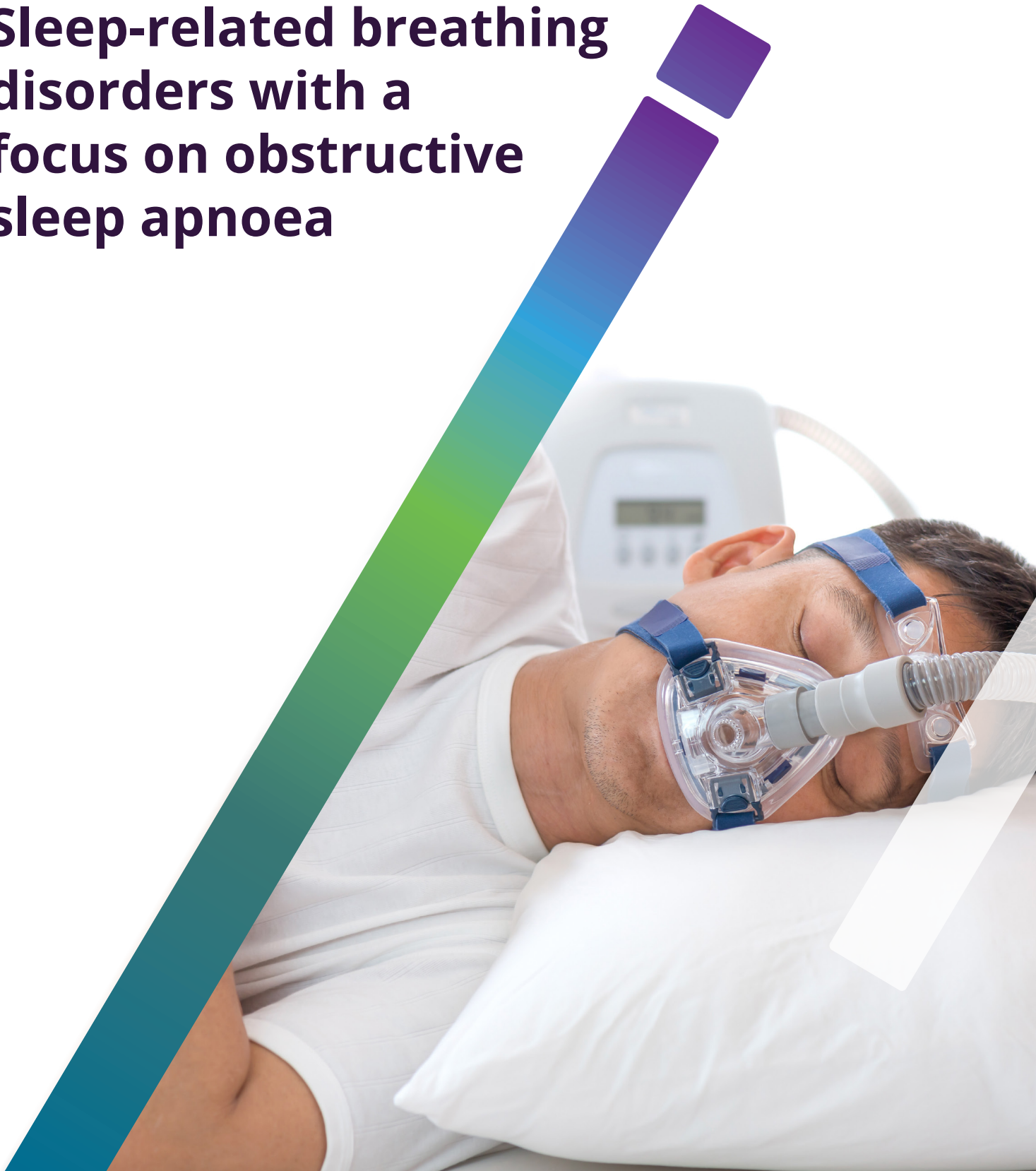




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Sleep-related breathing disorders with a focus on obstructive sleep apnoea



Sleep-related breathing disorders with a focus on obstructive sleep apnoea



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ISBN 978-1-76054-861-2 (PDF)

ISBN 978-1-76054-862-9 (Print)

DOI 10.25816/ae90-x421

Suggested citation

Australian Institute of Health and Welfare 2021. Sleep-related breathing disorders with a focus on obstructive sleep apnoea. Cat. no. PHE 294. Canberra: AIHW.

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Published by the Australian Institute of Health and Welfare.

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 amendment.

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Summary

Sleep-related breathing disorders, in particular obstructive sleep apnoea (OSA), can have detrimental effects on sleep quality and health. Effective diagnosis and successful treatment can reduce symptoms and improve the quality of life of patients. In Australia, eligible patients can access Medicare-funded sleep study services to clinically assess and diagnose sleep disorders, including OSA.

Using data from the Medicare Benefits Schedule and the National Hospital Morbidity Database, this report provides a snapshot of Australian health system activity on services related to the diagnosis, treatment and management of sleep disorders, with a focus on OSA. These data are supplemented with data from the National Mortality Database on deaths associated with OSA.



Around 133,000 patients received a Medicare diagnostic sleep study in 2019

This represents a rate of 6.7 per 1,000 Australians aged 18 and over. Claiming rates were higher for home-based sleep studies (4.7 per 1,000 population) than laboratory sleep studies (2.1 per 1,000). For both types of studies, rates were higher for men (8.3 per 1,000 population) than women (5.2 per 1,000). Laboratory studies were most common among patients aged 65–74, while home-based studies were most common for patients aged 45–64.



Claiming of diagnostic sleep studies varied by state and territory, remoteness and socioeconomic area of residence

Home-based sleep studies were more common than laboratory sleep studies in all states and territories. Claims were higher for laboratory studies in *Major cities* and for home-based studies in *Inner regional* areas. Rates were higher for laboratory studies in the highest socioeconomic areas.



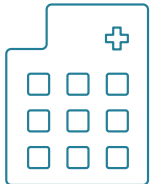
More than 21,100 patients received a Medicare treatment management sleep study service in 2019

This represents a rate of 1.0 per 1,000 Australians aged 18 and over. Most claims were for a treatment initiation sleep study (0.8 per 1,000 population). The rate of claiming was higher for men (1.0 per 1,000 population) than women (0.6 per 1,000), and for people aged 65–74 (1.8 per 1,000). Claiming rates were highest in Queensland (1.2 per 1,000 population) and in Outer regional areas.



Most patients accessed other Medicare services before or after their sleep study

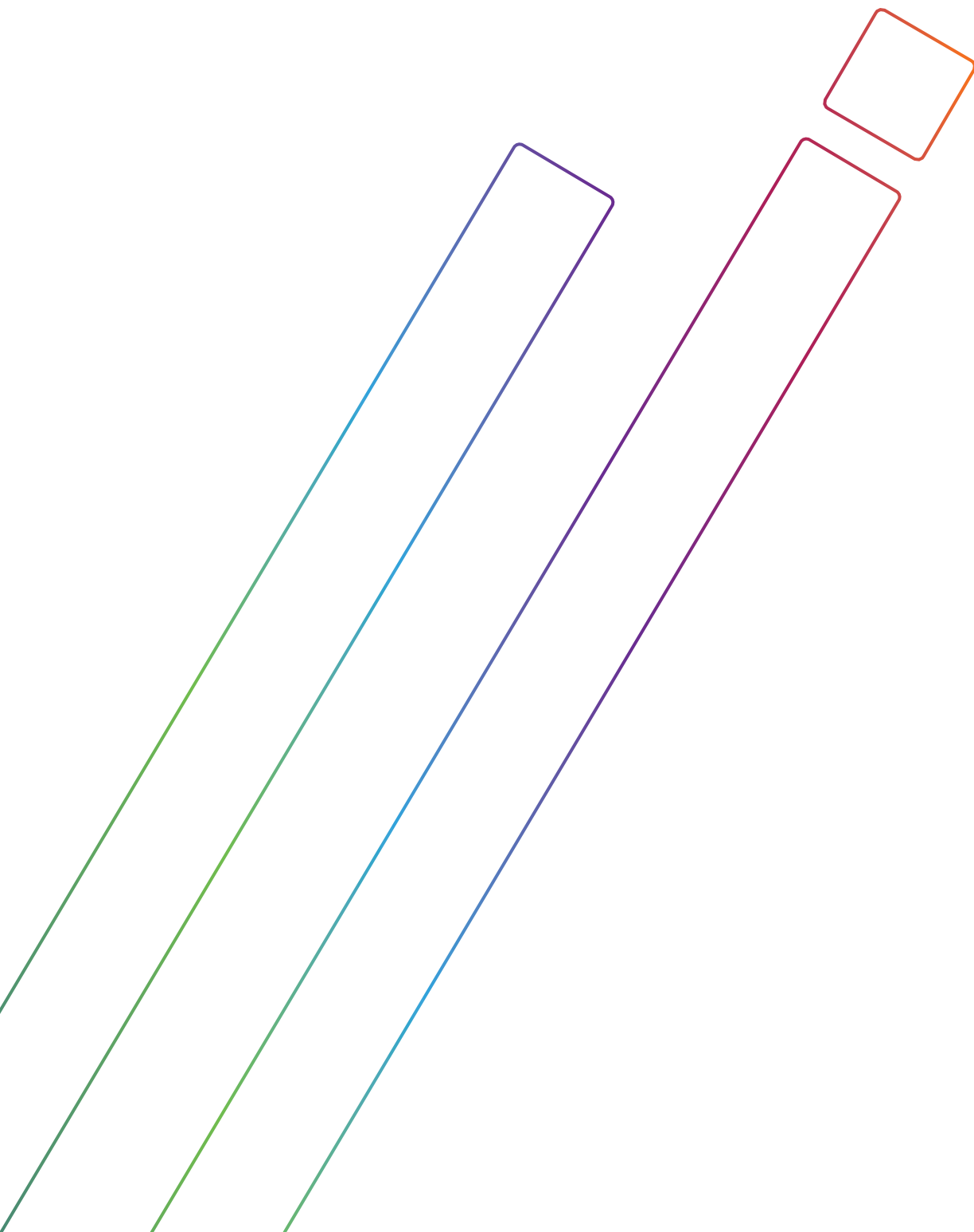
Between 93% and 98% of patients visited a general practitioner in the 6 months before or after their sleep study. More laboratory sleep study patients visited a specialist in this period (85–89%) than home-based study patients (56–63%). A respiratory and sleep medicine physician was the specialist most commonly visited by both laboratory and home-based sleep study patients.



There were 39,472 hospitalisations with a principal diagnosis of OSA in 2018–19

A further 18,870 hospitalisations had an additional diagnosis of OSA. Hospitalisation rates with OSA as the principal diagnosis were higher for men (254 per 100,000 population) than women (133 per 100,000).

There were 32,394 hospitalisations with procedures specifically for OSA. Of these, 95% were for polysomnography—a sleep study used to diagnose sleep disorders. The rest were surgical procedures to treat OSA.





