the late winter months (July and August), with the peak most pronounced among those aged 85 years and over (Figure 5.2). The lowest rates of mortality due to COPD are observed around February.



In the Northern Hemisphere, COPD exacerbations and deaths are also more likely to occur in winter months (Jenkins et al. 2012; Johnston 2007).

6 Deaths involving asthma and COPD

Death statistics are often based only on the underlying cause of death – that is, the disease or injury that initiated the train of events leading directly to death (See Box 1.2). Analysis of associated causes of death – either for deaths due to asthma or COPD, or for deaths due to other causes where asthma and/or COPD were involved in the death – may offer insights into the disease processes occurring at the end of life and give a more complete picture of all diseases involved in a death.

Associated causes of death are all causes listed on the death certificate other than the underlying cause of death. They include the immediate cause, any intervening causes, and conditions that contributed to the death but were not related to the disease or condition causing the death (See Box 1.2).

This section starts by describing the prevalence of selected associated causes of death listed on the death certificate where the underlying cause of death was asthma or COPD. The age range of this analysis is limited to those aged 55 and over since multiple associated causes of death are primarily relevant to older people. The associated causes of death we have presented were chosen on the basis of being in the top 20 leading causes of death among people aged 55 years and over between 2007 and 2011 [which were classified using an AIHW-modified version of Becker et al. (2006)] and potentially related to asthma or COPD due to either:

- shared risk factors;
- a potential causal relationship; or
- causing complications in the management of asthma or COPD.

Asthma

Among people aged 55 and over whose underlying cause of death was listed as asthma, the most common associated causes of death were *Influenza and pneumonia* and *COPD*, which were listed on 35% and 33% of all death certificates, respectively (Table 6.1). *Coronary heart diseases* was listed as an associated cause of death in 19% of all asthma deaths. *Heart failure and complications and ill-defined heart diseases* was listed as an associated cause of death in 18% of all asthma deaths and *Hypertensive diseases* in 15% of all asthma deaths.

Similar associated causes of death among people whose deaths were listed as due to asthma have been reported elsewhere. In France, where asthma was the underlying cause of death, cardiovascular disease was the most common associated cause of death among all ages (45%) and COPD was an associated cause of death in 11% of asthma deaths among those aged 65 and over (Fuhrman et al. 2009). In England, the most common other certified causes in asthma deaths were pneumonia (36%), chronic ischemic heart disease (11%) and COPD (9%) (Goldacre et al. 2012).

In recent years, there has been increasing interest in patients who have diagnoses or clinical features of both asthma and COPD (called the asthma-COPD overlap syndrome, or ACOS). This may include patients with long-standing asthma who have developed irreversible airflow limitation. Criteria for ACOS have varied, but the reported prevalence has ranged between 15–55% of patients with chronic airways disease (GINA 2014). Such patients have worse health outcomes, more exacerbations, and higher health utilisation than patients with either asthma or COPD alone (Andersen et al. 2013; Hardin et al. 2011). Australian data show

that approximately one-third of people whose deaths were listed as being due to asthma had COPD listed as an associated cause of death on their death certificate (Table 6.1), and hence could potentially have had ACOS.

COPD

Among people aged 55 and over whose underlying cause of death was COPD, the most common associated cause of death was *Influenza and pneumonia*, which was listed on 32.2% of all death certificates (Table 6.1). *Coronary heart diseases* was the next most common associated cause at 19.9% of COPD deaths and *Heart failure and complications and ill-defined heart diseases* was listed in 18.4% of cases.

