SLEEP: A CORE PILLAR OF HEALTH AND WELLBEING

Improving population sleep health to reduce preventable illness and injury –
Policy Evidence Review

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Glossary

Chronic insomnia: a clinical sleep disorder defined by frequent self-reported difficulty initiating and/or maintaining sleep, despite adequate opportunity, with associated distress and daytime impairment, over a time period of greater than 3 months. (Grima NA et al, 2019)

Chronotype: a person's natural inclination regarding the time/s during the 24-hour daily cycle when they prefer to sleep or when they are most alert or energetic. An early morning chronotype is commonly referred to as being an 'early bird' or 'lark' and a later night chronotype is often referred to as being a 'night owl' (1,2).

Circadian rhythms: physiological processes and functions that follow an approximate 24-hour cycle, controlled by an internal biological clock, including the sleep-wake cycle (3).

Dose-response relationship: describes the magnitude of the response, as a function of exposure to a quantity of a stimulus or stressor (4). An increase in exposure e.g., sleep deprivation is associated with increased or decreased risk of an outcome.

Fatigue: feeling of constant tiredness or weakness which can be physical, mental or both (5).

Healthy sleep: refers to sleep that is considered adequate across key metrics (e.g. quantity, quality and consistency) and is associated with avoiding the consequences of poor sleep (6).

Inadequate sleep: insufficient sleep duration and/or quality of sleep (7).

Non-rapid eye movement (NREM) sleep: a state of sleep also known as quiescent sleep. It is collectively, sleep stages 1–3 (N1, N2 and N3) (8).

N1 sleep: Stage 1 of NREM sleep, also called transitional sleep. It makes up approximately 5% of sleep (8).

N2 sleep: stage 2 of NREM sleep. It makes up approximately 45% of sleep and is important in memory consolidation (8).

N3 sleep: stage 3 of NREM sleep, also known as slow wave sleep or deep sleep. It makes up approximately 25% of sleep. Muscle tone, breathing rate and pulse slow during this stage (9).

Obstructive Sleep Apnoea (OSA): a sleep disorder characterised by intermittent airway blockage during sleep resulting in brief episodes of no breathing (10).

Polysomnography (PSG): a comprehensive sleep study conducted in a sleep laboratory or specialised clinic, or set up in a laboratory and used at home. It involves monitoring various physiological parameters during sleep, including brain activity (electroencephalography), eye movements (electrooculography), muscle tone, heart rate, and respiratory activity. PSG is considered the gold standard for diagnosing most sleep disorders and provides detailed information about sleep architecture and disturbances (11).

Poor sleep: refers to sleep that is not adequate across the key measures of quantity, quality and/or consistency, resulting in tiredness or lack of wakefulness, or other subjective measures and that can affect a person's health and wellbeing (12).

Rapid eye movement (REM) sleep: a state of sleep characterised by muscle atonia (temporary muscle paralysis) and rapid eye movement. Also known as dream sleep or active sleep. It makes up 20-25% of sleep (8).

Restless Legs Syndrome (RLS): a neurological disorder that causes unpleasant or uncomfortable sensations in your legs and an irresistible urge to move them. Symptoms are often worse at night and disrupt or prevent sleep (13).

Sleep architecture: is the basic structural arrangement of *normal sleep* – consisting of the two types of sleep known as non-rapid eye movement (NREM) sleep and rapid-eye-movement (REM) sleep (14).

Sleep deficiency: is a broad concept caused by not getting enough sleep (sleep deprivation); sleeping at the wrong time of day; not sleeping well or getting all the different types of sleep the body requires or having a sleep disorder that prevents adequate sleep or causes poor quality sleep (15).

Sleep disorders: conditions that interrupt and affect sleep on a regular basis - these include Obstructive Sleep Apnoea (OSA), chronic insomnia, Restless Legs Syndrome (RLS), circadian rhythm disorders and central disorders of hyper-somnolence (16,17).

Sleep efficiency: refers to the percentage of time in bed that is spent asleep (either objectively or self-report (18).

Sleep health: a multidimensional concept encompassing the various aspects of sleep that have been shown to contribute to health and wellbeing outcomes (19). Sleep health in individuals exists across a spectrum, from optimal sleep health to clinical sleep disorders.

Sleep Health Spectrum: is used in this paper to describe the overall range of sleep experience, that is - healthy sleep, transient or persistent sleep problems (poor sleep) and sleep disorders.

Sleep homeostasis: is a regulated balance between sleep and waking, for example, the longer we are without sleep, the stronger our propensity to fall asleep (20).

Sleep hygiene: describes behaviours, environmental factors and sleep-specific factors (e.g., sleep timing) that can improve sleep quality and quantity (21).

Sleep latency: the length of time, in minutes, it takes to transition from wake to sleep (22).

Sleep medicine: is the clinical care and treatment of sleep health. A range of health disciplines are involved in sleep medicine, including neurology, clinical neurophysiology, internal medicine (particularly pulmonology and cardiology), psychology, psychiatry, sleep technology, paediatrics, neurosurgery, otorhinolaryngology, and dentistry (23).

Sleep propensity: 'the readiness to transit from wakefulness to sleep, or the ability to stay asleep if already sleeping" (24).

Sleep quality: is described as an individual's "satisfaction with the sleep experience, integrating aspects of sleep initiation, sleep maintenance, sleep quantity, and refreshment upon awakening" (25) or in short, sleep quality refers to how well an individual slept.

Slow wave sleep: that portion of non–rapid eye movement (NREM) sleep characterized by high-amplitude, low-frequency (delta) brain waves, usually during stages 3 (N3) (8).

Social jetlag: a form of circadian misalignment when the sleep schedule on school/work days is different from free days, mainly due to obligations such as school, work or social commitments (26).

1 Executive summary

Sleep has been described as one of the three pillars of good health, alongside nutrition and physical activity. It is a "fundamental building block" for achieving and maintaining good health (17). Yet, sleep has been impacted by economic and social developments in the last century, such as the advent of night-time social and work activity and by the recent, pervasive 24/7 nature of digital communication and social media in daily life.

Sleep is a complex process affecting the whole body and is well known as an important biological function essential for life. While asleep, the body engages in physical recovery and repair including cardiovascular health, immunity, metabolism and brain development.

Sleep health can be described as a multidimensional concept encompassing the various aspects of sleep that have been shown to contribute to health and wellbeing outcomes. This paper identifies three principal domains of sleep health; sleep quantity (i.e. duration of sleep in a 24-hour period), sleep quality (i.e. ease of falling asleep, staying asleep through the night and feeling refreshed after sleep episode) and sleep consistency (i.e. the timing and regularity of sleep in the day-night cycle over time). When one or more of these domains are insufficient or compromised, an individual's sleep health will be poor or suboptimal, and they are more likely to experience the negative health and wellbeing consequences associated with poor sleep.

Sleep health for individuals can span a spectrum from healthy sleep to clinical sleep disorders. Sleep disorders are clinically diagnosed health conditions that interrupt and affect sleep on a regular basis. They are a highly prevalent, significant health issue for Australians across the lifespan and demand for health care and treatment for sleep disorders is increasing. Varying degrees of suboptimal sleep exist between healthy sleep and clinical sleep disorders, with a significant proportion of Australians thought to experience poor sleep without meeting the diagnostic threshold for a sleep disorder. A 2016 Sleep Health Foundation survey, which included a nationally representative sample of over 1,000 Australian adults, found that nearly two-thirds of those surveyed (65.9%) reported one or more sleep problems and almost half (48%) reported at least two sleep-related problems (27).

Sleep health is a significant contributor to health and wellbeing for individuals at all ages, and there is growing evidence of the broader population health, societal and economic benefits associated with healthy sleep. Healthy sleep is essential in children and young people for brain and body development and is associated with improved learning outcomes. In adults, it plays an important role in supporting physical and mental health, social and economic participation, and occupational health and safety. Healthy sleep is also a significant contributor to healthy ageing.

There is considerable evidence of the negative health outcomes associated with poor sleep. Poor sleep can negatively affect mood, mental health, cognitive functioning, concentration and productivity and is a significant risk factor for accidents and injury, including motor vehicle accidents (MVAs). In Australia in 2016-17, 23% of all MVAs, and 25.8% of workplace injuries were attributable to inadequate sleep (28). Furthermore, poor sleep health is associated with a range of chronic health conditions such as Type 2 diabetes, hypertension, obesity, cardiovascular disease, dementia, depression and all-cause mortality. Sleep disturbances are also an under-recognised and potentially significant risk factor for suicidal ideation and behaviour. Injuries, accidents and sequelae of chronic

diseases directly attributable to poor or inadequate sleep were estimated to result in 3017 deaths in Australia in 2016-2017 (29).

In addition to the substantial health and wellbeing impacts, poor sleep health also incurs significant economic costs in Australia each year. Based on a 2016-17 economic analysis of inadequate sleep in Australia, the direct financial costs (e.g. health system costs, productivity losses) of poor sleep health were estimated to be in excess of $26 billion annually. A further $40 billion of non-financial costs (e.g. years of life lost due to premature death and years of healthy life lost to disability) were estimated for the same one-year period (30).