Introduction

Sleep is an essential biological function. It is important for vital functions such as neural development, learning, memory, and emotional regulation. Good quality and quantity of sleep are therefore essential for good health and overall quality of life. The amount of sleep an individual needs varies largely with age.

Despite its importance, problems with sleep, known as sleep disorders, are common (National Sleep Foundation 2014). There are many types of sleep disorder, such as insomnia, obstructive sleep apnoea (OSA), restless leg syndrome, narcolepsy, circadian rhythm disorders, and mental idiopathic hypersomnia (Ryu et al. 2016, Younes & Hanly 2016).

OSA is the most common sleep disorder in the general population worldwide. Its prevalence varies, depending on the population studied and the definition used. Studies in the United States and Europe found its prevalence in adults ranged from 9.0–38% (higher in men and older people) when OSA is defined as disordered breathing present in a sleep study, and from 4.0–6.0% when OSA in a sleep study is combined with symptoms of excessive daytime sleepiness (Heinzer et al. 2015; Senaratna et al. 2017).

The effects of sleep disorders on the body are numerous and widely varied across multiple body systems, including associations with heart disease, stroke, diabetes, cognitive dysfunction and depression (Medic et al. 2017; Sarkissian et al. 2019). Although there is no cure for sleep apnoea, there is evidence that successful treatment can reduce symptoms and improve the quality of life of patients (Merino et al. 2018).

Using data from the Medicare Benefits Schedule (MBS) and the National Hospital Morbidity Database (NHMD), this report provides a snapshot of Australian health system activity on services related to diagnosis, treatment and management of sleep disorders, with a focus on OSA. These data are supplemented with data from the National Mortality Database (NMD) on deaths associated with OSA.

The MBS and NHMD data do not provide information on the outcome of sleep studies, such as:

- how many people undertaking the sleep studies were diagnosed with OSA
- how many received an intervention (for example, Continuous Positive Airway Pressure [CPAP], dental splint or other appliances)
- whether the intervention was effective and used as prescribed
- the impact on other health conditions.

Detailed description of data sources, MBS sleep study items, and statistical tables for data presented in the report can be found in the [Technical supplement](#).

What are sleep-related breathing disorders?

Sleep-related breathing disorders are those that involve abnormal breathing (respiration) during sleep (Burman 2017). Internationally, related studies have shown that sleep disordered breathing:

- is quite common; its prevalence has increased over time in the United States (from 14% in 1988 to 55% in 2011) (Heinzer et al. 2018; Peppard et al. 2013)
- is more common among men than women
- increases with increasing age (Peppard et al. 2013).

Sleep-disordered breathing leads to disturbed sleep, which is a risk factor for chronic conditions that include obesity, diabetes, coronary heart disease (also known as ischaemic heart disease), myocardial infarction and stroke (Grandner et al. 2012), hypertension (Schlafer et al. 2014) and depression (Chen et al. 2012). It is considered to be a public health issue that is often unrecognised, under-reported, and that has high economic costs (Chattu et al. 2018).

Sleep-related breathing disorders are grouped into OSA, central sleep apnoea, sleep-related hypoventilation, and sleep-related hypoxemia disorder. The most frequent and often the most severe of these is OSA (Ho & Brass 2011; Senaratna et al. 2016).

What is obstructive sleep apnoea?

OSA is characterised by repeated episodes of complete or partial obstructions of the upper airway during sleep. The duration of this obstruction may last up to a minute and occasionally longer, and may occur hundreds of times during the night (Sleep Health Foundation 2017).

A distinguishing feature of OSA is a persistent effort to breathe against the obstructed upper airway, accompanied by snoring. Other symptoms are waking unrefreshed, daytime sleepiness, tiredness and fatigue, poor concentration and irritability (Hamilton & Chai-Coetzer 2019).

Evidence on the prevalence of OSA in Australian populations is limited (Appleton et al. 2015; Simpson et al. 2013) and varies between different studies. Recent data from the Busselton Healthy Ageing Study found the prevalence of any, and moderate to severe OSA to be 58% and 20% in men and 42% and 10% in women aged 46–69 (Cunningham et al. 2021). Using the Berlin Questionnaire, a study showed that 1 in 10 Western Australians suffered from undiagnosed OSA (Simpson et al. 2013). Data from the Men Androgen Inflammation Lifestyle Environment and Stress Study in Adelaide—using full in-home polysomnography and the Epworth Sleepiness Scale and SF 36 questionnaire—found the prevalence of OSA in men aged 40–69 to be as high as 49% and as high as 62% in men aged 70 and over (Appleton et al. 2015).

A different study using data from 13,423 adult men included in the baseline wave of Ten to Men—a national study of the health of Australian men—found that the prevalence of self reported sleep apnoea diagnosed by a health professional increased from 2.2% in men aged 18–25 to 7.8% in men aged 45–54 (Senaratna et al. 2016).

Data on sleep disorders among Aboriginal and Torres Strait Islander people are limited. International research from high-income countries around the world has identified the prevalence of OSA to be higher—and the severity greater—among indigenous populations compared with non-indigenous populations (Woods et al. 2014). A recent study found Indigenous Australians to be at increased risk of cardiovascular disease, as they are likely to experience poor sleep quality, more frequent sleep disorders, and greater rates of insufficient sleep compared with non-Indigenous Australians (Yiallourou et al. 2020).

OSA has detrimental effects on sleep quality and health. If untreated, it is a major determinant of cardiovascular morbidity and mortality (Spicuzza et al. 2015), with severe OSA being a strong independent predictor of future cardiovascular and all-cause mortality (Ge et al. 2013). People with OSA have greater increased risk of motor vehicle accidents and occupational accidents; however, this risk is reduced when sleep apnoea is treated effectively using CPAP therapy (Garbarino et al. 2016; Karimi et al. 2015).

Risk factors

Many risk factors for OSA are modifiable, including being overweight or obese, smoking, high levels of alcohol consumption and being insufficiently physically active (Senaratna et al. 2016). Other risk factors include having a narrow airway or a large tongue, type 2 diabetes, treatment-resistant hypertension, and sedative use (Hamilton & Chai-Coetzer 2019). There is also some evidence on the association between post-traumatic stress disorder and OSA among veterans (Baird et al. 2018). A recent review suggested lifestyle changes, including reducing weight, and quitting alcohol and smoking, may improve the quality of life for patients suffering from OSA (Kaleelullah & Nagarajan 2021).

Comorbidity

Comorbidities are common in OSA patients. Research has found OSA to be associated with asthma, chronic obstructive pulmonary disease (COPD), diabetes, hypertension, myocardial infarction, heart attack, heart failure, angina, stroke, impotence, peptic ulcer disease, gastroesophageal reflux, chronic liver disease as well as some mental disorders such as depression and mood disorders (Chiang et al. 2017; Jordan et al. 2014; Senaratna et al. 2016; Vaessen et al. 2014).

People with OSA are also at increased risk of cognitive decline and dementia. A recent study has shown a link between OSA and Alzheimer disease, the most common form of dementia, finding identical signs of brain damage in both conditions (Owen et al. 2020).

Comorbidities differ between men and women. Studies have shown diabetes and ischaemic heart disease to be more prevalent in men with OSA, and hypertension and depression more prevalent in women with OSA (Heinzer et al. 2018; Mokhlesi et al. 2016). The prevalence of comorbidities has been found to increase with OSA severity (Appleton et al. 2018; Ruel et al. 2018; Tveit et al. 2018).

OSA diagnosis and treatment have been found to have a favourable outcome for comorbidities, and vice versa. OSA treatment may reduce high blood pressure among those with treatment-resistant hypertension (Martínez-García et al. 2013; Montesi et al. 2012). Management of obesity can help to improve OSA treatment effectiveness and reduce cardiovascular risk (Chirinos et al. 2014; Hamilton & Joosten 2017). The 2020 report of the Lancet Commission recommended responding to putative risk factors such as sleep through lifestyle interventions to improve the general health in people with dementia (Livingston et al. 2020).

OSA and COVID-19

A recent study identified OSA as an independent risk factor for severe coronavirus disease 2019 (COVID-19). Although having OSA did not affect the risk of contracting COVID-19, COVID-19 patients with OSA were at a higher risk of being hospitalised due to severe illness (Strausz et al. 2021). Researchers proposed the following 2 potential pathological reasons for this association:

- firstly, some comorbidities in patients with OSA are also known risk factors for severe COVID-19 (for example, high body mass index both is associated with OSA and increases the risk of severe COVID-19)
- secondly, OSA patients generally have lower levels of oxygen in the blood during the night (Kohler & Stradling 2010), which may worsen the key symptoms of severe COVID-19.

Economic impact

At a societal level, OSA not only leads to reduced economic productivity, but also has a substantial economic impact on health-care systems. An Australian study estimated the total health system cost of OSA to be approximately \$541 million, comprising 57% of the total health system cost of sleep disorders (\$944 million) in 2019–20 (Deloitte Access Economics 2021).

How are sleep-related breathing disorders and OSA diagnosed?

A sleep study is used to clinically assess or diagnose people with sleep-related breathing disorders and OSA (see Box 1.1), to develop treatment plans, and to improve patient outcomes.

Box 1.1: What is a sleep study?

A sleep study is a non-invasive examination that allows doctors to monitor a patient while the patient is sleeping to see what is happening in their brain and body. A sleep study will also measure aspects such as eye movements, oxygen levels in the blood (through a sensor—there are no needles involved), heart and breathing rates, snoring, and body movements.

The 2 main types of sleep studies are diagnostic, and treatment management studies.

The first sleep study that most patients have is an overnight diagnostic sleep study. Known as 'polysomnography', it can be done in a hospital, a sleep centre or at home. While sleeping, an electroencephalogram monitors the sleep stages and the cycles of rapid eye movement (REM) and non REM (NREM) sleep to identify possible disruptions in the pattern of sleep.

Overnight sleep studies help doctors to diagnose sleep disorders such as sleep apnoea, periodic limb movement disorder, restless leg syndrome, insomnia, and night time behaviours like sleepwalking and REM sleep behaviour disorder. Often these disorders cannot be identified during a normal office visit—the doctor needs to gather more conclusive evidence while the patient is asleep.

In some circumstances, after the overnight sleep study, the physician may refer the patient for a daytime sleep study that assesses the levels of sleepiness during the day. The daytime sleep studies are known as the Multiple Sleep Latency Test (MSLT) and the Multiple Wakefulness Test (MWT).

An MSLT is used to diagnose narcolepsy, while an MWT is used to measure how alert and awake a person is in a stimulation-free environment.

This report focuses on overnight sleep studies for adults aged 18 and over.

Sources: NHLBI 2020; Sleep Health Foundation 2011.

In Australia, eligible patients can access MBS-subsidised sleep study services to clinically assess or diagnose sleep disorders, including OSA.