Table 6.1: Associated causes of death in people who died from asthma and COPD, age 55 years and over, 2007–2011

Selected associated causes of death	Proportion of deaths (per cent)	
	Asthma was underlying cause (n=1,647)	COPD was underlying cause (n=26,766)
Asthma	0.06*	0.44
COPD	32.91	3.58*
Coronary heart diseases	19.37	19.92
Stroke	6.31	5.07
Lung cancer	0.67	2.25
Dementia and Alzheimer disease	11.72	7.93
Diabetes mellitus	10.75	7.16
Heart failure and complications and ill-defined heart diseases	17.91	18.44
Influenza and pneumonia	34.97	32.21
Hypertensive diseases	15.24	9.93

* These two seemingly anomalous instances most probably reflect the range of disease codes used to define asthma and COPD, whereby the coding of underlying cause of death and associated cause of death appear to be the same but represent different individual ICD-10 codes used to define asthma and COPD in this report (see Tables A1 and A2). For example, a death may have had the underlying cause of death recorded as *J46 Status asthmaticus* and have *J45.0 Predominantly allergic asthma* listed as an associated cause of death, or vice versa. In the case of COPD, *J43.2 Centrilobular emphysema* and *J44.9 COPD, unspecified* may have been listed as the underlying cause and associated cause of death, or vice versa.

Notes

1. Contributing factors are not mutually exclusive. Therefore, the columns for each condition can add up to more than 100%.
2. Asthma and COPD were classified according to International Classification of Diseases, 10th Revision (ICD-10) codes—Asthma codes J45 and J46, COPD codes J40–J44. Associated causes of death were also classified according to ICD-10 using the following codes: coronary heart diseases—codes I20–I25, stroke—codes I60–I69, lung cancer—codes C33–C34, dementia and Alzheimer disease—F00–F03 and G30, diabetes mellitus—E10–E14, heart failure and complications and ill-defined heart diseases—codes I50–I51, influenza and pneumonia—codes J09–J18, hypertensive diseases—codes I10–I15.

Source: AIHW National Mortality Database.

Asthma and COPD as associated causes of deaths due to other causes

Reporting deaths based on the underlying cause of death only (as is commonly done) may underestimate the mortality contribution of other chronic diseases. This is particularly the case for highly prevalent, slowly progressive, chronic diseases such as asthma and COPD, as well as several other diseases, including end-stage renal failure, diabetes and dementia and Alzheimer disease (see AIHW 2012).

In the period 2007–2011, of all deaths among those aged 55 and over with asthma as any cause of death (that is, recorded on the death certificate), only 27% had asthma recorded as

the underlying cause of death. Of all deaths with COPD as any cause, only 40% had COPD recorded as the underlying cause of death.

Among deaths where *Hypertensive diseases* and *Diabetes* were the underlying causes of death, asthma was listed as an associated cause of death in 1.5% and 1.1% of cases, respectively. COPD was listed as an associated cause of death in 16.5% of deaths from *Lung cancer* and 10.0% of deaths from *Heart failure and complications and ill-defined heart diseases*.

Appendix: Technical notes

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 of 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 of the states and territories.

This report focuses primarily on analysis of the underlying cause of death reported on each certificate. However, Chapter 6 presents information on associated causes of death, which are other conditions listed on the death certificate that are not underlying cause of death.

Deaths from 1997 onward were coded according to the International Statistical Classification of Disease and Related Health Problems 10th revision (ICD-10). Data before 1997 were classified using earlier versions of the International Classification of Diseases and, therefore, these data are not directly comparable with more recent data. To analyse long-term trends, where applicable, age-specific comparability factors were applied to data on deaths that occurred before 1997 (see 'Comparability factors for mortality data' section in this Appendix).

There is some variation in the time frames presented for analyses throughout this report. For example, SEIFA and remoteness category breakdowns have been analysed over the period 2009–2011 while other population subgroup analyses were for the period 2007–2011. This reflects differences in the availability of population data by SEIFA category and remoteness categories.

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 asthma or COPD and to label patients as dying from these conditions.

Australian and international validation studies of asthma deaths coded on death certificates reveal that adult deaths from asthma can be under-counted (Guite & Burney 1996; Hunt et al. 1993; Smyth et al. 1996) or over-counted (Jones et al. 1999; Sears et al. 1986; Sidenius et al. 2000), 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 for these ages. However, under-enumeration of deaths due to asthma has also been demonstrated among children and young adults (Jorgensen et al. 2000).

Generally, for older people the attribution of death to asthma, or alternatively to one of a range of illnesses with clinical features that overlap with asthma, is problematic, and therefore deaths data for asthma are less reliable for older people (Jones et al. 1999; Sidenius et al. 2000; Smyth et al. 1996).