The Australian Parliament House of Representatives Standing Committee on Health, Aged Care and Sport undertook an inquiry into sleep health awareness in Australia in 2019. The Inquiry report, *Bedtime Reading* (17), considered that sleep has not received the "attention it deserves within our community and in the health programs run by state and federal governments" (17). The National Mental Health Commission (NMHC), in a submission to the Parliamentary Inquiry (31) said there is evidence of a close link between sleep health and mental health and that sleep should be a primary factor considered in all mental health assessments and treatment. Importantly, these indicate increasing concern about the lack of national awareness of the importance of sleep health to health and wellbeing outcomes.

Current health information, policy and practice approaches to sleep health focus on sleep disorders and on specific instances in which disrupted or poor sleep is an occupational health and safety risk, such as in high-risk and shift work industries. However, sleep is a universal experience and biological necessity and the evident prevalence of poor sleep and sleep disorders warrants a whole-of-population focus on the importance of sleep to health and wellbeing.

This policy evidence review has drawn together the available evidence on sleep health relevant to the Australian policy context and has identified policy approaches that would enable a nationally consistent approach to improving sleep health in Australia. In particular, it focusses on how policy can best support the prevention and treatment of poor sleep in the Australian population. The role of population health policy in improving public awareness, understanding and engagement in improved sleep health is considered together with the potential for primary care services, particularly general practice, to identify, prevent and treat poor sleep and sleep disorders. The clinical treatment and management of sleep disorders within specialist sleep health services are beyond the scope of this paper.

The recommended policy options for improving sleep health in Australia included in this paper, have been informed and endorsed by an expert working group of leading Australian sleep health experts through a collaboration between the Mitchell Institute, Victoria University and the Sleep Health Foundation of Australia.

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2 A confusion of terms and those used in this paper

Across scientific and public health literature, sleep health is a term that is infrequently defined and there is not one universally agreed upon definition or description of sleep health in common use. In this paper, *'sleep health'* can be best described as a multidimensional concept encompassing the various aspects of sleep that have been shown to contribute to health and wellbeing outcomes (19). Sleep health in individuals exists across a spectrum, ranging from healthy sleep to clinical sleep disorders. '*Healthy sleep*' refers to sleep that is considered adequate across key metrics (particularly the quantity, quality and consistency of a person's sleep) and is associated with improved health and wellbeing outcomes.

In contrast, there is a multiplicity of terms used (often interchangeably) to describe issues with sleep, including sleep problems, poor sleep, sleep disturbances and inadequate or insufficient sleep (32–34). The term *sleep problems* is widely used and refers to problems with the quantity, quality or consistency of sleep which impact functioning and wellbeing. The National Heart, Lung and Blood Institute (NHLBI, USA) describes sleep problems as including *sleep deprivation* (i.e. a short-term lack of sleep) or *sleep deficiency* – which can be characterised by ongoing sleep deprivation, frequently sleeping at the wrong time of day or not getting good quality sleep that includes all the different types of sleep that the body requires (15). However, in the NHLBI Guide to Healthy Sleep (2011) they refer only to *'sleep problems'* without referencing either sleep deprivation or sleep deficiency (35). More recent NHLBI publications advise that sleep deficiency can "interfere with work, school, driving and social functioning" and is linked to many chronic health problems including heart disease, kidney disease, high blood pressure, diabetes, stroke, obesity, depression, mood and social functioning and to accidents and associated injuries (15).

A Parliamentary Inquiry into Sleep Health Awareness in Australia was undertaken through 2018-19 at the request of the then-national Health Minister. The Inquiry Report, 'Bedtime Reading', considers the common causes and impacts of *insufficient sleep* on the health and wellbeing of the Australian population (17). The report also refers to *inadequate sleep* estimated to be regularly experienced by four in every ten Australians. The report describes *inadequate sleep* as caused by sleep disorders or by *insufficient sleep* due to lifestyle factors, such as work patterns, or the use of electronic media. Environmental factors such as noise or light may also contribute to insufficient sleep. The Australian Epidemiological Association, in a submission to the parliamentary inquiry, referred to *inadequate sleep* and to *poor habitual sleep* and sleep disorders in the community (36).

For clarity, the term '*poor sleep*' is used in this paper to refer to sleep that is 'not good enough' in terms of quality, quantity and/or consistency, encompassing the varying degrees of suboptimal sleep health (i.e. transient sleep disturbances through to persistent sleep disturbances and sleep disorders).

3 What is sleep?

Sleep is a state that is characterized by changes in brain wave activity, breathing, heart rate, body temperature, and other physiological functions (37).

Sleep is a complex process affecting the whole body and is an essential part of physical and mental health and wellbeing (38). Definitions describing sleep as "A recurring, reversible neuro-behavioural state of relative perceptual disengagement from and unresponsiveness to the environment" by Mary Carskadon and William Dement (39) underplay its restorative power for the body, affecting nearly every tissue in the body.

The physiological sleeping process comprises two alternating states – rapid eye movement (often called 'REM sleep') and non-rapid eye movement (NREM). With the help of an electroencephalogram (EEG) electrical brain activity during sleep can be measured and the states and stages of sleep identified in more detail (39,40). In adults, NREM sleep is broken down into 3 stages – N1, N2 and N3. The two states, NREM and REM, cycle approximately every 90 minutes throughout the sleep episode. The states and stages of sleep will show as different patterns on an EEG (39,40).

In adults, a sleep episode usually begins with the individual attempting to go to sleep. The time between this and sleep onset, that is, commencing N1 sleep, is called sleep latency. Once asleep, an individual progresses through NREM N1 (light sleep), through N2 sleep and into N3 (deep sleep/slow-wave sleep), before progressing back up through the stages to light sleep and REM sleep, hence completing the first sleep cycle. Over the course of 4-6 sleep cycles throughout the night, an individual typically experiences progressively less deep sleep and more light sleep, awakenings, and REM sleep. Brief awakenings/arousals from sleep are completely normal. The cumulative time an adult spends awake between first falling asleep and subsequently getting out of bed the next morning is referred to as 'wake after sleep onset' (WASO). The amount of time an individual is actually sleeping is the sleep duration. Time asleep divided by the time spent in bed during the sleep episode is referred to as sleep efficiency (39,40).

Figure 1 gives an example of the typical sleep architecture of a healthy young adult. In this age group, sleep typically occurs in 4-6 cycles each lasting for approximately 90 minutes. Most deep sleep occurs in the first half of the sleep period (pink N3), and most light sleep, awakenings and REM sleep occurs more in the second half of the sleep period. This sleep architecture varies across the lifespan and especially in older age when the time spent in slow-wave sleep reduces.
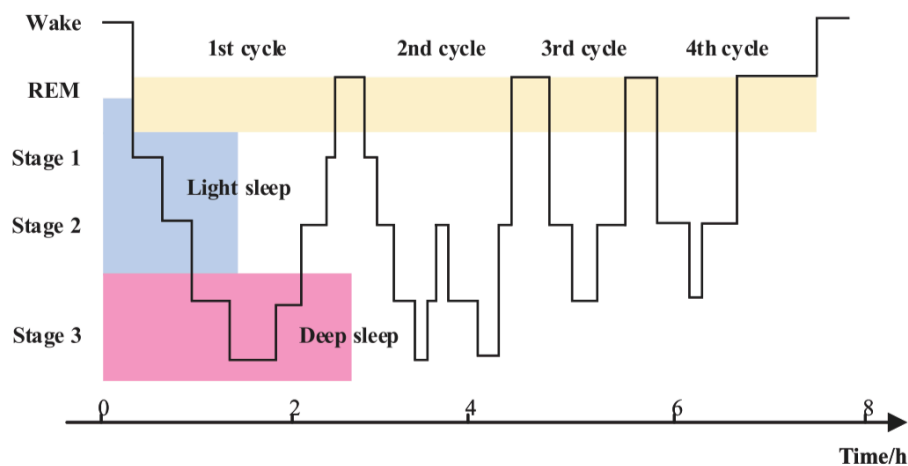
FIGURE 1: TYPICAL SLEEP ARCHITECTURE OF HEALTHY YOUNG ADULT (41)

Successfully cycling through all the sleep stages multiple times each night allows sleep to perform the critical function of restoration and recovery for the body and mind. Sleep is well known as an important biological function essential for life (42). While asleep, the body engages in physical recovery and repair including for cardiac health, body metabolism and brain development. Sleep supports learning, memory and mood and is particularly important for healthy growth and development in babies and children. Sleep also affects various other physiological processes and functions and how they interact with the body's biological clock (43).

3.1 Circadian rhythms

Sleep is regulated by the interaction of two processes – sleep homeostasis and the sleep circadian rhythm. Sleep homeostasis is a regulated balance between sleep and waking. Homeostatic mechanisms counteract deviations from an average reference level of sleep. The sleep homeostatic process can be described as a rise of sleep pressure during wakefulness – or propensity to sleep – and its dissipation during sleep (24). The longer we are without sleep, the stronger our propensity to fall asleep (20).

Circadian rhythms are physiological processes that follow an approximate 24-hour cycle, controlled by an internal biological clock (44). This master circadian clock is located in a small brain structure called the suprachiasmatic nucleus, which sends signals to different parts of the body to regulate a wide range of physiological functions and processes in repeating 24-hour cycles. Circadian rhythms coordinate mental and physical systems throughout the body to ensure that the body's processes are optimised at various points during a 24-hour period (45).