From 1 November 2018, changes to the MBS mandate that direct referral for a sleep study via a general or other practitioner is permitted only if questionnaire screening criteria are met (see Box 1.2). Direct referral for a sleep study by a general practitioner should be for patients who have a high probability of symptomatic moderate to severe OSA, using the screening tools. Otherwise, referral to a sleep physician for assessment before a polysomnogram (sleep study) is required (DoH 2018). These changes were introduced to ensure better identification and management of patients with sleep disorders.

Comparison of the sleep study items before and after the changes on 1 November 2018 are provided in Table 2.1 in the Technical supplement.

Box 1.2: Screening criteria to diagnose sleep disorders, including OSA

In order to directly refer patients for a diagnostic sleep study (laboratory or home-based), general practitioners must use assessment tools to determine the patient's eligibility. Patients can receive a positive screening result from the criteria below:

Either one of:

STOP-BANG score ≥ 4 : a screening tool for OSA. Screening items include snoring, tiredness, observed apnoea, high blood pressure (STOP items), body mass index age, neck circumference, and male gender (BANG items).

It consists of 8 dichotomous (yes/no) items related to the clinical features of sleep apnoea. The total score ranges from 0 to 8. Patients can be classified for OSA risk based on their respective scores.

Note: The data used in this report are based on STOP-BANG score ≥ 4 criteria. From 1 March 2021, the MBS was amended to reduce the scoring criteria from 4 to 3.

OSA-50 score ≥ 5 : a brief 4-item OSA screening tool for patients aged 50 and over. It is a separate validation test to STOP-BANG. A patient with a score greater than or equal to 5 has a high probability of having moderate to severe OSA.

Berlin Questionnaire result of High Risk: a questionnaire that reliably identifies middle aged and older people in the community who are at high risk for OSA. The questionnaire consists of 3 categories related to the risk of having sleep apnoea.

Based on their responses to the individual items and their overall scores in the symptom categories, patients can be classified as High Risk (if there are 2 or more categories where the score is positive) or Low Risk (if there is only 1 or no categories where the score is positive),

Plus:

Epworth Sleepiness Scale ≥ 8 : a self-administered questionnaire with 8 questions, to identify a person's 'daytime sleepiness'. The Epworth Sleepiness Scale score (the sum of 8 item scores, 0–3) can range from 0 to 24.

The higher the score, the higher the person's 'daytime sleepiness'.

For details, see Technical supplement.

Source: <http://www.mbsonline.gov.au/internet/mbsonline/publishing.nsf/Content/Factsheet-SleepDisorders>.

Patients who score a positive screening result are eligible for a Medicare rebatable sleep study test referred by a general practitioner. Medicare rebates do not cover the full cost of medical services. The Australian Government sets a Medicare Schedule Fee to determine the amount of the rebate that patients receive from the government. Medicare rebates are paid as a percentage of the Medicare Schedule Fee.

Box 1.3 provides some information on the fees and rebates for MBS laboratory and home-based sleep studies.

Box 1.3: Fee summary for MBS sleep studies

MBS fees (as at 1 July 2020)

Laboratory sleep study (Items 12203, 12204, 12205, 12207 & 12208)

Fee: \$606.35

Benefit: 75% rebate = \$454.80 (for professional services delivered when the patient is admitted as a private patient in hospital)

85% rebate = \$521.65 (for other professional services)

Home-based study (Item 12250)

Fee: \$345.75

Benefit: 75% rebate = \$259.35

85% rebate = \$293.90

Source: MBS Online.

Note: MBS fees are subject to indexation and may change over time.

In-hospital costs for laboratory sleep studies (MBS items 12203, 12204 & 12205)

The costs provided below are typical amounts for the sleep study procedures delivered to patients in private hospitals.

Typical amount means the median or middle amount (that is, half of patients will pay more than this and the other half will pay less).

Typical doctors' fees: \$760.00

The government typically pays: \$450.00

Private insurer typically pays: \$250.00 (As well as payments for doctors' fees, insurers pay for hospital costs like accommodation, theatre and medical device fees. In that case, the typical amount for a sleep study is \$640.00.)

Patients typically pay: \$110.00 (does not include hospital payments such as excess, co payment or other hospital payments).

Out-of-hospital costs for MBS items 12203, 12204 & 12205

Typical doctors' fees: \$700/\$664/\$664

The government typically pays: \$512.70 (for all 3 items)

Patients typically pay: \$187/\$150/\$151

Private health insurance does not cover out-of-hospital treatment.

Note: The above is a guide to understanding the cost of MBS sleep studies provided by specialists in Australia. The fee charged by a doctor can vary. The amount patients pay can also vary depending on the amounts paid by different private health insurers.

Source: <https://www.health.gov.au/resources/apps-and-tools/medical-costs-finder/medical-costs-finder#/ih-procedures>.

In Australia, there are a few MBS items for sleep study services related to diagnosis of sleep related breathing disorders, including OSA. This report includes the following specific diagnostic items that were used for people aged 18 and over:

- **Adult attended laboratory sleep study (MBS item 12203):** performed overnight in a sleep study centre and with a trained sleep technician, to confirm diagnosis of a sleep disorder, including OSA. In this report this item will be referred to as a 'laboratory sleep study'
- **Adult unattended home-based sleep study (MBS item 12250):** performed at home to confirm diagnosis of suspected OSA in less complex patients. In this report this item will be referred to as 'home-based sleep study'
- **Additional attended laboratory sleep study (MBS item 12208):** additional overnight laboratory sleep study in a 12-month period where an initial MBS diagnostic study (adult laboratory sleep study: item 12203) has failed due to insufficient sleep.

Further details of the above items are provided in the Technical supplement.

How are sleep-related breathing disorders and OSA managed?

Sleep-related breathing disorders, in particular OSA, require long-term, multidisciplinary management. The goals of OSA therapy are to resolve signs and symptoms of OSA and improve sleep quality (Sarkissian et al. 2019). There is evidence of the benefits of treatments for OSA.

- Effective treatment can reduce high blood pressure (Martínez-García et al. 2013; Montesi et al. 2012) and motor vehicle accidents (Tregear et al. 2010).
- There is also evidence that management of obesity can help improve the effectiveness of OSA treatment and reduce cardiovascular risk (Chirinos et al. 2014; Hamilton & Joosten 2017).

In most adults, first-line therapy for OSA consists of behavioural modification, including weight loss if appropriate, and CPAP (Sarkissian et al. 2019). CPAP is a form of positive airway pressure ventilation, which applies mild air pressure on a continuous basis. It keeps the airways continuously open in people who are able to breathe spontaneously on their own, but need help keeping their airway unobstructed.

Oral appliances (such as mandibular advancement devices or tongue retaining devices) are an alternative therapy in patients who prefer not to use CPAP or who fail to respond to it. Positional therapy devices (to improve sleeping position) and nasal devices (to open the airway) may also be considered (Sarkissian et al. 2019).

In Australia, there are MBS items for sleep study services related to the treatment and management of sleep-related breathing disorders, in particular in the assessment of CPAP therapy.

The 3 main types included in this report are:

- **Treatment initiation sleep study (MBS item 12204):** to assess positive airway pressure. This study is performed overnight in a sleep study centre following diagnosis of a sleep disorder and the recommendation of CPAP therapy
- **Treatment effectiveness sleep study (MBS item 12205):** follow-up study for patients with a sleep-related breathing disorder after behavioural or therapeutic intervention to assess effectiveness. Interventions may include, but are not limited to, positive airway pressure, upper airway surgery, positional therapy, appropriate oral appliance, weight loss of more than 10% in the previous 6 months or oxygen therapy
- **Further investigative sleep study (MBS item 12207):** for patients with severe cardio respiratory failure who failed CPAP or oxygen therapy. This further investigation is indicated in the same 12-month period to which items 12204 and 12205 apply.

Further details of the above items are provided in the Technical supplement.

Surgery is usually considered as a second-line therapy for OSA, either as secondary therapy in patients who cannot adhere to CPAP or as adjunctive therapy along with CPAP or an oral appliance. The type of surgery depends on the severity of the disease, the patient's anatomy, risk factors and preferences (Phan et al. 2016). These procedures can be categorised as nasal, upper pharyngeal, lower pharyngeal, and global upper airway procedures. The aim of surgical procedures is to eliminate airway collapse, reduce airway resistance during sleep and to improve:

- nasal patency and breathing (for example, septoplasty, turbinate reduction, or both)
- retropalatal obstruction (for example, uvulopalatopharyngoplasty, uvulopalatal flap)
- tongue-base and hypopharyngeal obstruction (for example, tongue-base, temperature controlled radiofrequency and coblation; tongue-base suspension, transoral robotic surgery for tongue-base reduction; posterior midline glossectomy; genioglossus advancement; and maxillomandibular advancement) (Carvalho et al. 2012).

The effectiveness of OSA treatment/ management is evaluated using the apnoea hypopnoea index and oxyhemoglobin saturation levels.

- The apnoea hyponoea index measures the frequency of breathing cessation (apnoea) and shallow breathing (hypopnoea) during sleep. A reduction in the frequency of breathing interruptions indicates an improvement of OSA severity.
- The oxyhemoglobin saturation is a measure of blood oxygen levels, with the normal level of oxygen saturation being between 95–100%. In sleep apnoea, oxygen saturation can often decrease due to breathing interruptions. A reduced oxygen saturation can affect the brain, kidneys and heart; therefore, maintaining a good level of oxygen saturation is important.

Purpose of this report

This report provides a profile of people undertaking sleep studies and treatments for sleep related breathing disorders with a focus on OSA, using several data sources.

- **MBS data** provide information on the number of attended and unattended sleep study services provided, who is claiming these services, and the benefits paid for these services. Information on services for treatment and review of the treatment for sleep related breathing disorders is also provided.
- **NHMD data** provide the number and rate of OSA diagnoses (ICD-10-AM code: G47.32) among those admitted to hospital. Information on specific procedures for OSA within hospital are also provided. The presence of comorbid chronic conditions is investigated by using the principal and additional diagnoses.
- **NMD data** provide the number of deaths due to OSA (ICD-10 code: G47.32), where OSA is the underlying cause and associated cause of death.

Note: There may be some overlap between the sleep studies reported in MBS and hospital data in NHMD, resulting in double counting of a small number of services. This is due to the differences in definitions of 'hospital' (which can include day surgery) between Medicare and the relevant state/territory health authority licensing. While the exact overlap cannot be quantified, the impact on results is expected to be minimal. See Technical supplement for a further description of the data sources.