Changes in classification schemes and/or coding have a quantifiable impact on time trends in deaths data. However, the extent to which changes over time in diagnostic practices affect deaths data is less well studied. We also know that asthma and COPD are more frequently coded as an associated cause of death rather than as an underlying cause of death, and this may underestimate their overall contribution to mortality in analyses that use underlying cause of death data only.

Reliability of death certificates for deaths due to COPD was examined as part of a large clinical trial in which cause of death was adjudicated (Drummond et al. 2010). In 80% of cases, the primary or secondary cause of death from death certificates agreed with the adjudicated cause of death, but COPD was not listed on the death certificate in 21% of deaths adjudicated to be caused by COPD exacerbation.

It should be noted that the data used in this report are not directly abstracted from the death certificate. ICD codes for underlying cause of death have been assigned according to coding standards designed to select the most likely underlying cause of death from those listed on the death certificate according to agreed rules. Various issues arise with coding deaths and these must be taken into account when interpreting deaths 'due to' a particular condition, including asthma and COPD.

The data quality statements underpinning the AIHW National Mortality Database can be found in the following ABS publications:

ABS Quality declaration summary for *Causes of death 2012* (Cat. no. 3303.0)
<<http://www.abs.gov.au/Ausstats/abs@.nsf/0/D4A300EE1E04AA43CA2576E800156A24?OpenDocument>> and

ABS Quality declaration summary for *Deaths, Australia 2012* (Cat.no. 3302.0)
<<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/3302.0Explanatory%20Notes12012?OpenDocument>>.

Cause of death codes

The classification of asthma or COPD as the underlying cause of death was based on the ICD-2 (1911 to 1922), ICD-3 (1923 to 1929), ICD-4 (1930 to 1939), ICD-5 (1940 to 1949), ICD-6 (1950 to 1957), ICD-7 (1958 to 1967), ICD-8 (1968 to 1978), ICD-9 (1979 to 1996) and ICD-10 for deaths from 1997 onwards (see Tables A1 and A2 for ICD-10 codes and description).

Data for asthma deaths were available from 1907 from the National Mortality Database. Data coded using ICD-1 (1907–1910) were not included in our analysis because emphysema and asthma were grouped together under code 119 and, therefore, we could not differentiate deaths attributed to asthma or emphysema (one form of COPD).

Data for COPD deaths were available from 1964.

Comparability factors (where applicable) were applied to data classified under ICD-2 through to ICD-9 to make the data comparable to that coded using ICD-10 (see 'Comparability factors for mortality data' section in this Appendix).

Table A1: ICD codes included for asthma mortality data from ICD versions ICD-2 to ICD-10

ICD classification	ICD-2	ICD-3	ICD-4	ICD -5	ICD-6	ICD7	ICD8	ICD 9	ICD-10
Years covered	1911–22	1923–29	1930–39	1940–49	1950–57	1958–67	1968–78	1979–96	1997+
Description									
Asthma	96	105	112		241	241	493		
Status asthmaticus									J46
Asthma, unspecified								493.9	J45.9
Asthma with 'flu as contributing or secondary cause'				112.1					
Asthma without any of above complications				112.6					
Extrinsic asthma								493.0	
Intrinsic asthma								493.1	
Predominantly allergic asthma									J45.0
Non-allergic asthma									J45.1
Mixed asthma									J45.8

Source: (WHO 2007).

Table A2: ICD codes included for COPD mortality data from ICD versions ICD-7 to ICD-10

ICD classification	ICD-7	ICD-8	ICD-9	ICD-10
Years covered	(1958–67)	(1968–78)	(1979–96)	(1997+)
Description				
Bronchiectasis	526	518	494	J47
Bronchitis, chronic and unqualified	501, 502	491	491	
Bronchitis, not specified as acute or chronic		490	490	J40
Simple and mucopurulent chronic bronchitis			491.0, 491.1	J41
Obstructive chronic bronchitis			491.2	
Unspecified chronic bronchitis			491.9	J42
Emphysema		492	492	J43
Emphysema without mention of bronchitis	527.1			
Other obstructive airways disease		519.8	496	
Other COPD				J44

Source: (WHO 2007).