While it is common to refer to one, singular "circadian rhythm", there are actually several interconnected circadian rhythms occurring in the human body, with the most prominent being the sleep-wake cycle (45). Other physiological processes and functions that are influenced or regulated by circadian rhythms include hormone secretion, metabolism and energy production, appetite and feeding, body temperature regulation and immune function (46).

Circadian rhythms are internal physiological processes that run independently of external stimuli. However, they are still influenced by and can be synchronised to environmental cues, particularly

exposure to light and the day-night cycle (47). Circadian rhythms have evolved to synchronise biology and behaviour to external time (i.e. the day-night cycle) and therefore exposure to light can advance or delay circadian rhythm timing (46,48).

Circadian rhythm disruptions refer to disruptions of internal biological timing mechanisms (which can increase the risk of several adverse health outcomes), or a mismatch between internal and behavioural or environmental (e.g., night-day) cycles (47). Night shift work and jetlag are common examples of circadian disruption. Individuals experiencing circadian rhythm disruptions may sleep or be awake at times that are 'out of sync' with their regular sleep-wake cycle and external environment time of day. This can also disrupt other physiological processes that are regulated by the circadian clock, highlighting the importance of circadian consistency to physical and mental health (47–49).

Despite being closely aligned with the day-night cycle, the precise timing of circadian rhythms and sleep-wake cycles varies from person to person (47). An individual's natural or preferred sleep and wake times are known as their chronotype, with early risers (larks) at one end of the spectrum and late-night types (night owls) at the other. The chronotype is influenced by an individual's age, genetics, development, and history of exposure to light (50). Individuals can usually alter their sleep patterns to accommodate both their social demands and circadian clock, however, misalignment with the external light-dark cycle can lead to disrupted sleep-wake cycles, fatigue and exhaustion (47).

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4 Sleep health

Sleep health is a multidimensional concept that encompasses the various aspects, or domains, of sleep that have been shown to contribute to health and wellbeing outcomes (19). The concept of sleep health emphasises that good sleep is essential for good health and that 'healthy sleep' is more than just the absence of a clinical sleep disorder. By highlighting the positive role of sleep in overall health, sleep health contrasts with the historically dominant focus on negative outcomes associated with sleep problems or disorders (19). Understanding the various aspects of sleep that contribute to overall health and wellbeing can also assist with identifying potential areas of focus to improve sleep health in the population through health promotion and prevention activities (19).

This paper identifies three principal domains of sleep health:

- **Quantity** – total sleep duration (in hours) over a 24-hour period;
- **Quality** – the ease of falling asleep (sleep initiation), staying asleep through the night (sleep maintenance) and feeling subjectively satisfied/refreshed after a sleep episode; and
- **Consistency** – a consistent sleep schedule that aligns with the natural circadian cycle (i.e. most sleep occurs during the hours of darkness overnight) and minimises night-to-night variability in bed and wake times.

Within each of these principal domains, there are various associated indicators and dimensions of sleep health, these are discussed in detail in section 5.2. When one or more of these domains are insufficient or compromised, an individual's sleep health will be poor or suboptimal, and they are more likely to experience the negative health and wellbeing consequences associated with poor sleep.

It is important to note that sleep health refers to the long-term pattern of an individual's sleep. A person whose sleep is usually healthy may have occasional episodes of poor sleep, but it is the pattern over time that indicates their overall sleep health.

4.1 Why sleep health matters

Sleep health is a significant but under-recognised public health issue. Sleep, alongside diet and physical activity, has been described as one of the three pillars of health and as a "fundamental building block" for achieving and maintaining good health (17,33,51). These pillars are also three aspects of daily life that have significantly and rapidly changed due to economic and social developments over the past century. Historical diets made up of locally produced and minimally processed foods have been transformed by the rapid growth of the international food industry and the subsequent increase in the availability of manufactured/ processed food products (52). Physical activity has shifted from an integral part of domestic and work activity to a personal choice or option as an adjunct to a largely sedentary social and work (53). Sleep health has been similarly impacted by changes to social patterns, globalised commercial activities and work and employment trends that impinge upon factors that support sleep (54).

Contemporary research has identified many functions of sleep and has established that "sufficient, quality sleep is (…) an essential requirement for a person's wellbeing" (Parliament of the Commonwealth of Australia, 2019, p. 2). Within the last decade, the understanding of the mechanisms and biological importance of sleep has improved (55) and the health and social impacts of poor sleep have been better recognised (54). There is growing evidence of the societal and economic benefits of

healthy sleep and growing attention to the importance of sleep in Australian health information and health policy (17).

Healthy sleep is a significant contributor to health and wellbeing for individuals at all ages (17,54). In children and young people, good sleep health is important for healthy brain and body development and is associated with improved learning outcomes In adults, healthy sleep is critical to support physical and mental health and wellbeing, social and economic participation and workplace and occupational health and safety (43). In older people, good sleep health has also been shown to be an important contributing factor to healthy ageing (56,57).

There is a robust, well-established evidence base demonstrating the associations between poor sleep health and a range of preventable chronic conditions, including cardiovascular disease, Type 2 diabetes, stroke, obesity, and all-cause mortality (28,58). Poor sleep health can also contribute to the development of and exacerbate mental health issues (e.g. depression, anxiety, psychosis, suicidality) and is implicated as a risk factor for early onset dementia (59,60). Furthermore, poor sleep health has been shown to negatively affect mood, concentration, cognitive functioning, motivation and productivity (61). Injuries, accidents and sequelae of chronic diseases directly attributable to poor or inadequate sleep were estimated to result in 3017 deaths in Australia in 2016-2017 (28).

4.2 A conceptual framework for sleep health

To enable the multidimensional and complex nature of sleep health to be readily understood, a conceptual framework for sleep health (see *Figure 2* on the next page) was developed for this paper. The framework was developed in collaboration with the working group of Australian sleep health experts, who informed and guided this work. The conceptual framework is based on three principal domains of sleep health (quantity, quality and consistency) and a subset of sleep health dimensions, indicators and outcomes related to each domain (explained in detail below).

The development of the conceptual framework was informed by existing resources and tools, including scales and suites of indicators designed to assess sleep health. One of these is the RuSATED Scale – a self-report scale measuring sleep health using six dimensions: regularity, subjective satisfaction, timing, duration, sleep efficiency and alertness during the day (19). The conceptual framework incorporates the RuSATED dimensions of sleep health under each high-level domain. Whilst these dimensions can be used as direct indicators of sleep health, the conceptual framework also identifies, where relevant, additional specific indicators related to each domain and highlights additional outcomes related to sleep health not included in the RuSATED tool. Use of the RuSATED scale as a sleep health assessment tool is discussed in section 9.

Sleep health conceptual framework

Domains

Dimensions/
Indicators

Outcomes
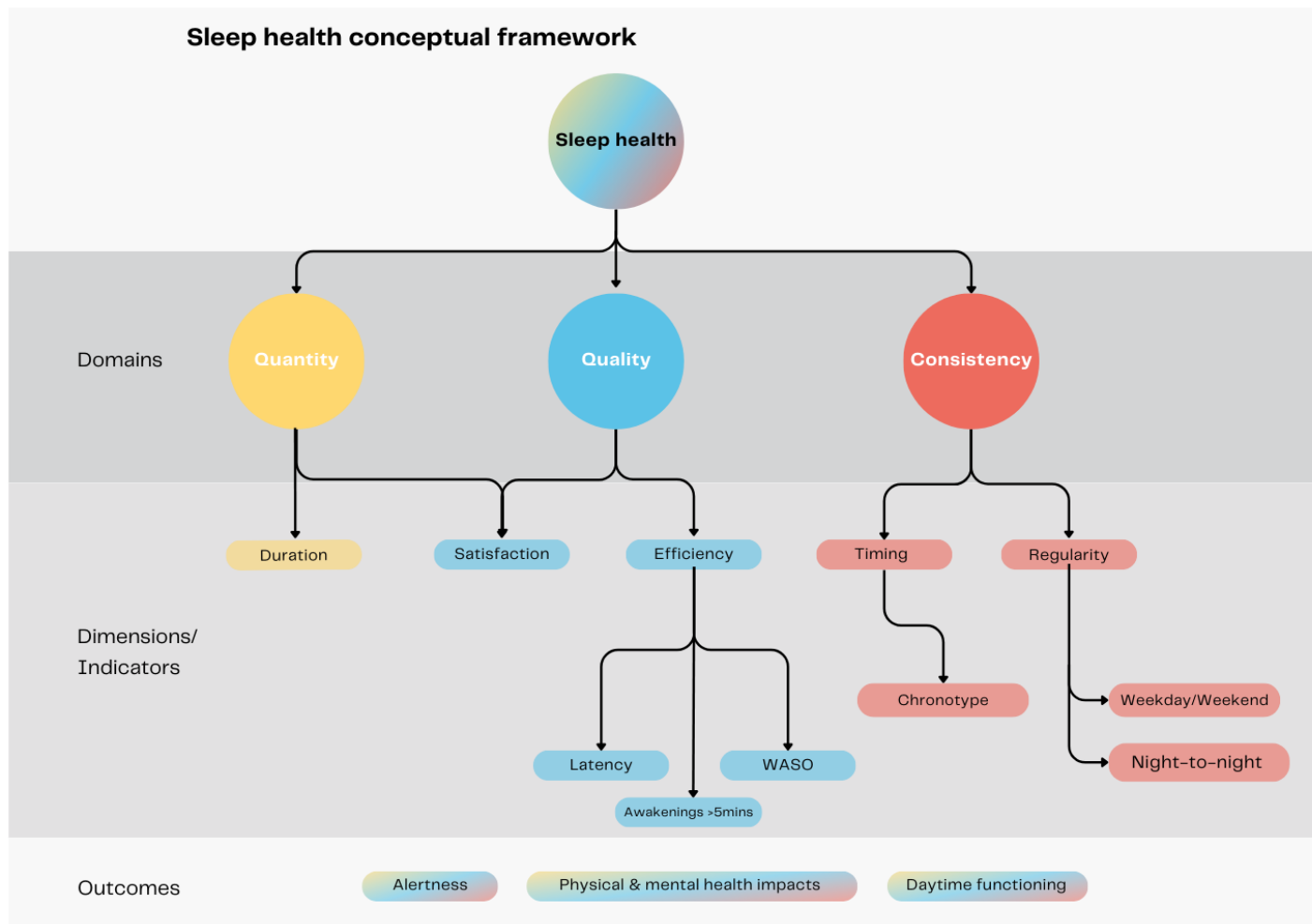
FIGURE 2: SLEEP HEALTH CONCEPTUAL FRAMEWORK