Use of MBS sleep studies, people with sleep-related breathing disorders and OSA

This report includes the following MBS sleep study items for the diagnosis and treatment of sleep-related breathing disorders and OSA in patients aged 18 and over. They are:

Diagnostic assessment sleep studies

- Adult attended laboratory sleep study (MBS item 12203)
- Adult unattended home-based sleep study (MBS item 12250)
- Additional adult attended laboratory sleep study (MBS item 12208)

Treatment/ management sleep studies

- Treatment initiation sleep study (MBS item 12204)
- Treatment effectiveness sleep study (MBS item 12205)
- Investigative sleep study (MBS item 12207)

Use of MBS diagnostic study

Analysis of MBS data show that 132,576 patients (6.7 per 1,000 Australian population aged 18 and over) received 132,578 diagnostic sleep study services in 2019. Of these:

- 42,041 patients (2.1 per 1,000 population) received 42,041 laboratory sleep study (item 12203) services
- 92,316 patients (4.7 per 1,000 population) received 92,317 home-based sleep study (item 12250) services
- 124 patients claimed an additional laboratory sleep study (item 12208) service, representing less than 1% of laboratory sleep study patients.

Claiming patterns of diagnostic sleep study services varied by demographic characteristics, jurisdiction, remoteness and socioeconomic area.

Adult attended laboratory sleep study (MBS item 12203): The rate of the population claiming this study was:

- higher for men than women (2.5 versus 1.7 per 1,000 population)
- highest among patients aged 65–74. Some differences were noted by age and sex. Rates increased with age until 65–74 then dropped, for both men and women; for all age groups, rates were higher for men than women (Figure 2.1)
- highest in the Australian Capital Territory (3.3 claims per 1,000 population) and lowest in Tasmania (0.7 claims per 1,000) (Figure 2.3)
- higher in *Major cities* than in *Remote* and *Very remote* areas (2.1 compared with 1.1 per 1,000 population) (Figure 2.4)
- higher in the highest socioeconomic areas (1.6 per 1,000 population) than in the lowest socioeconomic areas (0.8 per 1,000) (Figure 2.4).

Adult unattended home-based sleep study (MBS item 12250): The rate of the population claiming this study was:

- higher for men than women (5.8 versus 3.5 per 1,000 population)
- higher in patients aged 45–64. Across all age groups, claiming rates were greater for men than women (Figure 2.2)
- highest in Queensland (6.2 claims per 1,000 population) and lowest in Victoria and the Northern Territory (3.6 claims per 1,000) (Figure 2.3)
- higher in *Inner regional* areas (5.1 per 1,000 population) compared with *Very remote* areas (2.5 per 1,000) (Figure 2.4)
- minimally different by socioeconomic area (Figure 2.4).

These differences by remoteness and socioeconomic areas could be for a number of reasons, such as:

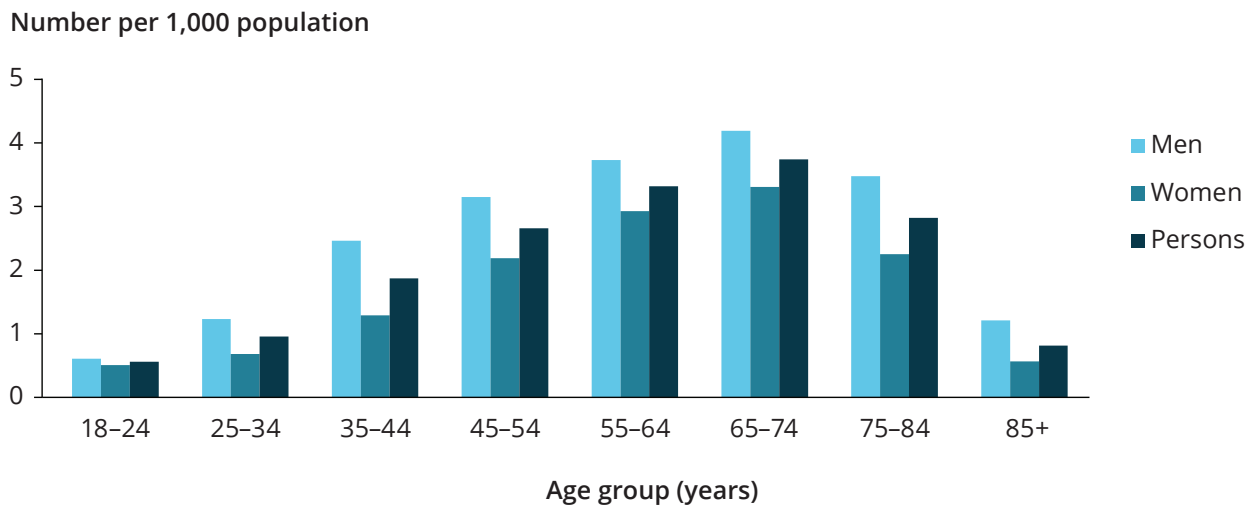
- the distance patients are located from health-care providers, resulting in fewer attendances and referrals for sleep studies
- reduced patient access to appropriate facilities or equipment for diagnostic sleep studies; for example, due to distance from health-care providers.

By jurisdiction, patterns of remoteness generally aligned with national results. Another possible reason for the differences by remoteness and socioeconomic areas might be jurisdictional differences in economic industries; for example, in Queensland, the highest claim rates of laboratory sleep studies was found in *Outer regional* areas (2.0 per 1,000 population). This could be driven by higher populations of mining workers in these areas, who may be referred to undertake sleep studies through occupational health assessments.

The claiming patterns of laboratory sleep studies by socioeconomic area and jurisdiction generally aligned with national results. Some variation was noted for home-based sleep studies; for example, in South Australia, an opposite trend was found where the highest claim rate was in the lowest socioeconomic areas (3.1 per 1,000 population) compared with the highest socioeconomic areas (1.6 per 1,000).

Additional attended laboratory sleep study (MBS item 12208): Less than 1% of laboratory sleep study patients claimed this service. No difference was noted by state and territory of residence, remoteness or socioeconomic area.

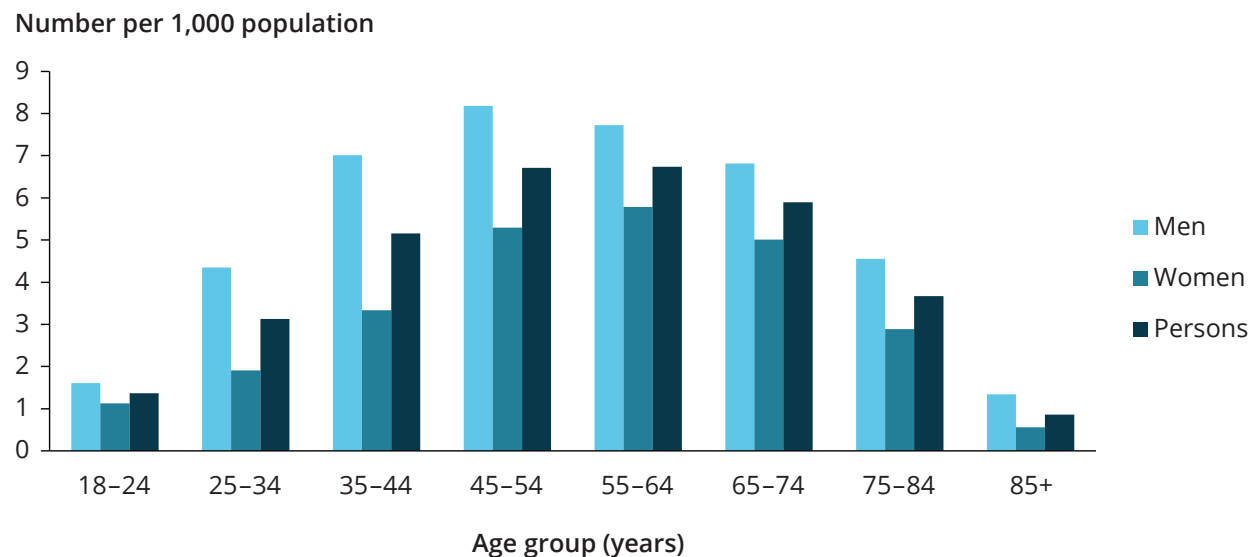
Figure 2.1: Patients, per 1,000 population, aged 18 and over who claimed a laboratory diagnostic sleep study, by age and sex, 2019



Note: Data are reported by calendar year in which the service was provided (1 January to 31 December 2019) and the claim has been processed by 30 June 2020.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Services Australia.

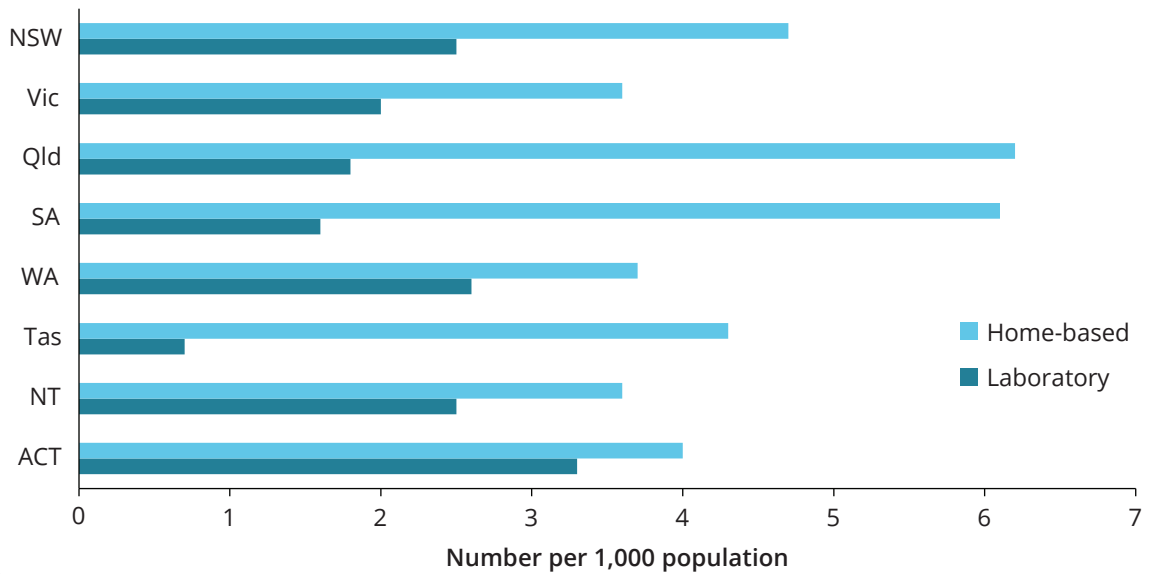
Figure 2.2: Patients, per 1,000 population, aged 18 and over who claimed a home-based diagnostic sleep study, by age and sex, 2019



Note: Data are reported by calendar year in which the service was provided (1 January to 31 December 2019) and the claim has been processed by 30 June 2020.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Services Australia.