Comparability factors for mortality data

Table A3 shows the age-group specific comparability factors calculated for converting number of asthma deaths from ICD-2, ICD-3, ICD-4, ICD-5, ICD-6, ICD-7, ICD-8, and ICD-9 directly to ICD-10. For example, if there were 350 deaths due to asthma among males aged 75 years and over using ICD-4, then you would multiply 350 by 0.88 (Table A3) to convert it to a comparable number of deaths coded to ICD-10. Thus 350 deaths among males aged 75 and over using ICD-4 equates to 308 deaths coded to ICD-10.

The method for calculating these comparability factors was described previously (ACAM 2003, section A1.3).

Table A3: Comparability factors for converting asthma mortality data coded using earlier ICD versions to ICD-10

	ICD 2	ICD 3	ICD 4	ICD 5	ICD 6	ICD7	ICD8	ICD 9
Sex/Age group	(1911-1922)	(1923-1929)	(1930-1939)	(1940-1949)	(1950-1957)	(1958-1967)	(1968-1978)	(1979-1996)
Males								
0-4 years	1.41	1.41	1.41	1.41	1.27	1.27	1.30	1.00
5-14 years	1.41	1.41	1.41	1.41	1.27	1.27	1.30	1.00
15-24 years	1.09	1.09	1.09	1.09	0.92	1.01	1.06	1.00
25-34 years	0.96	0.94	0.91	0.88	0.82	1.00	1.06	1.00
35-44 years	1.33	1.22	1.12	1.03	0.74	0.84	0.89	0.84
45-54 years	1.24	1.13	1.04	0.95	0.65	1.01	1.12	0.84
55-64 years	1.23	1.16	1.09	1.03	0.65	0.97	1.12	0.84
65-74 years	0.99	0.93	0.88	0.83	0.49	0.79	0.91	0.68
75 years and over	0.99	0.93	0.88	0.83	0.49	0.79	0.91	0.68
Females								
0-4 years	1.12	1.12	1.12	1.12	1.12	1.30	1.30	1.00
5-14 years	1.12	1.12	1.12	1.12	1.12	1.30	1.30	1.00
15-24 years	1.14	1.10	1.06	1.02	0.99	1.03	1.06	1.00
25-34 years	1.17	1.13	1.08	1.04	0.85	1.01	1.06	1.00
35-44 years	0.97	0.91	0.86	0.81	0.70	0.86	0.89	0.84
45-54 years	1.62	1.46	1.31	1.18	0.91	1.08	1.12	0.84
55-64 years	1.84	1.64	1.47	1.31	0.81	1.08	1.12	0.84
65-74 years	1.30	1.12	0.97	0.84	0.54	0.87	0.91	0.68
75 years and over	1.30	1.12	0.97	0.84	0.54	0.87	0.91	0.68

For the purposes of examining long-term trends in COPD mortality in this report, the codes used to define COPD were those outlined in Table A4.

A published report on deaths attributed to COPD between 1901 and 1991 in Britain (Marks & Burney 1997) determined that there was less than 6% net change in deaths attributed to the condition after the introduction of ICD-6, ICD-7, ICD-8 and ICD-9 when COPD was defined using the codes in Table A2.

Analysis of Australian data from 1997 and 1998 that was coded using both ICD-9 and ICD-10 codes (as defined in Table A2) demonstrated that there was less than 5% difference in deaths attributed to COPD after the introduction of ICD-10. This was true for all age groups and for males and females. Therefore, we concluded that conversion factors were not required for the purposes of analysing long-term trends in COPD data from as early as 1958 when COPD was defined using the codes outlined in Table A2.