4.2.1 Domain 1: Quantity

The quantity of sleep refers to the overall amount of sleep an individual attains in a 24-hour period. It is predominantly defined by one dimension/indicator – sleep duration – but can also be partially indicated by subjective sleep satisfaction.

- **Sleep duration:** the amount of time, in hours, that a person sleeps in a 24-hour period.
- **Sleep satisfaction:** a self-reported subjective assessment of an individual's satisfaction/dissatisfaction with their sleep.

In 2015, the National Sleep Foundation (NSF) (USA) convened a multidisciplinary panel of sleep experts to evaluate and review existing scientific literature regarding sleep duration recommendations across the lifespan (62). The panel's consensus recommendations for sleep duration across the lifespan are presented in *Figure 3*. The blue band represents recommended hours, the yellow band represent potentially appropriate hours in certain people or circumstances and grey represents too few or too many hours of sleep.
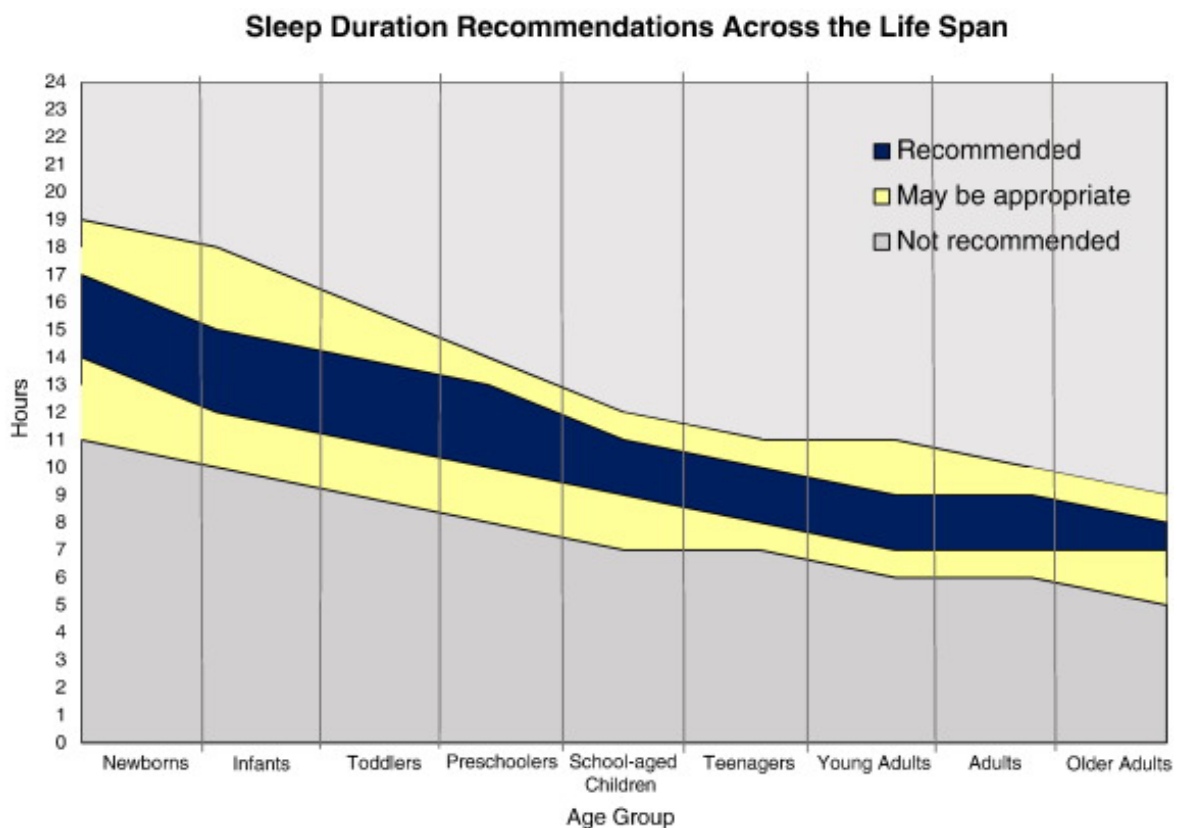
FIGURE 3: SLEEP DURATION RECOMMENDATIONS ACROSS THE LIFESPAN (62)

The Australian 24-Hour Movement Guidelines for infants, children and young people (published by the Department of Health and Aged Care in 2021) provides recommendations for sleep duration in people aged 0-17 (see section 8.1 for full recommendations) (63,64). Sleep duration was included in these guidelines as sleep health is considered an important contributor to physical activity levels in children and young people (63). The Australian recommendations for sleep duration, which are a derivation of the Canadian 24-hour movement guidelines (65), are the same as the NSF (USA) recommendations other than for infants 4-11 months old (where the Australian and Canadian recommendations are 12-16 hours, rather than 12-15).

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There are currently no equivalent, government-endorsed guidelines or recommendations regarding sleep duration in Australian adults (although adult 24-hour movement guidelines are in development). Despite the lack of formal guidelines, it is generally accepted that adults require between 7 and 9 hours of quality sleep for cognitive and physical health (62,66). The American Academy of Sleep Medicine and Sleep Research Society's 2015 joint consensus statement on recommended sleep quantity for healthy adults recommends no less than 7 hours per night (67). More recent research has demonstrated a U-shaped association between sleep duration and health outcomes, with both short and long sleep durations (<7 or >9 hours) being associated with various adverse physical and health outcomes, including all-cause mortality (68). However, more than 9 hours may be appropriate for young adults and individuals who are recovering from sleep debt or are unwell (67).

The majority of contemporary research investigating sleep health trends globally has concluded that average sleep duration in adults has remained largely unchanged over recent decades (69–71). This includes multiple studies that reviewed self-reported sleep health data collected in national population health surveys across various countries, and studies that analysed objective polysomnographic (sleep study) data (69–71). However, a 2015 study looking at the sleep health of US adults did find that average sleep duration had decreased slightly between 1985-2004, then remained steady from 2004-2012 (72).

In contrast, data on children's sleep health seem to be consistently pointing towards declining sleep duration over time (71). A meta-analysis of data from 690,747 children across 20 different countries reporting children's sleep data since 1901 confirmed a long-term persistent decline in the total hours of sleep among children (71). A study of American adolescents found that the percentage of children who reported having more than 7 hours of sleep between 1991 and 2012 also declined by 30% (73).

4.2.2 Domain 2: Quality

Sleep quality includes aspects of sleep initiation (ease of falling asleep), sleep maintenance (staying asleep through the night), feeling well-rested upon awakening and an individual's subjective satisfaction with their sleep (25). In short, sleep quality refers to how 'well' you have slept. The sleep health conceptual framework identifies two major dimensions (sleep satisfaction and sleep efficiency) which are generally indicative of sleep quality. A subset of three additional indicators that contribute to sleep efficiency were also identified. Together, the dimensions and indicators provide a suite of sleep quality measures, which are listed below:

- **Sleep satisfaction:** a self-reported subjective assessment of an individual's satisfaction/dissatisfaction with their sleep.
- **Sleep efficiency:** percentage of time in bed spent asleep.
- **Awakenings > 5mins:** the number of incidences in which an individual is awake for greater than five minutes per overnight sleep episode (once sleep has been initiated).
- **Sleep latency:** the length of time, in minutes, it takes to first transition from wake to sleep (i.e. sleep initiation).
- **Wake after sleep onset:** the amount of time spent awake after sleep has been initiated and before final awakening (i.e. cumulative time of awakenings throughout a sleep episode).

In 2017, the NSF (USA) again convened a large multidisciplinary panel of sleep experts to develop evidence-based, consensus recommendations regarding indicators of good sleep quality across the lifespan (74). This included recommendations for sleep quality indicators such as sleep latency,

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number of awakenings (>5 minutes), wake after sleep onset (WASO) and sleep efficiency, which are outlined in *Table 1*.