Figure 2.3: Patients, per 1,000 population, aged 18 and over who claimed laboratory and home-based diagnostic sleep studies, by state/ territory, 2019

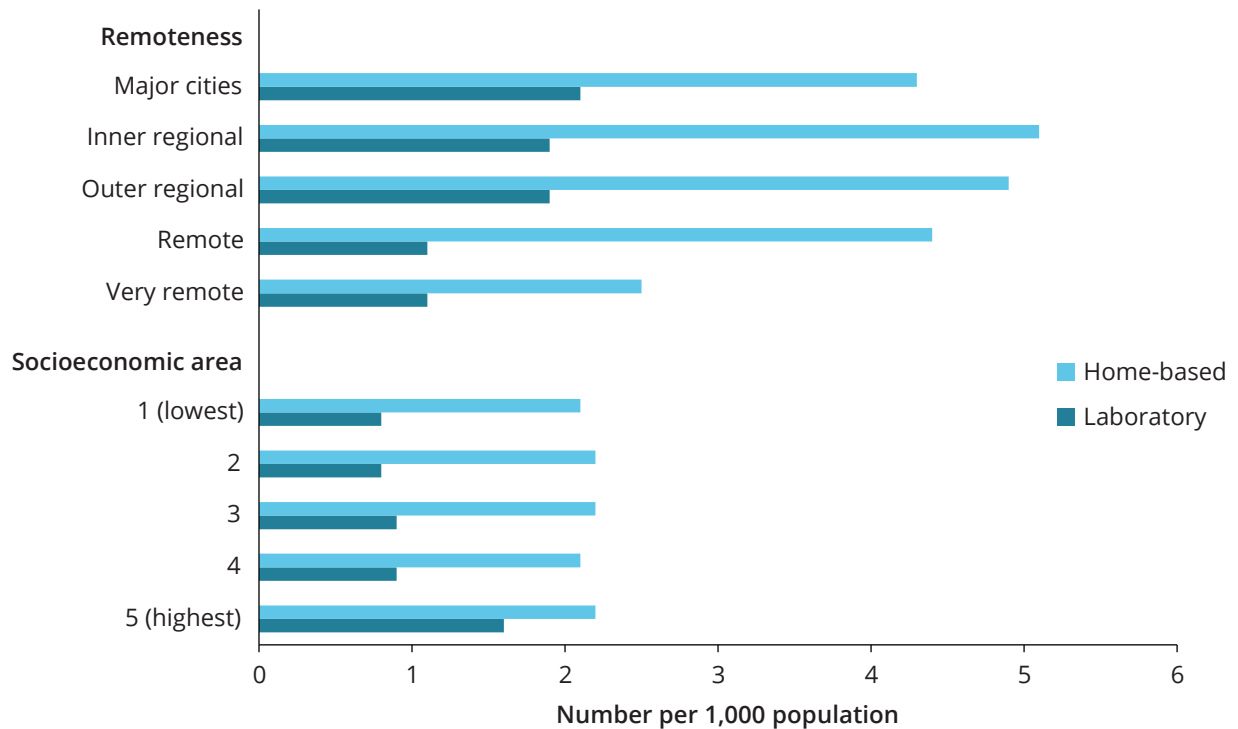


Notes

1. Data are reported by calendar year in which the service was provided (1 January to 31 December 2019) and the claim has been processed by 30 June 2020.
2. Rates are age standardised to the 2001 Australian Standard Population.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Services Australia.

Figure 2.4: Patients, per 1,000 population, aged 18 and over who claimed laboratory and home-based diagnostic sleep studies, by remoteness and socioeconomic area, 2019



Notes

1. Data are reported by calendar year in which the service was provided (1 January to 31 December 2019) and the claim has been processed by 30 June 2020.
2. Rates are age standardised to the 2001 Australian Standard Population.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Services Australia.

There was considerable variation in the distribution of sleep study services by Statistical Area Level 3 (SA3). The 3 SA3 areas with the highest rates (crude) of laboratory sleep study services were:

- Kempsey–Nambucca (New South Wales) (5.3 per 1,000 population)
- Port Macquarie (New South Wales) (4.8 per 1,000 population)
- Coffs Harbour (New South Wales) (4.7 per 1,000 population) (Figure A1).

The 3 SA3 areas with the highest rates of home-based sleep study services were:

- Beenleigh (Queensland) (8.5 per 1,000 population)
- Redcliffe (Queensland) (7.4 per 1,000 population)
- Gympie–Cooloola (Queensland) (7.1 per 1,000 population) (Figure A2).

Comparing claiming patterns by patients using laboratory and home-based sleep studies

In summary, claiming patterns for MBS diagnostic sleep studies varied by the type of sleep study. Overall, the rate of the population claiming the services was higher for home-based study than laboratory study. Although claims were higher for men for both type of studies, some differences were noted:

- For laboratory studies, the rate of claiming was highest among patients aged 65–74; for home-based studies, it was highest among patients aged 45–64.
- Home-based studies were more common than laboratory studies in all states and territories.
- For laboratory studies, claims were higher in *Major cities*; for home-based studies, claims were higher in *Inner regional* areas.
- For laboratory studies, claims were higher in the highest socioeconomic areas. Minimal differences were noted for home-based studies.
- For laboratory studies, the top 3 SA3 areas with the highest rates (crude) of services were in New South Wales. For home-based studies, the top 3 SA3 areas were in Queensland.

The total benefits paid for the diagnostic sleep studies was around \$47 million in 2019. Of this, \$20 million was for laboratory sleep studies and \$27 million for home-based sleep studies.

Use of MBS treatment management study

Analysis of MBS data show that 21,111 patients received a treatment management sleep study service in 2019, representing 1.0 patient per 1,000 Australian population aged 18 and over. These services cover treatment initiation, assessing treatment effectiveness and further investigation of sleep-related breathing disorders.

The total benefits paid for treatment sleep studies was around \$10 million in 2019. Of this, \$7.9 million was for treatment initiation and \$2.4 million for effectiveness sleep studies.

Treatment initiation sleep study (MBS item 12204)

In 2019, 16,631 patient received a treatment initiation sleep study service. This represents a rate of 0.8 patients per 1,000 population aged 18 and over.

- The rate of the population claiming this sleep study service was higher for men (1.0 per 1,000 population) than women (0.6 per 1,000).
- The rate of claiming was higher for people aged 65–74 (1.8 per 1,000 population).
- Claiming of services was highest in Queensland (1.2 per 1,000 population, after adjusting for age) and lowest in Western Australia (0.3 per 1,000).
- After adjusting for age, the rate of claiming this service was higher in Outer regional areas (0.9 per 1,000 population) than in *Very remote* areas (0.4 per 1,000). Minimal differences were noted by socioeconomic area.

Treatment effectiveness sleep study (MBS item 12205)

Treatment effectiveness sleep studies make up a small proportion of claims for MBS treatment management sleep studies. This study is a follow-up study for patients with a sleep-related breathing disorder who received treatment but whose symptoms recurred, or who had a significant change in weight or other medical conditions.

In 2019, there were 4,999 patients who received this service, representing 0.2 per 1,000 Australian population aged 18 and over. The rate of the population claiming this sleep study service was higher for men, and for people aged 65–84. Minimal differences were noted by state and territory of residence, remoteness and socioeconomic area.

Further investigative sleep study (MBS item 12207)

This study is for patients with severe cardio-respiratory failure, who require further investigation where previous studies (treatment initiation and effectiveness) demonstrated failure of CPAP or oxygen therapy. In 2019, 325 patients claimed this service, representing 1.6% of patients who had an initiation and effectiveness study (MBS items 12204 & 12205).

See supplementary tables 3.7, 3.8, 3.9 for details ([Technical supplement](#)).

Use of general practitioner/ specialist/ allied health services by sleep study patients: a cohort analysis

This section provides data on health services used by patients before and after their diagnostic sleep study. The analysis identifies a patient's first diagnostic sleep study in 2019 and explores the use of Medicare-subsidised general practitioner, specialist and allied health services in the 6 months before and after the sleep study.

The study cohort includes patients claiming either a laboratory (item 12203) or home-based sleep study (item 12250) between 1 January and 31 December 2019. The analysis looks at other services they have used in the 6 months before their initial sleep study (in this report, between 1 July 2018 and 31 December 2018) and 6 months after their initial sleep study (in this report, between 1 January 2020 and 30 June 2020). It is not possible to know whether other services used by a patient relate to their potential/diagnosed sleep disorder or to another condition entirely. However, some inferences can be drawn (for example, for patients who visited a respiratory and sleep medicine physician).

It should be noted that the COVID-19 pandemic has had a major impact on which patients are accessing health services and on the ways in which health professionals are delivering services (AIHW 2020). It is not possible to know what impact this had on the use of other MBS services by sleep study patients in the March to June 2020 period. COVID-19 items (including general practitioner telehealth items) that became available during this period are out of scope and therefore not included in this report.

For information on the overall changes in MBS services and benefits paid during the COVID 19 pandemic, see the Australian Institute of Health and Welfare (AIHW) report *Impacts of COVID-19 on Medicare Benefits Scheme and Pharmaceutical Benefits Scheme service use* (AIHW 2020).

Laboratory sleep study cohort

In 2019, 41,256 patients received an initial laboratory sleep study (item 12203) and no other sleep study services. Of these, the majority visited a general practitioner either before (97%) and/or after (93%) their initial study (Table 2.1). The proportion of patients visiting a specialist was higher in the 6-month period after their initial sleep study (89% after, compared with 85% before). Of all specialist visits, the most common visit was to a respiratory and sleep medicine specialist (62% before; 70% after) and a cardiologist (21% before; 18% after).

More than half of the patients visited a general practitioner once (58% before; 56% after the initial sleep study), while one-fifth visited twice (20% before; 19% after) (Table 2.2). A similar pattern is noted for patients visiting a specialist once (69% before; 58% after); the proportion visiting a specialist twice was higher after the initial sleep study (19%) than before it (10%).

Overall, the proportion of patients using allied health services was similar for patients before and after (17% before; 18% after) their initial sleep study (Table 2.1). Of all patients visiting allied health services, the most common visit was to a podiatrist (50% before; 51% after), followed by physiotherapist (30% before; 28% after) (Table 2.1).

Table 2.1: Use of other MBS services, initial laboratory sleep study cohort (item 12203), aged 18 and over

MBS service type	6 months before the initial sleep study		6 months after the initial sleep study	
	Number of patients	Proportion of patients claiming the initial sleep study (%)	Number of patients	Proportion of patients claiming the initial sleep study (%)
General practitioner	39,937	96.8	38,180	92.5
Specialist	34,878	84.5	36,800	89.2
<i>Respiratory & sleep medicine</i>	21,589	61.9	25,922	70.4
<i>Cardiology</i>	7,346	21.1	6,631	18.0
<i>Anaesthesia</i>	5,554	15.9	5,724	15.6
Allied health	6,994	17.0	7,211	17.5
<i>Podiatrist</i>	3,515	50.3	3,640	50.5
<i>Physiotherapist</i>	2,082	29.8	2,036	28.2
<i>Dietitian</i>	949	13.6	1,069	14.8
Oral maxillofacial consult	77	0.2	68	0.2

Notes

1. Number of patients in the initial laboratory sleep study cohort 41,256.
2. Data are reported by the time period in which the service was provided. Includes services with a date of service between 1 July 2018 and 30 June 2020.
3. General practitioner includes BTOS 101,102,103; Specialist includes BTOS 200; Allied health includes Group M03; Oral maxillofacial consult includes item 51700 and 51703.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Services Australia.