Calculation of years of life lost (YLL)

To calculate YLL, conversion factors were first applied to the number of asthma deaths (see Table A3). There were no conversion factors applied to deaths due to COPD; see previous section 'Comparability factors for mortality data' for a detailed description. For asthma deaths, data for all ages were included in the calculation. For COPD deaths, only those aged 55 years and over were included. The number of deaths were aggregated by sex, age and year. YLL were calculated from the aggregated number of deaths multiplied by a standard life expectancy at the age at which death occurs. The standard life expectancy used for YLL at each age was derived from ABS Life Tables. Missing data for life expectancy were estimated using linear interpolation. A rate per 100,000 population was calculated.

Definitions of associated causes of death

To examine associated causes of death among people whose underlying cause of death was asthma (ICD-10 codes J45, J46) or COPD (J40–J44), we examined the top 20 leading causes of death among people aged 55 years and over between 2007 and 2011 and selected diseases (or disease groups) potentially related to asthma and/or COPD due to either:

- shared risk factors;
- a potential causal relationship; or
- causing complications in the management of asthma/COPD.

These conditions were:

- coronary heart diseases (I20–I25)
- stroke (I60–I69)
- lung cancer (C33–C34)
- dementia and Alzheimer disease (F00–F03 and G30)
- diabetes mellitus (E10–E14)
- heart failure and complications and ill-defined heart diseases (I50–I51)
- influenza and pneumonia (J09–J18)
- hypertensive diseases (I10–I15).

In the section investigating 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 the same eight underlying causes of death listed above.

Glossary

Aboriginal or Torres Strait Islander: A person of Aboriginal and/or Torres Strait Islander descent who identifies as an Aboriginal and/or Torres Strait Islander. See also *Indigenous*.

Age-specific rate: A rate for a specific age group. The numerator and denominator relate to the same age group.

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.

ASGS classification: The Australian Statistical Geography Standard (ASGS) is a geographical classification which defines 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) (ABS 2011).

Associated causes of death: All causes listed on the death certificate, other than the underlying cause of death. They include the immediate cause, any intervening causes, and conditions which contributed to the death but were not related to the disease or condition causing the death. (See Box 1.2 for more information.)

Asthma: Asthma is a chronic lung disease, which can be controlled but not cured. In clinical practice, asthma is defined by the presence of both the following: (1) excessive variation in lung function ('variable airflow limitation', i.e. variation in expiratory airflow that is greater than that seen in healthy people); and (2) respiratory symptoms (e.g. wheeze, shortness of breath, cough, chest tightness) that vary over time and may be present or absent at any point in time (National Asthma Council Australia 2014).

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.

Case-fatality rate: The proportion of reported cases of a specified disease or condition (such as asthma or COPD) which are fatal within a specified time period.

Cause of death: 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 2014).

Chronic obstructive pulmonary disease (COPD): 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 2014). It may be characterised by *Emphysema* and/or *Chronic bronchitis*. By far the greatest cause is cigarette smoking.

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 country of birth* and *Non-English-speaking country of birth*.

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.

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 country of birth: Includes anyone born in Australia, New Zealand, United Kingdom, Ireland, United States of America, Canada, Zimbabwe or South Africa (DIMIA English proficiency group 1).

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.

Indigenous: A person of Aboriginal and/or Torres Strait Islander descent who identifies as an Aboriginal and/or Torres Strait Islander. See also *Aboriginal or Torres Strait Islander*.

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 used for deaths data from 1997 onward.

Life expectancy: An indication of how long a person can expect to live. Technically it is the expected number of years of life remaining to a person at a particular age if mortality rates do not change.

Mortality: Death.

Non-English-speaking country of birth: 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 country of birth*.

Non-Indigenous: People who have declared they are not of Aboriginal or Torres Strait Islander descent.

Other Australians: People who have declared they are not of Aboriginal or Torres Strait Islander descent, or whose status is not known.

Prevalence: The number or proportion (of cases, instances, and so forth) present in a population at a given time.

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. In this report, all the mortality rates presented are age-standardised (see *age-standardisation*).

Risk factor: See *Health risk factor*.

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.

Underlying cause of death: the condition, disease or injury that initiated the train of events leading directly to death, or the circumstances of the accident or violence that produced the fatal injury. Deaths are referred to in this report as 'due to' the *underlying cause of death*. (See Box 1.2 for more information.)