TABLE 1: SLEEP QUALITY INDICATOR RECOMMENDATIONS ACROSS THE LIFESPAN (74)

Quality indicator	Scale	Age group					
		3-5 years	6-13 years	14-17 years	18-25 years	26-64 years	65+ years
Sleep efficiency	Good	≥85%	≥85%	≥85%	≥85%	≥85%	≥85%
	Uncertain	75-84%	75-84%	75-84%	65-84%	75-84%	75-84%
	Poor	≤74%	≤74%	≤74%	≤64%	≤74%	≤74%
Sleep latency	Good	0-30 mins	0-30 mins	0-30 mins	0-30 mins	0-30 mins	0-30 mins
	Uncertain	31-45 mins	31-45 mins	31-45 mins	31-45 mins	31-45 mins	31-60 mins
	Poor	≥46 mins	≥46 mins	≥46 mins	≥46 mins	≥46 mins	≥60 mins
Awakenings >5 minutes	Good	≤1	≤1	≤1	≤1	≤1	≤2
	Uncertain	2-3	2-3	2	2-3	2-3	3
	Poor	≥4	≥4	≥3	≥4	≥4	≥4
Wake after sleep onset	Good	≤20 mins	≤20 mins	≤20 mins	≤20 mins	≤20 mins	≤30 mins
	Uncertain	21-50 mins	21-40 mins	21-50 mins	21-50 mins	21-50 mins	≥31 mins
	Poor	≥51 mins	≥41 mins	≥51 mins	≥51 mins	≥51 mins	NA

The sleep quality recommendations outlined above did not include self-reported sleep satisfaction, as it is a subjective indicator of sleep quality that can be measured using different satisfaction scales across various sleep health assessment tools. Consequently, there is no standardised rating scale or numerical metric used consistently for measuring sleep satisfaction and data from different sources related to sleep satisfaction is inconsistent and not easily comparable.

Recent research examining global sleep health trends has found evidence of declining sleep quality in both adults and young people (70). It has been suggested that the increased cognitive demands of modern life could be responsible for relative declines in sleep quality observed in some population data (71). There is also an important – but not yet fully understood – developmental component to the impact of reduced sleep quality on later life. Poor quality sleep can therefore be understood as a noxious and chronic exposure that can, over time, fundamentally alter development in children and young people, resulting in poorer long-term health and wellbeing outcomes (75).

4.2.3 Domain 3: Consistency

Sleep consistency comprises two major dimensions; sleep timing and sleep regularity.

- **Sleep timing:** the time within the 24-hour cycle that sleep occurs (i.e. an individual's usual bedtime and wake-up time).

- **Sleep regularity:** night-to-night and weeknight-to-weekend consistency of sleep timing and sleep duration.

Due to the regulation of sleep by a circadian rhythm, optimal quality and quantity of sleep are most likely during hours of darkness (47,76). Sleep timing that aligns with the light-dark cycle is essential for good sleep health and suboptimal timing can affect mental health, cardiovascular function, metabolism, and other elements of overall health. (49,50,76). There are significant person-to-person differences in usual and/or optimal timing of sleep, largely driven by differences in chronotype and external factors that affect circadian rhythms (e.g. shift work) (2). Whilst variations in chronotype are expected, most sleep should occur at night, as healthy sleep timing is underpinned by circadian consistency (i.e. being asleep at the time that aligns with the body's circadian cycle) (77).

A consistent sleep schedule that minimises night-to-night variability of sleep timing and sleep duration is an important contributor to good sleep health. (77). This includes night-to-night variability throughout the week and weekday-to-weekend variability of sleep timing and duration. (77). External social and environmental factors (e.g. irregular work hours, social commitments, childcare responsibilities) can inhibit sleep regularity.

4.2.4 Outcomes of sleep

The outcomes of sleep refer to how an individual feels and performs during their wake time as a result of their sleep. The indicators for these outcomes are measures that are influenced by any or all of the three sleep domains.

- **Alertness during the day:** the presence of or lack of daytime sleepiness (i.e. ability to stay awake during the day). There is a natural dip in the circadian system in the afternoon that can reduce alertness, but excessive daytime sleepiness is often a sign of an underlying sleep disorder (Bes et al., 2009).
- **Daytime functioning:** the ability to perform daily tasks productively and effectively. Various consequences of poor sleep health can inhibit or impair daytime functioning, including sleepiness, fatigue, irritability, lack of motivation and/or concentration difficulties (61).
- **Physical and mental health impacts:** sleep health is associated with a range of physical and mental health outcomes and conditions Type 2 diabetes, hypertension, obesity, cardiovascular disease, anxiety, depression, suicidality and all-cause mortality (28,58,78). Sleep health is also a significant contributor to mood and physical performance (61).

4.3 The Sleep Health Spectrum

The term spectrum describes something in terms of its position on a scale between two distant points – in the case of sleep health, these points are healthy sleep and clinical sleep disorders. Sleep health has previously been described as occurring along a continuum from good to poor (19). However, 'continuum' implies that sleep health occurs on a sliding scale that an individual moves along in a linear fashion. While this may be accurate in some instances, changes to an individual's sleep experience can vary over time without that being predictive of subsequent sleep experience. That is, someone with healthy sleep can develop sleep disorders and vice versa. This paper therefore proposes that considering sleep health as a occurring on a spectrum may be more appropriate. An individual may also experience transient sleep disturbances which resolve with no intervention, or which may develop into a pattern of episodic or persistent sleep disturbances.

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Traditionally, sleep medicine and health policy related to sleep has focused almost exclusively on the treatment and management of clinical sleep disorders, with little attention given to the rest of the sleep health spectrum (19). This has contributed to a significant cohort of the general population, who experience sleep problems but may not meet the diagnostic threshold for a clinical sleep disorder, not having their sleep problems adequately addressed (27). The Sleep Health Spectrum (see *Figure 4* on the next page) also illustrates the need for population-wide preventive health activities aimed at improved sleep health education and awareness and highlights opportunities to identify and address sleep disturbances before they potentially progress into clinical sleep disorders.

Sleep Health Spectrum

Healthy sleep	Transient sleep disturbances	Persistent and/or episodic sleep disturbances	Sleep disorders
Age and life stage appropriate healthy sleep most of the time	Short term sleep deficit or excessive sleep Acute/transient insomnia Temporary circadian disruption (social jetlag, transmeridian jetlag, temporary irregular work hours)	Prolonged sleep deficiency Persistent/episodic hypersomnia symptoms Persistent/episodic insomnia Circadian misalignment (severe social jetlag, shift work)	Obstructive Sleep Apnoea (OSA) Chronic Insomnia Disorder Restless Legs Syndrome (RLS) Circadian rhythm disorders e.g. Shift Work Disorder, Delayed Sleep-Wake Phase Disorder Rare sleep disorders: e.g. Narcolepsy, Idopathic hypersomnia

public policy strategies

Healthy sleep	Transient sleep disturbances	Persistent and/or episodic sleep disturbances	Sleep disorders
Sleep health education **Policies that promote sleep health**	**Sleep health education** **Preventive activities for sleep health** **Policies that promote sleep health** **Organisational policies**	**Sleep health education** **Preventive activities for sleep health** **Primary care and treatment pathways** **Organisational policies**	**Sleep health education** **Primary care pathways** **Specialist pathways** **Treatment pathways** **Organisational policies**

FIGURE 4: SLEEP HEALTH SPECTRUM

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4.3.1 Healthy sleep

Sleep that is considered healthy should align with the three high-level domains identified in the sleep health conceptual framework i.e. it should be high-quality sleep that is sufficient in duration (quantity) and follows a consistent schedule that aligns with an individual's natural circadian cycle (consistency). Healthy sleep should also facilitate attentive wakefulness and daytime functioning and meet an individual's subjective assessment of 'good sleep'(19).

4.3.2 Transient sleep disturbances

Almost everyone experiences episodes of suboptimal sleep throughout their life, generally characterised by trouble falling or staying asleep and/or temporary insufficient sleep duration. In most cases, transient sleep disturbances do not persist over time or lead to ongoing sleep problems or clinical sleep disorders (79). If caused by an obvious trigger (e.g. acute pain, psychological stress, transmeridian travel, substance use, bereavement or temporary changes to the sleep environment), sleep normally returns to normal after the trigger has subsided. Transient sleep disturbances can include acute/short-term insomnia (ranging from a few nights to a few weeks), temporary circadian rhythm disruptions (e.g. jetlag caused by transmeridian travel) or voluntary sleep restriction (e.g. curtailing sleep because of work, childcare or social commitments). These are unlikely to lead to ongoing, chronic sleep problems or the development of clinical sleep disorders (79).

Although transient sleep disturbances are temporary, generally attributable to an external trigger and rarely require treatment in their own right, they can still negatively affect health and well-being. Even a short-term sleep deficit can result in reduced alertness and impaired daytime functioning, increasing the risk of accidents and negatively affecting an individual's work or education (80).

4.3.3 Persistent and/or episodic sleep disturbances

People can experience patterns of poor sleep or recurring episodes of sleep disturbances that persist into the medium to long term but may not necessarily meet the clinical threshold for diagnosis of a recognised sleep disorder. Persistent or relapsing-remitting sleep disturbances and ongoing patterns of poor sleep are less likely to resolve themselves over time than transient sleep disturbances and in some cases can progress into clinical sleep disorders. Persistent sleep disturbances (which may not meet the diagnostic criteria for a clinical disorder) can include episodic insomnia, recurring circadian rhythm disruptions and/or the ongoing presence of one or more sleep disorder symptoms.