Table 2.2: Number of times patients visited a general practitioner/ specialist/ allied health, initial laboratory sleep study cohort, aged 18 and over

Speciality type	Number of times visited			
	1	2	3	More than 3
6 months before the initial laboratory sleep study				
General practitioner	58.0	19.8	7.6	11.3
Specialist	68.7	10.4	2.6	2.9
Allied health	6.0	5.4	3.2	2.3
6 months after the initial laboratory sleep study				
General practitioner	56.2	19.2	7.2	9.9
Specialist	57.9	19.1	6.3	5.8
Allied health	5.9	5.7	3.4	2.4

Notes

1. Data are reported by the time period in which the service was provided. Includes services with a date of service between 1 July 2018 and 30 June 2020.
2. General practitioner includes BTOS 101,102,103; Specialist includes BTOS 200; Allied Health includes Group M03.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Services Australia.

Home-based sleep study cohort

In 2019, 91,568 patients had their initial home-based sleep study (item 12250) and no other sleep study services. Of these, the majority visited a general practitioner either before (99%) and/or after (94%) their study (Table 2.3). A higher proportion of patients visited a specialist in the 6-month period after their initial sleep study (63%) than before it (56%). Of all specialist visits, the most common were visits to respiratory and sleep medicine physicians (49% after the initial sleep study compared with 41% before it), followed by cardiologists (21% before; 17% after).

More than half of the patients visited a general practitioner once (61% before the initial sleep study; 58% after it), while one-fifth visited twice (20% before; 19% after) (Table 2.4). The proportion of patients who visited a specialist once before and after the initial study was almost the same (47%). Patients were more likely to visit a specialist twice after their initial sleep study (11%) than before it (6.5%) (Table 2.4).

Overall, the proportion of patients using allied health services was similar for patients before (16%) and after their initial sleep study (17%) (Table 2.3). Of all patients visiting allied health services, the most common visit was to a podiatrist (41% before; 39% after), followed by a physiotherapist (34% before, 31% after) and then a dietitian (17% before; 22% after).

Table 2.3: Use of other MBS services, initial home-based sleep study cohort (item 12250), aged 18 and over

MBS service type	6 months before the initial sleep study		6 months after the initial sleep study	
	Number of patients	Proportion of patients claiming the initial sleep study (%)	Number of patients	Proportion of patients claiming the initial sleep study (%)
General practitioner	90,149	98.5	86,379	94.3
Specialist	51,248	56.0	57,258	62.5
<i>Respiratory & sleep medicine</i>	20,745	40.5	28,057	49.0
<i>Cardiology</i>	10,798	21.1	9,981	17.4
<i>Anaesthesia</i>	6,275	12.2	7,521	13.1
Allied Health	14,390	15.7	15,583	17.0
<i>Podiatrist</i>	5,939	41.3	6,126	39.3
<i>Physiotherapist</i>	4,949	34.4	4,871	31.3
<i>Dietitian</i>	2,506	17.4	3,450	22.1
Oral maxillofacial consult	138	0.2	123	0.1

Notes

1. Number of patients in the initial home-based sleep study cohort 91,568.
2. Data are reported by the time period in which the service was provided. Includes services with a date of service between 1 July 2018 and 30 June 2020.
3. General practitioner includes BTOS 101,102,103; Specialist includes BTOS 200; Allied Health includes Group M03; Oral maxillofacial consult includes item 51700 and 51703.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Services Australia.

Table 2.4: Number of times patients visited a general practitioner/ specialist/ allied health, home-based sleep study cohort, aged 18 and over

Speciality type	Number of times visited			
	1	2	3	More than 3
6 months before the initial home-based sleep study				
General practitioner	60.6	20.3	7.6	10.0
Specialist	46.6	6.5	1.6	1.3
Allied health	6.2	4.6	2.7	2.2
6 months after the initial home-based sleep study				
General practitioner	57.6	19.4	7.3	10.0
Specialist	47.3	10.6	2.7	1.9
Allied health	6.8	5.2	2.9	2.2

Notes

1. Data are reported by the time period in which the service was provided. Includes services with a date of service between 1 July 2018 and 30 June 2020.

2. General practitioner includes BTOS 101,102,103; Specialist includes BTOS 200; Allied Health includes Group M03.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Services Australia.

Comparing other services used by laboratory and home-based sleep study patients

The use of Medicare-subsidised general practitioner, specialist and allied health services in the 6 months before and after the initial sleep study was fairly similar for patients claiming laboratory studies and home-based sleep studies. The proportion of patients visiting a general practitioner was slightly higher for the home-based study cohort (99% before; 94% after) than for the laboratory study cohort (97% before; 93% after). The proportion of patients visiting a specialist was higher for the laboratory study cohort (85% before; 89% after) than for the home-based study cohort (56% before; 63% after). For both cohorts, the most common specialist visit was to a respiratory and sleep study physician, followed by a cardiologist. For both cohorts, a similar proportion of patients used allied health services (17% before and 18% after for the laboratory study cohort; 16% before and 17% after for the home-based study cohort), with the most common visit being to a podiatrist.

For both the laboratory and home-based cohorts, the proportion of patients who visited a general practitioner once was higher before the initial sleep study. In contrast, the proportion of patients visiting a specialist once was higher for the laboratory study cohort (68% before the initial sleep study; 57% after), with very little difference noted for the home-based cohort patients (46% before; 47% after).

Hospitalisation among people with OSA

In 2018–19, there were 58,342 hospitalisations (both principal and additional diagnoses) with OSA. Of these, 39,472 hospitalisations (68%) had OSA as the principal diagnosis and 18,870 (32%) as an additional diagnosis. About 80% of all OSA-related hospitalisations were elective admissions and 62% were in private hospitals (excluding private free-standing day hospital facilities). Around 58% of hospitalisations (33,654) were for patients who used private health insurance to fund their admission.

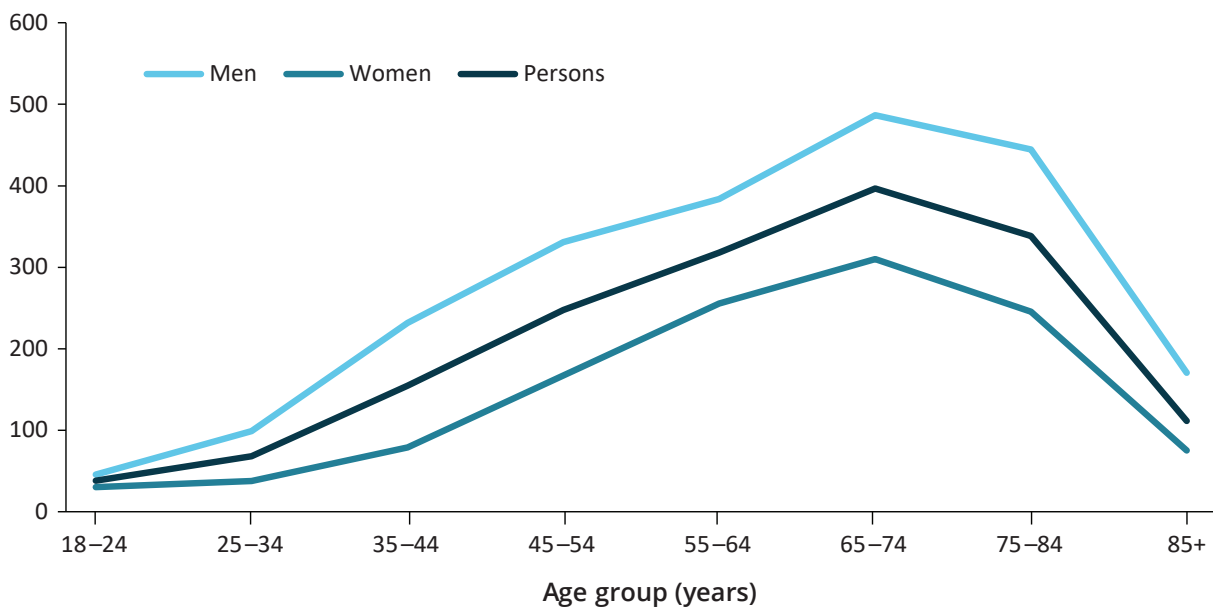
Hospitalisations

Hospitalisations with OSA as the principal diagnosis (ICD-10-AM code: G47.32):

- were higher for men (254 per 100,000 population) than women (133 per 100,000); this pattern was seen across all age groups (Figure 2.5)
- increased with age, peaking among men and women aged 65–74 (487 and 310 per 100,000 population, respectively) and thereafter declining (Figure 2.5).

Figure 2.5: OSA hospitalisations (principal diagnosis), people aged 18 and over, by age and sex, 2018–19

Hospitalisations per 100,000 population



Source: AIHW NHMD.

Procedures

In 2018–19, there were 32,394 hospitalisations for procedures or interventions specifically for OSA. Of these, 30,698 were for polysomnography, a diagnostic procedure used to diagnose sleep disorders (performed in 95% of all hospitalisations where a procedure was involved for OSA). The procedure polysomnography used in the NHMD and the MBS is synonymous (see Technical supplement Box 1.1).

Another 2,394 hospitalisations were for surgical procedures for OSA. The most common surgical procedures were:

- uvulopalatopharyngoplasty (2.3%)
- nasal surgery (1.6%)
- tonsillectomy and adenoidectomy (1.4%).

Codes for procedures for OSA are provided in Appendix 2 (see Technical supplement).

Other health conditions (additional diagnoses) in OSA hospitalisations

Additional diagnoses provide further insight into other health conditions or comorbidities of a patient that were relevant to their hospitalisation. However, they do not provide a complete picture of a patient's health conditions, the number of health conditions per patient, or OSA comorbidities at a population level.

In 2018–19, almost 1 in 3 (35%; 13,972) hospitalisations with a principal diagnosis of OSA also had 1 or more additional diagnoses. Common additional diagnoses were history of tobacco use (recorded in 9.9% of OSA hospitalisations) followed by type 2 diabetes mellitus without complication, and current tobacco use (2.8% each).

When OSA was an additional diagnosis, the most common principal diagnoses were:

- congestive heart failure (5.2% of these hospitalisations)
- arthrosis of the knee (3.9%)
- COPD with acute lower respiratory infection (3.5%)
- obesity, not elsewhere classified, body mass index ≥ 40 kg/m² (2.4%).

How many people die from OSA?

Left untreated, OSA can have serious and life-threatening consequences, with severe OSA shown to be a strong independent predictor of future cardiovascular and all-cause mortality (Gami et al. 2013; Ge et al. 2013).

In 2018, there were 1,111 deaths in Australia related to OSA (67% men and 33% women), representing 0.8% of all deaths. OSA was listed as the underlying cause of 45 deaths, with the majority of these in people aged 75 and over. OSA was listed as an associated cause for 1,066 deaths, mostly with another chronic disease listed as the underlying cause of death. Ischaemic heart disease was the topmost underlying cause of death in these cases (17%), followed by other heart diseases (15%), lower respiratory diseases (14%), and malignant neoplasm (cancer; 12%) (Table 2.5).