Wheeze: Breathing difficulty accompanied by an audible whistling sound.

References

- Abramson M, Bailey MJ, Couper F, Driver JS, Drummer OH, Forbes A et al. 2001. Are asthma medications and management related to deaths from asthma? *American Journal of Respiratory & Critical Care Medicine* 163:12-8.
- Abramson MJ 2005. Respiratory symptoms and lung function in older people with asthma or chronic obstructive pulmonary disease. *MJA* 183:S23-5.
- ABS (Australian Bureau of Statistics) 2003. Multiple cause of death analysis, 1997-2001. ABS cat. no. 3319.0.55.001. Canberra: ABS.
- ABS 2011. Australian Statistical Geography Standard (ASGS). Volume 1 – Main structure and greater capital city statistical areas July 2011. ABS cat. no. 1270. 0.5 5.0 0 1. Canberra: ABS.
- ABS (Australian Bureau of Statistics) 2012. Causes of death, Australia, 2012. ABS cat. no. 3302.0. Canberra: ABS.
- ABS 2013. Causes of death, Australia, 2011. ABS catalog number 3303.0. Canberra: ABS.
- ACAM (Australian Centre for Asthma Monitoring) 2003. Asthma in Australia 2003. AIHW Asthma Series 1. Cat. no. ACM 1. Canberra: AIHW.
- ACAM 2011. Asthma in Australia: with a focus chapter on chronic obstructive pulmonary disease 2011. AIHW Asthma series no. 4. AIHW cat. no. ACM 22. Canberra: AIHW.
- Adair T, Hoy D, Dettrick Z & Lopez AD 2012. 100 years of mortality due to chronic obstructive pulmonary disease in Australia: the role of tobacco consumption. *International Journal of Tuberculosis & Lung Disease* 16(12):1699-705.
- Ahmad O, Boschi-Pinto C, Lopez AD, Murray CJL, Lozano R & Inoue M 2001. Age standardization of rates: a new WHO standard. GPE Discussion Paper No. 31. Geneva: World Health Organization.
- AIHW (Australian Institute of Health and Welfare) 2014. Causes of death. Viewed 27 February 2014, <www.aihw.gov.au/deaths/causes-of-death/>.
- AIHW 2012. Multiple causes of death in Australia: an analysis of all natural and selected chronic disease causes of death 1997-2007. Bulletin no. 105. AIHW cat. no. AUS 159. Canberra: AIHW.
- AIHW 2013. Asthma hospitalisations in Australia 2010-11. AIHW cat. no. ACM 27. Canberra: AIHW.
- AIHW: De Looper M 2002. Seasonality of death. Bulletin no. 3. AIHW cat. no. AUS 29. Canberra: AIHW.
- Andersen H, Lampela P, Nevanlinna A, Saynajakangas O & Keistinen T 2013. High hospital burden in overlap syndrome of asthma and COPD. *The Clinical Respiratory Journal* 7(4):342-6.
- Anderson HR, Gupta R, Strachan DP & Limb ES 2007. 50 years of asthma: UK trends from 1955 to 2004. *Thorax* 62:85-90.
- Babin SM, Burkom HS, Holtry RS, Taberner NR, Stokes LD, Davies-Cole JO et al. 2007. Pediatric patient asthma-related emergency department visits and admissions in Washington, DC, from 2001-2004, and associations with air quality, socio-economic status and age group. *Environmental Health* 6:9-19.
- Becker R, Silvi J, Ma Fat D, L'Hours A & Laurenti R 2006. A method for deriving leading causes of death. *Report of the World Health Organization* 84:297-304.