Circadian rhythm disruptions can be either transient (e.g. jetlag) or persistent (e.g. shift work) and have many underlying causes (49). Jetlag tends to be transient as circadian rhythms adapt to the new time zone over the course of a few days. In contrast, shift work, particularly rotating shift work may perpetuate ongoing circadian disruption. Those with evening chronotype who delay bedtime or those experiencing 'social jetlag', a phenomenon caused by significantly differing bed/wake times between work days and non-work days, can also experience regular circadian disruptions (49).

4.3.4 Sleep disorders

Sleep disorders require clinical diagnosis and can have significant implications for a person's health and wellbeing. A broad range of online resources have emerged to provide information regarding common disorders, such as the Sleep Health Foundation factsheets (81). As the focus of this paper is on policy responses that are relevant to address population sleep health, the clinical treatment and

management of sleep disorders within specialist sleep health services are beyond the scope of this discussion. However, understanding what these are and the potential role of policymakers and Australia's primary health care system in improving the prevention and early detection of sleep disorders is explored throughout.

The two most commonly diagnosed sleep disorders, both in Australia and internationally, are insomnia and obstructive sleep apnoea (OSA). While insomnia and OSA are the most prevalent, they are just two of over 100 diagnosable clinical sleep disorders, which can be grouped into six main categories:

- Insomnias (e.g. chronic insomnia disorder);
- Sleep-related breathing disorders (e.g. OSA);
- Sleep-related movement disorders (e.g. restless legs syndrome);
- Circadian rhythm disorders (e.g. shift work sleep disorder);
- Central disorders of hypersomnolence (e.g. narcolepsy, idiopathic hypersomnia); and
- Parasomnias (e.g. night terrors, REM sleep behaviour disorder)

A summary of these categories (or the most common sleep disorder within the category) is provided below.

4.3.4.1 Chronic insomnia

Chronic insomnia is a sleep disorder characterised by frequent self-reported difficulty falling and/or staying asleep (despite the opportunity to do so) and impaired daytime functioning (e.g. fatigue, and difficulty concentrating) (82). To meet the diagnostic criteria for chronic insomnia, as outlined in the Diagnostic and Statistical Manual for Mental Disorders, 5th edition (DSM-5), symptoms must be present for three or more nights per week for more than three months (83). If symptoms do not meet this threshold, the insomnia is considered acute/short-term or episodic and is better categorised as a transient or persistent sleep disturbance than as a clinical sleep disorder.

Chronic insomnia shares a bidirectional relationship with other physical or mental health concerns and reduced quality of life (84). Insomnia frequently co-occurs with other mental and physical health conditions, including other sleep disorders. Although insomnia has historically been viewed as a secondary symptom of these other conditions (85), substantial evidence and diagnostic schema now indicate it should be conceptualised as a distinct disorder even when it occurs alongside other mental/physical/sleep conditions (86). Insomnia is a significant risk factor for the development, exacerbation and relapse of other co-morbid conditions and treating insomnia often also improves the management of comorbidities (e.g., behavioural treatments for insomnia also improve depression, pain and sleep apnoea severity) (87). However, treatment of a comorbid condition does not necessarily improve insomnia symptoms, which usually need to be addressed in their own right (80).

4.3.4.2 Obstructive Sleep Apnoea (OSA)

Obstructive sleep apnoea (OSA) is a breathing disorder where an individual experiences repeated episodes of partial or complete airway obstruction during sleep, causing them to stop breathing. Apnoeas—the pause in breathing—can occur multiple times a night for between 10-90 seconds each time. Blood oxygen levels fall as a result of the apnoea leading to a sleep interruption—brief waking, which in turn re-commences breathing (88,89). Multiple factors can underpin the development and

progression of OSA, including genetic factors, craniofacial structure, obesity, and obstructions within the upper airway (e.g. tonsils) (90). The disorder can occur across the lifespan. OSA is associated with a range of sleep disturbances, including sleep fragmentation, insomnia, and daytime sleepiness (91).

4.3.4.3 Restless leg syndrome (RLS)

Restless leg syndrome (RLS) is a sleep-related sensorimotor disorder. Symptoms include the urge to move that occurs at rest or in the evening and is also relieved by movement (92). As RLS seems to worsen during the night or early morning hours, it can be very disruptive to sleep and is linked with difficulties falling asleep, interrupted sleep and reduced total sleep time (92).

4.3.4.4 Circadian rhythm disorders

Circadian rhythm disorders (also known as sleep-wake disorders) are characterised by ongoing, significant disruptions to the body's internal clock, which regulates the sleep-wake cycle. Examples of circadian rhythm disorders include shift-work sleep disorder, advanced sleep phase disorder (early sleep) and delayed sleep phase disorder (later sleep) (12). Circadian rhythm disorders and persistent circadian rhythm disruption (even at a subclinical level) have been linked with psychiatric and neurodegenerative diseases (48,93), metabolic disorders, cardiovascular disease and autoimmune disorders (49).

4.3.4.5 Central disorders of hypersomnolence

Central disorders of hypersomnolence are characterised by severe daytime sleepiness in the absence of disrupted nocturnal sleep or circadian rhythm disorders. They include:

- Narcolepsy – a sleep disorder characterised by excessive daytime sleepiness and an irresistible urge to nap. Other symptoms can include cataplexy (muscle weakness triggered by strong emotion), sleep paralysis and sleep hallucinations (81).
- Idiopathic hypersomnia (IH) - a neurological disorder where an individual sleeps for a long time overnight, feels sleepy during the day, takes long naps, has difficulty waking and does not feel refreshed by sleep (94).

4.3.4.6 Parasomnias

Parasomnias are abnormal behaviours or experiences that occur during sleep. Examples include sleepwalking, night terrors, sleep-related eating disorder, and REM sleep behaviour disorder (acting out dreams physically). These disorders can disrupt sleep and affect the overall quality of rest (86).

5 Sleep health in Australia: prevalence and burden of poor sleep and sleep disorders

Poor sleep health is prevalent in the Australian population. A 2016 survey of 1011 Australian adults that was weighted to be representative of the population, commissioned by the Sleep Health Foundation, found that nearly two-thirds of those surveyed (65.9%) reported one or more sleep problems, categorized as difficulty falling asleep, waking up a lot overnight, daytime sleepiness, daytime fatigue or exhaustion, feeling irritable or moody, or pathological daytime sleepiness. Almost half (48%) reported at least two sleep-related problems (27). Between 33-45% of respondents reported both inadequate sleep, in either duration or quality, and daytime consequences (27). The Royal Australian College of Physicians, in its submission to the 2019 Parliamentary Inquiry into Sleep Health, said that when both adolescents and adults are considered, 'poor or inadequate sleep affects over 20 per cent of people on a daily or nearly-daily basis' (33).

The large cohort of Australians experiencing poor sleep includes those living with common sleep disorders such as chronic insomnia, obstructive sleep apnoea (OSA) and restless legs syndrome (RLS).

- Chronic insomnia is estimated to affect 12.2-14.8% of adults, however, only 7.5% had a clinical diagnosis, suggesting that there are many Australians living with undiagnosed chronic insomnia (95).
- Prevalence estimates of OSA in Australia vary considerably. It is thought that there is significant under-diagnosis of the condition, with up to 80% of OSA remaining undiagnosed (96). Results from the 2016 Sleep Health Foundation (SHF) National Survey included 8.3% of adults reporting a clinical diagnosis of OSA, with a further 19.0% reporting symptoms indicating likely undiagnosed OSA, suggesting that it is a pervasive, widespread health issue across the population. OSA prevalence increases with age and is considerably higher in men than in women (32). A study of a middle-aged (45-64yo) community sample found the prevalence of clinically significant OSA to be 24.0% in females and 47.3% in males (97).
- Prevalence estimates of RLS in Australia are also highly variable, with 17.4% of adults reporting symptoms of restless legs, however only about one-sixth of these (2.8%) are estimated to meet the diagnostic threshold for primary restless legs syndrome (98). In the middle-aged (45-56yo) community, RSL was prevalent in 3.7% of females and 2.2% of males (97).

Poor or inadequate sleep increase the risk of suffering a workplace injury or being involved in a motor vehicle accident (MVA) (28). A 2017 Deloitte Access Economics report found that four in every ten Australians regularly experienced inadequate sleep and estimated that inadequate sleep was the primary contributing factor in nearly a quarter of all MVAs and workplace injuries (28).

According to the 2013 Household, Income and Labor Dynamics in Australia (HILDA) study of nearly 15,000 Australians aged 15 or older, self-reported poor sleep quality was linked with lower scores on scales measuring physical, emotional and social functioning (99). Insufficient sleep duration and/or poor sleep quality have also been identified as a risk factor and a warning sign for suicide behaviours (100–102).