Table 2.5: Deaths with OSA as an associated cause of death, by underlying cause of death, people aged 18 and over, 2018

Underlying cause of death	ICD-10 codes	Number of deaths	%
Ischaemic heart disease	I20-I25	179	16.8
Other heart and vascular disease	I10-I15; I26-I99	163	15.3
Chronic lower respiratory diseases	J44-J47	152	14.3
Malignant neoplasm	C01-C96	128	12.0
Diabetes mellitus	E10-E14	81	7.6
Obesity and other hyperalimentation	E66	47	4.4
Other causes	All codes, excluding the above codes	316	29.6
Total		1,066	100.0

Source: AIHW NMD.

3

Challenges in collecting and reporting data on sleep-related breathing disorders

In Australia, there is a lack of information on the prevalence of sleep-related breathing disorders in the general population. While MBS data provide an accurate measure of patients receiving sleep studies, the number of patients diagnosed with a sleep-related breathing disorder is not known. The number of patients who receive treatment services (treatment initiation, treatment effectiveness or further investigative services) likely represent a small number of patients with a diagnosed sleep-related breathing disorder. As well, it is not possible to know how many people are living with an undiagnosed or untreated sleep-related breathing disorder.

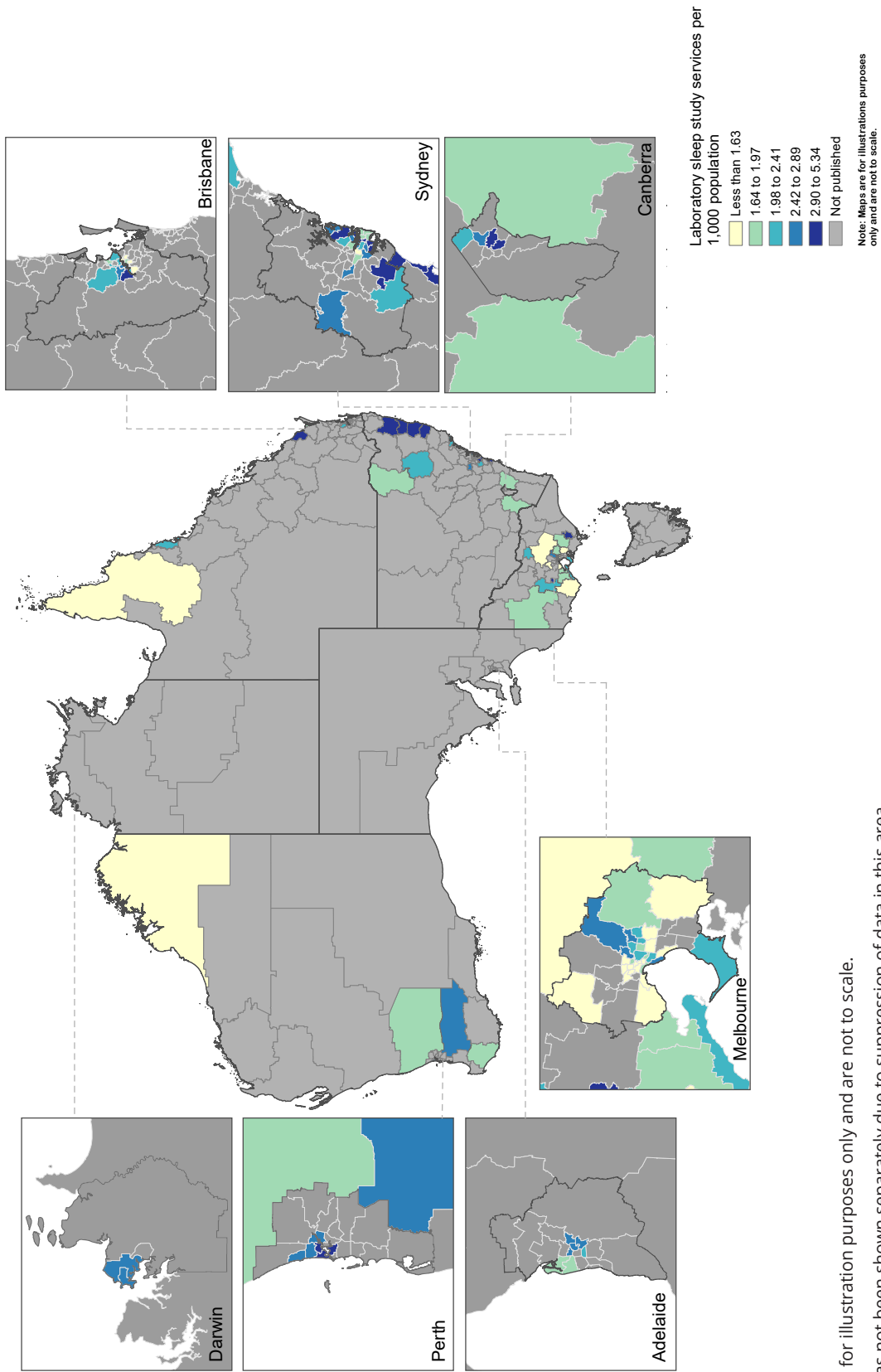
Of sleep study patients identified through MBS data, little is known about their broader health characteristics, such as comorbidities or the proportion who are overweight and obese. The MBS does not provide specific information on OSA, as the items are broader than this and used to diagnose and treat other sleep-related breathing disorders.

A data gap also exists for the number of people using OSA-related therapeutic equipment, such as CPAPs, dental devices, and over-the counter oral appliances.

A better understanding of the people living with OSA and other sleep-related breathing disorders in Australia could be achieved through linked data. Linked data could allow the exploration of comorbidities for OSA in detail (for example, obesity and other chronic conditions). It could also allow for the exploration of patient pathways following sleep-related breathing disorder diagnostic services, such as emergency department attendances, hospital admissions and mortality.

Appendix: Distribution of MBS sleep study services by SA3

Figure A1: Distribution of laboratory sleep study services (per 1,000 population) in Australia, and capital cities, by quintiles, by SA3, 2019

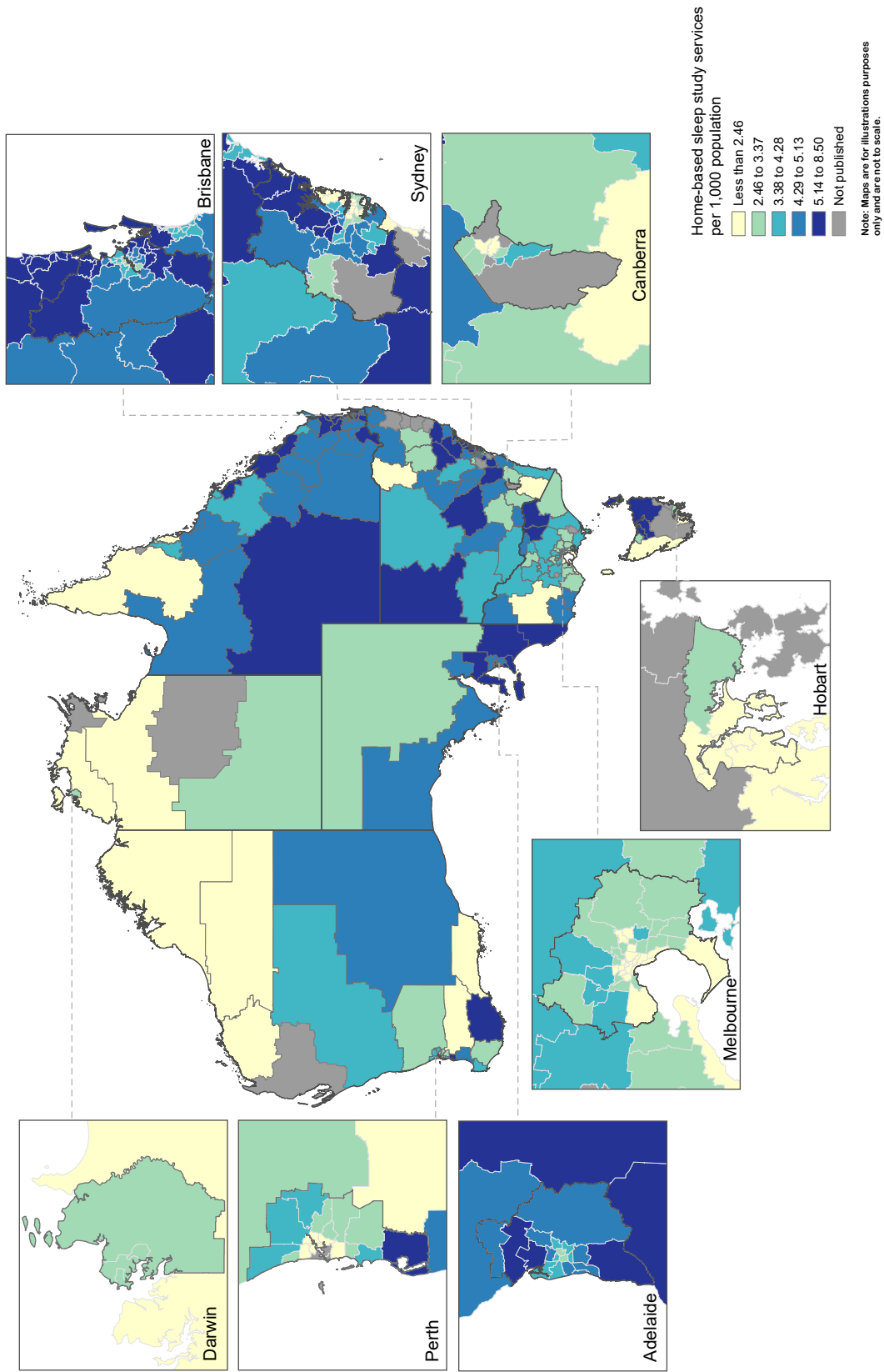


Notes

1. Maps are for illustration purposes only and are not to scale.
2. Hobart has not been shown separately due to suppression of data in this area.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Department of Human Services (Data Table).

Figure A2: Distribution of home-based sleep study services (per 1,000 population) in Australia, and capital cities, by SA3, 2019



Note: Maps are for illustration purposes only and are not to scale.

Source: AIHW analysis of MBS data maintained by the Department of Health and sourced from Department of Human Services (Data Table).

Acknowledgements

This report was written by Naila Rahman and Melissa Wilson from the Australian Institute of Health and Welfare (AIHW), with input from Louise Catanzariti, Katherine Faulks, Sophie Lindquist, JooShan Ong and Imaina Widagdo. The report was reviewed by Richard Juckes and Jason Thomson of the AIHW, as well as by members of the National Asthma and Other Chronic Respiratory Conditions Monitoring Advisory Group, chaired by Professor Graeme Maguire. The authors would also like to thank Karen Higgins, Leanne Luong, Michael McTigue and Ross Saunders for their advice.