- Campbell D, McLennan G, Coates JR, Frith PA, Gluyas P, Latimer KM et al. 1992. Accuracy of asthma statistics from death certificates in South Australia. *MJA* 156(12):860-3.
- Castro M, Schechtman KB, Halstead J & Bloomberg G 2001. Risk factors for asthma morbidity and mortality in a large metropolitan city. *Journal of Asthma* 38(8):625-35.
- Department of Health and Ageing 2010. Asthma cycle of care. Canberra: Commonwealth of Australia. Available at <www.health.gov.au/internet/main/publishing.nsf/Content/asthma-cycle>. Accessed 4 July 2014.
- Drummond MB, Wise RA, John M, Zvarich MT & McGarvey LP 2010. Accuracy of death certificates in COPD: analysis from the TORCH trial. *Journal of Chronic Obstructive Pulmonary Disease* 7:179-85.
- Fleming DM, Cross KW, Sunderland R & Ross AM 2000. Comparison of the seasonal patterns of asthma identified in general practitioner episodes, hospital admissions and deaths. *Thorax* 55:662-5.
- Fletcher C & Peto R 1977. The natural history of chronic airflow obstruction. *BMJ* 1:1645-8.
- Ford ES, Croft JB, Mannino DM, Wheaton AG, Zhang X & Giles WH 2013. COPD Surveillance-United States, 1999-2011. *Chest* 144(1):284-305.
- Fuhrman C, Jouglu E, Uhry Z & Delmas M-C 2009. Deaths with Asthma in France, 2000-2005: A multiple-cause analysis. *Journal of Asthma* 46:402-6.
- GINA (Global Initiative for Asthma) 2012. Global strategy for asthma management and prevention Bethesda, Maryland: National Institutes of Health, National Heart, Lung and Blood Institute. Available at <www.ginasthma.org>. Accessed 24 January 2014.
- GINA (Global Initiative for Asthma) 2014. Global strategy for asthma management and prevention 2014. Available at <www.ginasthma.org>. Accessed 6 May 2014.
- Goeman DP, Abramson MJ, McCarthy EA, Zubrinich CM & Douglass JA 2013. Asthma mortality in Australia in the 21st century: a case series analysis. *BMJ Open* 3:e002539. doi:10.1136/bmjopen-2012-.
- GOLD (Global Initiative for Chronic Obstructive Lung Disease) 2014. Global strategy for the diagnosis, management and prevention of COPD. Available at <www.goldcopd.org/guidelines-global-strategy-for-diagnosis-management.html>. Accessed 16 May 2014.
- Goldacre MJ, Duncan ME & Griffith M 2012. Death rates for asthma in English populations 1979-2007: Comparison of underlying cause and all certified causes. *Public Health* 126:386-93.
- Grant E, Lyttle C & Weiss K 2000. The relation of socioeconomic factors and racial/ethnic differences in US asthma mortality. *American Journal of Public Health* 90(12):1923-5.
- Guite HF & Burney PGJ 1996. Accuracy of recording of deaths from asthma in the UK: the false negative rate. *Thorax* 51(9):924-8.
- Han MK, Postma DS, Mannino DM, Giardino ND, Buist AS, Curtis JL et al. 2007. Gender and Chronic Obstructive Pulmonary Disease. *American Journal of Respiratory & Critical Care Medicine* 176(12):1179-84.
- Hardin M, Silverman EK, Barr RG, Hansel NN, Schroeder JD, Make BJ et al. 2011. The clinical features of the overlap between COPD and asthma. *Respiratory Research* 12:127.