Poor sleep health increases the risk of developing various chronic health conditions (e.g., diabetes, heart disease, stroke, depression) (103) which place an enormous burden on society and the health system. A 2021 Deloitte Access Economics analysis of the social, health and economic costs of sleep disorders in Australia estimated the specific number and proportion of cases of other chronic conditions considered directly attributable to sleep disorders (29). Around 3.5% of heart disease, 4% of stroke, 5.5% of depression and 1.5% of type 2 diabetes cases were estimated to be directly attributable to sleep disorders in 2019-20 (29). These incidence rates correlated to over 25,000 cases of heart disease and stroke and over 44,000 cases of depression estimated to be directly attributable to sleep disorders (29). Given that this analysis only focussed on sleep disorders rather than poor sleep more broadly, it is likely that total burden of disease related to poor sleep is considerably higher.

Injuries, accidents and sequelae of chronic diseases directly attributable to poor or inadequate sleep were estimated to result in 3017 deaths in Australia in 2016-2017 (28).

In addition to the substantial health and wellbeing impacts, poor sleep health also incurs significant economic burden in Australia each year (30,104). Based on a 2016-17 economic analysis of inadequate sleep in Australia, the financial costs (e.g. health system costs, productivity losses) of poor sleep health were estimated to be in excess of $26 billion AUD per year. A further $40 billion AUD of non-financial costs (e.g. years of life lost due to premature death and years of healthy life lost to disability) were estimated for the same one-year period (30). The non-financial impact of sleep disorders alone was estimated to account for 3.2% of the burden of disease among Australians for the 2019-2020 year (104).

Furthermore, Australian research has demonstrated an association between poor sleep (primarily insomnia) and reduced workplace productivity in young Australians, with estimated productivity losses of 28,644 hours per 1000 young workers per year (105). The majority of the sleep disorders identified in this research were not previously diagnosed (105).

Given the prevalence of poor sleep health, the direct and indirect costs and burden of poor sleep and sleep disorders are a growing public health and health expenditure issue that needs to be recognised nationally and addressed.

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6 Risk factors for and potential consequences of poor sleep health

Various risk factors can contribute to or arise from poor sleep health (27,106–109). Many of these risk factors are behavioural factors that are modifiable and are also well-known, significant risk factors for chronic disease.

Figure 5 is a schematic representation of the risk factors that contribute to an increased risk of poor sleep and of the conditions that can arise as a consequence of poor sleep.

Risk factors for and potential consequences of poor sleep

Risk factors | Potential consequences

stress
trauma
shift work
smoking | obesity
suicidality
hospital patients | pain | caffeine
heart disease | screen time
low immune function
pregnancy/ perinatal | low education attainment | alcohol & other drug use
caring responsibilites | physical inactivity | poor nutrition
work place incidents
unemployment | type 2 diabetes | mental health difficulties
over employment | stroke | dementia
light exposure | motor vehicle accidents
financial stress | musculoskeletal injuries

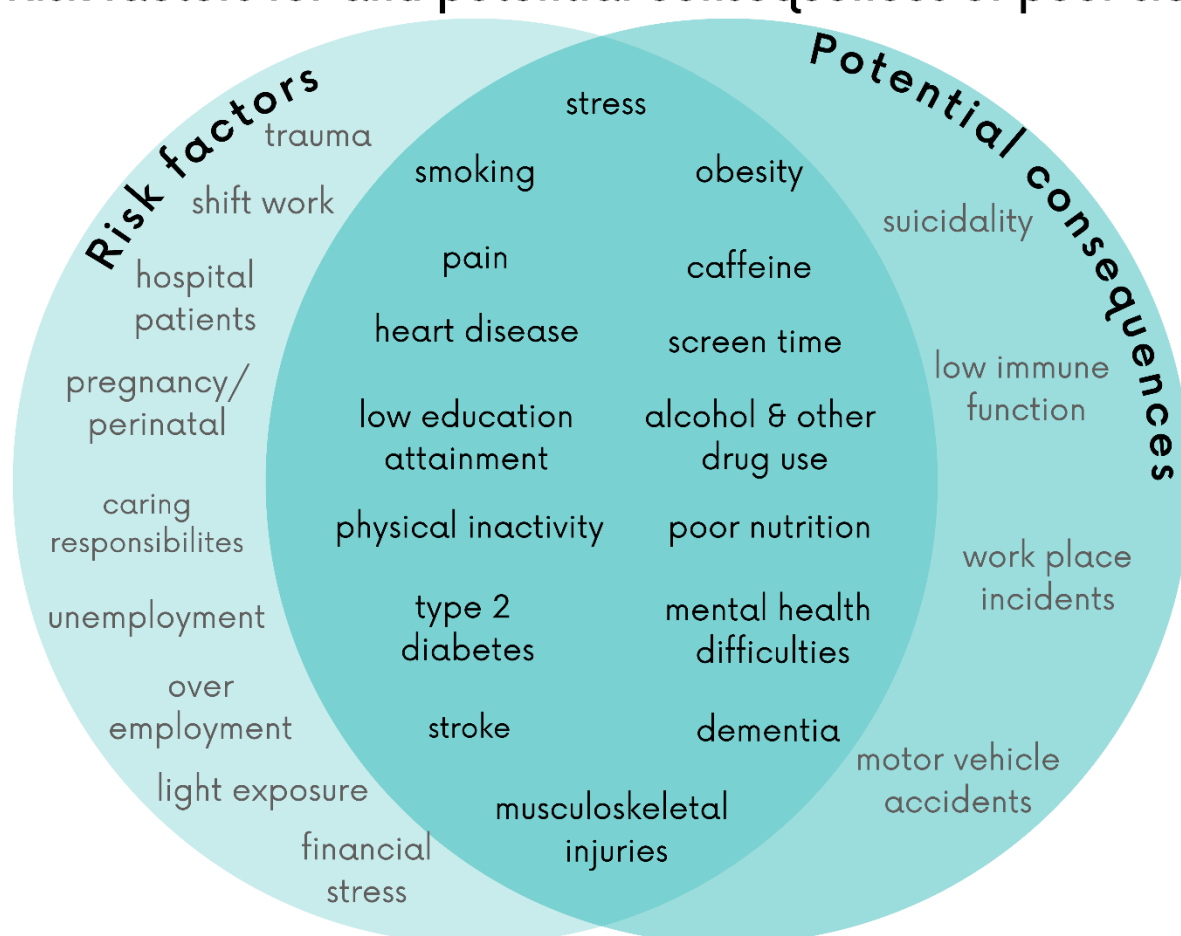**FIGURE 5: OVERLAPPING RISK FACTORS FOR AND POTENTIAL CONSEQUENCES OF POOR SLEEP**

6.1 Health behaviours impacting sleep

Health behaviours are actions that individuals take that impact their health (110). Some health behaviours form a component of sleep hygiene – a term used to describe a combination of behavioural and environmental factors that promote or inhibit sleep. However, other health behaviours can

constitute an independent risk or protective factor for sleep health. Health behaviours associated with sleep concerns and poor sleep include the following:

6.1.1 Bedtime behaviours and sleep hygiene

The activities of an individual during the day and prior to bedtime affect sleep quality (111). Sleep hygiene is the term used to describe behaviours, environmental factors and sleep-specific factors (e.g. bedtime routine, caffeine consumption, comfort/light in the bedroom) that influence sleep health (111,112). The Sleep Health Foundation (Australia) describes sleep hygiene as good sleep habits that improve sleep health, including:

- Having a consistent bedtime each night that aligns with an individual's circadian clock;
- using the hour before bed to 'wind down' and relax;
- timing meals so as not to go to bed with a full stomach or when hungry;
- not consuming caffeine or smoking before bedtime;
- not staying in bed if sleep is not initiated after 20 minutes;
- not having distracting items and devices in the bedroom;
- getting sunlight during the day; and
- ensuring sleep duration is within the 7-9 hour range (113).

While the evidence for sleep hygiene as a treatment for insomnia is limited (114), research into the influence of sleep hygiene on sleep health is developing and more research is required to fully understand the effects of sleep hygiene on sleep as well as individual variability in responses to sleep hygiene (111).

6.1.2 Screen time

Studies indicate that screen time before bed can increase the amount of time it takes to fall asleep, reduce sleep quality and affect attentiveness the following day. Working and using the internet in the hours before going to bed or going to sleep has been shown to be associated with reporting poor sleep or sleep difficulties (Adams et al., 2017). The timing of screen use is an important factor as the use of these devices can lead to delays in the time that users go to bed and, consequently, shorter sleep overall (115). Longer screen use time also may affect sleep by reducing the time spent doing other activities, such as exercise and spending time outdoors, that may be beneficial for sleep and sleep regulation (116). Viewing bright screens (such as a phone, computer or tablet) in the evening significantly impacts the time taken to start to feel sleepy and eventually fall asleep. Exposure to bright light, particularly shorter wavelengths of light, in the evening hours before sleep, can increase alertness (117), delay the timing of the body's naturally occurring circadian rhythms (76) and suppress the release of the hormone melatonin, which is important for maintaining and regulating the individual sleep-wake cycle (118).