The Department of Health funded this publication.

Abbreviations

AIHW	Australian Institute of Health and Welfare
COPD	chronic obstructive pulmonary disease
COVID-19	coronavirus disease 2019
CPAP	continuous positive airway pressure
ICD-10	International Statistical Classification of Diseases and Related Health Problems, 10th Revision
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian modification
MBS	Medicare Benefits Schedule
MSLT	Multiple Sleep Latency Test
MWT	Multiple Wakefulness Test
NHMD	National Hospital Morbidity Database
NMD	National Mortality Database
NREM	non rapid eye movement
OSA	obstructive sleep apnoea
REM	rapid eye movement
SA3	Statistical Area Level 3

Glossary

additional diagnosis: The diagnosis of a condition or recording of a complaint—either coexisting with the **principal diagnosis** or arising during the episode of admitted patient care (hospitalisation). Multiple diagnoses may be recorded.

apnoeahypopnoea index: An index used to indicate the severity of sleep apnoea. It is represented by the number of apnoea and hypopnea events per hour of sleep. The apnoeas (pauses in breathing) must last for at least 10 seconds and be associated with a decrease in blood oxygen.

associated cause(s) of death: A cause(s) listed on the Medical Certificate of Cause of Death, 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 death.

central sleep apnoea: A disorder in which breathing repeatedly stops and starts during sleep. Central sleep apnoea occurs because the brain does not send proper signals to the muscles that control breathing.

circadian rhythm disorders: A family of sleep disorders that affect the timing of sleep (also known as circadian rhythm sleep-wake disorders).

continuous positive airway pressure (CPAP): A type of positive airway pressure ventilator that applies continuous mild air pressure. It keeps the airways continuously open in people who are able to breathe spontaneously on their own, but need help keeping their airway unobstructed.

electroencephalogram (EEG): A test that detects electrical activity in the brain using small, metal discs (electrodes) attached to the scalp. Brain cells communicate via electrical impulses and are active all the time, even when asleep. This activity shows up as wavy lines on an EEG recording.

endotracheal tube: A flexible plastic tube that is placed through the mouth into the trachea (windpipe) to help a patient breathe. The tube is then connected to a ventilator, which delivers oxygen to the lungs. The process of inserting the tube is called endotracheal intubation.

genioglossus: A fan-shaped extrinsic muscle of the tongue that starts at the chin and attaches to the entire length of the tongue, from tip to base. The word comes from the Greek words genion (means chin) and glossa (means tongue).

glossectomy: The surgical removal of the tongue. The surgery may be (a) partial—removal of part of the tongue, (b) hemi—removal of one side of the tongue or (c) total—removal of the whole tongue.

history of tobacco use (replacement for **personal history of tobacco use disorder**): Tobacco consumption includes use of chewing tobacco, and smoking of cigarettes, cigars, pipes and water pipes (for example, hookah, narghile, shisha). As electronic nicotine delivery systems (ENDS) (for example, e-cigarettes, vape-pipes, e-shisha) deliver nicotine without tobacco, use of these devices does not require assignment of a code for tobacco use disorder. Z86.43 Personal history of tobacco use disorder is assigned where there is a history of tobacco consumption, excluding the previous month.

mandibular advancement device: A prescription custom-made medical device worn in the mouth and used to treat sleep-related breathing disorders including: **obstructive sleep apnoea (OSA)**, snoring, or temporomandibular joint and muscle disorders (TMJ) (a group of conditions that cause pain and discomfort in the jaw joint and chewing muscles). Also known as a mandibular advancement splint.

maxillomandibular advancement: A surgical procedure (sometimes called bimaxillary advancement or double jaw advancement) that moves the upper (maxilla) and lower (mandible) jaws forward; it effectively enlarges the airway in both the palate and tongue regions.

Medicare: A national, government-funded scheme that subsidises the cost of personal medical services for all Australians and aims to help them afford medical care. The Medicare Benefits Schedule (MBS) is the listing of the Medicare services subsidised by the Australian Government. The schedule is part of the wider Medicare Benefits Scheme (Medicare).

morbidity: The ill health of an individual and levels of ill health in a population or group.

mortality: Number or rate of deaths in a population during a given time period.

Multiple Sleep Latency Test (MSLT): Tests for excessive daytime sleepiness by measuring how quickly the person falls asleep in a quiet environment during the day. Also known as a daytime nap study, the MSLT is the standard tool used to diagnose **narcolepsy** and idiopathic hypersomnia.

Multiple Wakefulness Test (MWT): Tests used to measure how alert the person is during the day. It shows whether or not the person is able to stay awake for a defined period of time. This is an indicator of how well the person is able to function and remain alert in quiet times of inactivity.

narcolepsy: A long-term neurological disorder that involves a decreased ability to regulate sleep-wake cycles. Symptoms often include periods of excessive daytime sleepiness and brief involuntary sleep episodes.

National Hospital Morbidity Database (NHMD): A compilation of episode-level records from admitted patient morbidity data collection systems in Australian hospitals.

National Mortality Database (NMD): A database that holds records for all deaths in Australia since 1964.

oxyhemoglobin saturation levels: Haemoglobin is an element in the blood that binds with oxygen to carry it through the bloodstream to the organs, tissues and cells of the body. Oxygen saturation is the fraction of oxygen-saturated haemoglobin relative to total haemoglobin (unsaturated + saturated) in the blood. The human body requires and regulates a very precise and specific balance of oxygen in the blood. Normal arterial blood oxygen saturation levels in humans are 95–100%.

pharyngeal (upper and lower): Relating to the pharynx (plural: pharynges)—the part of the throat behind the mouth and nasal cavity, and above the oesophagus and larynx (the tubes going down to the stomach and the lungs).

polysomnography: A test used to diagnose sleep disorders (also called a sleep study). Polysomnography records brain waves, the oxygen level in the blood, heart rate and breathing, as well as eye and leg movements during the study.

principal diagnosis: The diagnosis established after study to be chiefly responsible for the patient's episode of admitted patient care.

procedure: A clinical intervention that is either surgical, carries an anaesthetic risk, requires specialised training and/or requires special facilities or services available only in an acute care setting.

pulmonary function tests: Non-invasive tests that show how well the lungs are working. They measure lung volume, capacity, rates of flow, and gas exchange.

restless leg syndrome: A condition that causes unpleasant or uncomfortable sensations in the legs and an irresistible urge to move them, also called Willis-Ekbom Disease. Symptoms commonly occur in the late afternoon or evening hours, and are often most severe at night during rest, such as sitting or lying in bed.

septoplasty: A corrective surgical procedure to straighten the bone and cartilage dividing the space between the 2 nostrils (septum).

sleep-related hypoventilation: A breathing-related disorder that interrupts normal sleep. This condition may be diagnosed when all other sleep disorders have been ruled out, though it may appear simultaneously with other sleep disorders.

sleep-related hypoxemia disorder: An abnormally low level of oxygen in the blood.

tracheostomy tube: A curved tube that is inserted through the hole in the windpipe (trachea) and secured in place with a strap around the neck. It is used in the surgical procedure tracheostomy that provides an alternative airway for breathing.

transoral robotic surgery: A modern surgical technique used to treat tumours of the mouth and throat via direct access through the mouth.

turbinate reduction: A procedure where the inferior nasal turbinates (small structures inside the nose that cleanse and humidify air that passes through the nostrils into the lungs) are examined and reduced in size to improve nasal breathing. Surgery is typically performed through the nostrils on both sides of the nose.

underlying cause of death: 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.

uvulopalatopharyngoplasty (UPPP): A surgical procedure used to remove tissue and/or remodel tissue in the throat. This could be because of sleep issues. Tissues that may typically be removed include the tonsils and the adenoids. Tissues that may typically be remodelled include the uvula (fleshy piece of tissue hanging down over the tongue towards the back of the mouth), the soft palate (soft tissue constituting the back of the roof of the mouth), and the pharynx (part of the throat behind the mouth and nasal cavity).

uvulopalatal flap (UFP): A modification of uvulopharyngoplasty. Instead of removing the uvula and soft palate, the uvula is retracted and tucked superiorly under the soft palate.

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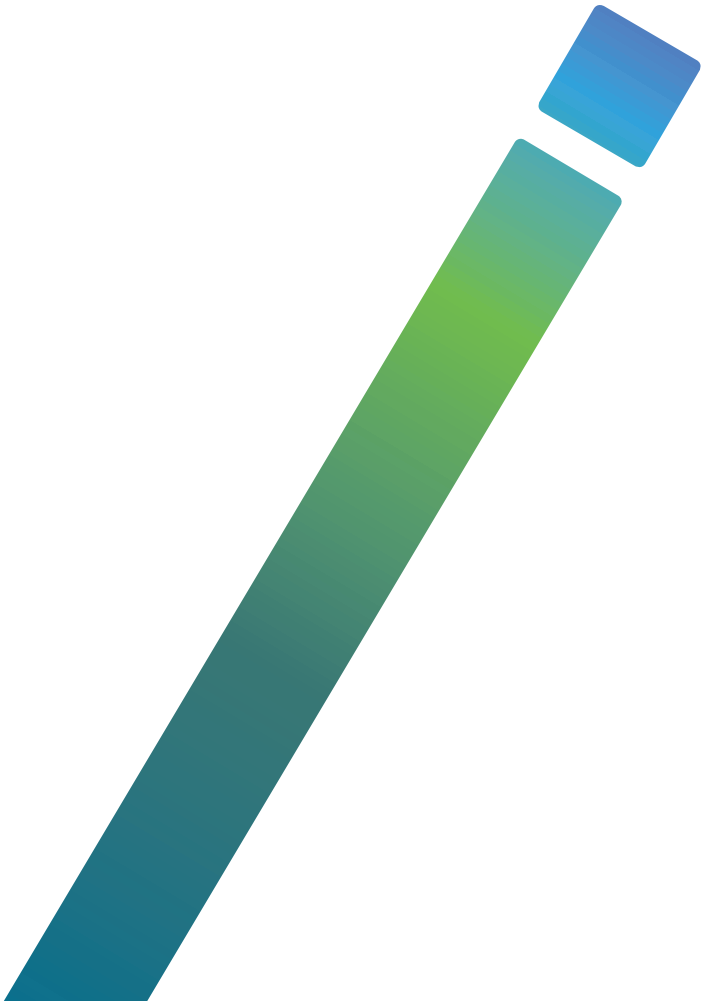
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Sleep-related breathing disorders, in particular obstructive sleep apnoea (OSA), can have detrimental effects on sleep-quality and health. Effective diagnosis and successful treatment can reduce symptoms and improve the quality of life of patients. In Australia, eligible patients can access Medicare-funded sleep study services to clinically assess and diagnose sleep disorders, including OSA.

This report provides a profile of people undertaking sleep studies and treatments for sleep disorders with a focus on OSA.



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