- Hunt LW, Silverstein MD, Reed CE, O'Connell EJ, O'Fallon WM & Yunginger JW 1993. Accuracy of the death certificate in a population-based study of asthmatic patients. *Journal of the American Medical Association* 269(15):1994-5.
- Jenkins CR, Celli B, Anderson JA & al E 2012. Seasonality and determinants of moderate and severe COPD exacerbations in the TORCH study. *European Respiratory Journal* 39:38-45.
- Johnston NW 2007. The similarities and differences of epidemic cycles of chronic obstructive pulmonary disease and asthma exacerbations. *Proceedings of the American Thoracic Society* 4:591-6.
- Jones A, Bentham G & Horwell C 1999. Health service accessibility and deaths from asthma. *International Journal of Epidemiology* 28:101-5.
- Jorgensen IM, Bulow S, Jensen VB, Dahm TL, Prahl P & Juel K 2000. Asthma mortality in Danish children and young adults, 1973-1994: epidemiology and validity of death certificates. *European Respiratory Journal* 15:844-8.
- Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V et al. 2012. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet* 380(9859):2095-128.
- Malmstrom K, Kaila M, Kajosaari M, Syvanen P & Juntunen-Backman K 2007. Fatal Asthma in Finnish Children and adolescents 1976-1998: Validity of death certificates and clinical description. *Pediatric Pulmonology* 42:210-15.
- Marks GB & Burney P 1997. Diseases of the respiratory system. In: Charlton J & Murphy M (eds). *The health of adult Britain*. Vol. 2. London: The Stationery Office, 93-113.
- Marks GB, Poulos LM, Jenkins CR & Gibson PG 2009. Asthma in older adults: a holistic, person-centred and problem-oriented approach. *MJA* 191(4):197-9.
- Mielck A, Reitmeir P & Wjst M 1996. Severity of childhood asthma by socioeconomic status. *International Journal of Epidemiology* 25:388-93.
- National Asthma Council Australia 2014. *Australian asthma handbook, version 1.0*. Melbourne: National Asthma Council Australia. Available at <www.astmahandbook.org.au>. Accessed 7 March 2014.
- Sears MR, Rea HH, De Boer G, Beaglehole R, Gillies AJD, Holst PE et al. 1986. Accuracy of certification of deaths due to asthma. *American Journal of Epidemiology* 124(6):1004-11.
- Sidenius KE, Munich EP, Madsen F, Lange P, Viskum K & Soes-Petersen U 2000. Accuracy of recorded asthma deaths in Denmark in a 12 month period in 1994-95. *Respiratory Medicine* 94(4):373-7.
- Smyth ET, Wright SC, Evans AE, Sinnamon DG & MacMahon J 1996. Death from airways obstruction: accuracy of certification in Northern Ireland. *Thorax* 51(3):293-7.
- Tan WC, Seale P, Ip M, Shim Y-S, Chiang C-H, Ng T-P et al. 2009. Trends in COPD mortality and hospitalizations in countries and regions of Asia-Pacific. *Respirology* 14:90-7.
- Weiss K 1990. Seasonal trends in US asthma hospitalisations and mortality. *Journal of the American Medical Association* 263:2323-8.
- WHO (World Health Organization) 2007. *International Classification of Diseases (ICD)*. Geneva: WHO.
- WHO (World Health Organization) 2011. *World health statistics 2011*. Geneva: WHO. Available at <www.who.int/whosis/whostat/EN_WHS2011_Full.pdf?ua=1>. Accessed 24 January 2014.

Wijesinghe M, Weatherall M, Perrin K, Crane J & Beasley R 2009. International Trends in Asthma Mortality Rates in the 5- to 34-Year Age Group: A Call for Closer Surveillance. *Chest* 135:1045-9.

Woolcock A, Rubinfeld A, Seale JP, Landau L, Antic R, Mitchell C et al. 1989. Asthma management plan, 1989. *MJA* 151:650-3.

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Related publications

This report, *Mortality from asthma and COPD in Australia*, can be downloaded for free from the AIHW website (www.aihw.gov.au/publications). The website includes information on ordering printed copies.

The following AIHW publications relating to asthma and COPD might also be of interest:

- Australian Centre for Asthma Monitoring (ACAM) 2011. *Asthma in Australia 2011*, with a focus chapter on chronic obstructive pulmonary disease. AIHW Asthma Series no. 4. Cat. No. ACM 22. Canberra: AIHW (available free of charge on AIHW website; print copies also available, at cost)
- *Asthma snapshot* (web only). Available at < www.aihw.gov.au/asthma/ >
- *COPD snapshot* (web only). Available at < www.aihw.gov.au/COPD/ >.

Asthma death rates in Australia are high compared with many other countries and chronic obstructive pulmonary disease (COPD) is a leading cause of deaths in Australia and internationally. This report provides current information about mortality due to these conditions in Australia, examining trends over time, seasonal variation, international comparison and variation by age, sex, remoteness, Indigenous status, country of birth and socioeconomic disadvantage.