6.1.3 Dietary factors

Sleep can be influenced by diet through a number of mechanisms. Sleep can be directly influenced by substances like caffeine, discussed below, and melatonin-containing foods which work by affecting receptors in the brain that induce sleep. The regulation of sleep can be affected by bioactive metabolites, and insomnia has been linked to diet-induced inflammation (119). Carbohydrates, fatty acids, amino acids and vitamins can all affect sleep in various complex ways (119). High Glycaemic

Index (GI) carbohydrates (i.e. carbohydrates that are broken down quickly by the body) can be associated with increased insomnia incidence, but a high GI meal four hours before bed has been found to decrease sleep latency compared to a low GI meal (119). Low protein intake is associated with poor sleep quality and high protein intake is associated with difficulty maintaining sleep (120). Certain micronutrient deficiencies (e.g. Vitamin A, C, D and E, calcium and magnesium in women and Vitamin D in men) are linked to short sleep duration (121). Excessive intake of total kilojoules and diets high in fat, free sugars and highly processed foods are associated with poorer sleep (122). Patterns of irregular eating have also been linked with indicators of poor sleep (123).

6.1.4 Alcohol

Although alcohol is associated with reduced time to fall asleep, alcohol consumption in the hours before bed is associated with sleep disturbances, more frequent awakenings and decreased restorative slow-wave sleep (124). Results from a community-based survey indicate that there was a dose-response relationship between alcohol consumption and sleep problems - that is, more sleep problems were associated with higher alcohol consumption - including short sleep duration, snoring and obstructive sleep apnoea (Zheng et al., 2021). Alcohol use is also associated with circadian rhythm disruptions (125). The impact of acute alcohol use may be transient and depend on the dose, whereas more regular use may have lasting impacts on circadian rhythm and can take 3-12 weeks of abstinence to resolve (125). There is also a long-established link between insomnia and an increased risk of relapse in alcohol dependence (126,127).

6.1.5 Caffeine consumption

Caffeine consumption is associated with reduced sleep quality and quantity (128). Caffeine consumption is linked with prolonged sleep latency, reduced sleep time, reduced sleep efficiency and lower self-reported sleep quality (129). Although there is substantial individual variability in response to caffeine, the timing and dose of caffeine are the most important aspects to consider (129). A systematic review and meta-analyses by Gardiner et al (130) on the effect of caffeine on subsequent sleep found that the reduction of total sleep time from caffeine effects could be avoided if caffeine was not consumed in the hours before bedtime. Small studies in humans indicate that caffeine close to bedtime can impact circadian melatonin rhythm and delay sleep onset (131), but larger studies would be required to support a substantial impact of caffeine on circadian rhythm.

6.1.6 Smoking

There is a bi-directional relationship between smoking and sleep quality as smoking impacts sleep quality and poor sleep quality impacts nicotine dependence (132). Overall, sleep disturbances are more common among cigarette smokers than non-smokers (133).

6.1.7 Physical inactivity and sedentary behaviour

Physical inactivity (not meeting daily physical activity guidelines) and sedentary behaviour (being inactive e.g., sitting or lying for long periods) are both associated with poor sleep (134,135). The evidence indicates that the relationship between physical inactivity and sleep is bi-directional, where physical inactivity impacts sleep and sleep impacts levels of physical activity (135). Physical inactivity is also linked with moderate-to-severe obstructive sleep apnoea (136). Similarly, sedentary behaviour is associated with poor sleep quality. For example, results of a large study of community-dwelling

adults show that those with higher sedentary time (+8 hours/day) had greater odds of sleep problems compared to those with less sedentary time (less than 4 hours per day) (137). A recent study showed the all-cause mortality risks associated with short and long sleep could be reduced by increasing levels of moderate-to-vigorous physical activity (138).

6.1.8 The interconnected relationships between sleep, physical activity and diet

Sleep, exercise and diet have been described as the three pillars of healthy life (78). All three are interconnected and influence one another in complex ways. They individually contribute to health and wellbeing, positively or negatively, and each influences the impact of the other two on health and wellbeing (78).

Nutrition affects almost all aspects of health with a healthy, balanced diet shown to reduce the risk of a wide range of health conditions. Various dietary factors are also known to influence sleep quality and duration (see section 7.1.3 above). A systematic review of evidence of the impact of sleep interventions in children on the body mass index, diet and physical activity published in 2016 found that improvements in sleep duration had a positive impact on BMI, nutrition and physical activity. The report also noted that childhood obesity has been recognised by the World Health Organization (WHO) as a public health priority for the prevention of non-communicable diseases (139). Whilst research has focussed on the physical activity and nutrition of children to identify child obesity prevention interventions, systematic reviews have shown mixed results in the effectiveness of these. There is also significant evidence to suggest that poor dietary choices are made by individuals when inadequate sleep is obtained (140) and that poor dietary choices can result in poor quality sleep (141).

Physical activity is well recognised as a core pillar of health. The benefits of consistent exercise include improvements to mental health, cardiometabolic health and sleep health and a subsequent reduction in the risk of developing various preventable chronic diseases. A substantial amount of research has shown that getting regular exercise can improve sleep. Both aerobic exercise like cardio and running, as well as resistance exercise like weightlifting, can improve sleep quality. Physical activity can also reduce the risk of sleep problems, like insomnia, obstructive sleep apnea (OSA), and restless legs syndrome (RLS). Multiple studies have shown that exercise can reduce pre-sleep anxiety and improve sleep quality in people with insomnia. There are strong associations between levels of physical activity, sleep health and overall health and wellbeing. For example, the risk of all-cause mortality is significantly increased in people who have both inadequate physical activity and inadequate sleep, compared to inadequate physical activity or sleep individually (138,142). Further, exercise can improve sleep quality in healthy and clinical populations (143) and improve changes in metabolism associated with inadequate sleep (144).

Sleep health can be significantly impacted by diet and exercise, but poor sleep also hinders good nutrition and physical activity. Sleep facilitates both physical and cognitive recovery and repair, affecting nearly every tissue in the body. Sufficient sleep is also important in having the energy to exercise. Not getting enough sleep can lead to being less physically active during the day and reduced muscle strength during workouts. Sleep deprivation can also affect the safety of exercise, with increased sports injuries reported in those who are sleep deprived. Insufficient sleep duration and/or poor sleep quality make individuals more likely to overeat and choose unhealthy foods. Sleep deprivation affects the body's release of ghrelin and leptin, two neurotransmitters that play a key role

in regulating hunger and appetite (145). Ongoing poor sleep health and long-term sleep deficiency are also associated with an increased risk of obesity.

6.1.9 Clustering of behaviours

It is important to note that a number of health behaviours or 'lifestyle factors' tend to cluster together for a range of environmental and psychosocial reasons (146,147). Behavioural clustering means that one 'risky' behaviour is likely to occur with other 'risky' behaviours. (e.g., smoking, alcohol use, poor quality diet). People identified as poor sleepers have also been shown to have a poor health profile, indicating a cluster of health risks occurring at once (148). Furthermore, a healthy lifestyle and high-quality diet is associated with a lower risk of sleep apnoea (149). Importantly, both health behaviours and sleep are underpinned by complex social determinants and this warrants consideration in targeting these behaviours and outcomes. Much of the current evidence tends to examine individual health behavioural risk factors in isolation (e.g. nutrition, physical activity) on sleep, when the impact of multiple risk factors such as socioeconomic status, may be synergistic or some offset each other's impact. Current evidence may not capture the extent of the complex interactions between sleep hygiene, other health behaviours, sleep health status and various health outcomes.

6.2 Common health conditions and outcomes associated with poor sleep

6.2.1 Chronic diseases and chronic pain

Chronic physical conditions and pain are associated with sleep disturbances (150). Poor sleep is associated with physiological changes such as altered hypothalamic-pituitary-adrenal (HPA) functioning, metabolism and stress reactivity, which are risk factors for chronic disease (151). In population studies, short sleep duration (<6 hours in adults) is associated with increased risk of diabetes, cardiovascular disease, coronary heart disease, obesity and hypertension (152) whereas long sleep duration (>9 hours sleep) is associated with diabetes, cardiovascular disease, coronary heart disease, obesity and stroke (153). However, the significance of the association between sleep duration and these chronic health conditions differs with age and sex (152,153).

People who suffer from a sleep disorder, such as obstructive sleep apnoea (OSA) or insomnia, are more likely to have a chronic condition (27). There are also associations between poor sleep and mental health conditions, and sleep loss increases susceptibility to poor mental health (154) as discussed in section 7.2.3.

Chronic physical pain and sleep disturbances have a bi-directional relationship (155,156). Persistent or chronic pain increases symptoms of insomnia and reduces daytime functioning (150) and short sleep can exacerbate pain intensity (156).

6.2.2 Obesity

Overweight and obesity (BMI ≥ 30kg/m^2) have been linked to poor sleep (157). Compared with adults with an average BMI, adults who are obese have a greater risk of short sleep duration and poor sleep quality (Angarita et al., 2016). Weight gain may also be an independent risk factor for poor sleep (157). At a population level, obesity is the strongest predictor of daytime sleepiness, independent of OSA (159). The relationship between sleep and obesity is bi-directional, with poor sleep leading to

increased appetite and increased risk of adiposity and obesity (160,161). Additionally, obesity is one of the biggest risk factors for the development of Obstructive Sleep Apnoea (OSA) (162).

6.2.3 Mental health

Sleep health and mental health concerns, including depression, anxiety and acute stress, are known to have a bi-directional relationship, whereby poor mental health often disrupts sleep and poor sleep health can precipitate or exacerbate mental health concerns (59,108,163). Evidence indicates that addressing sleep can improve mental health and sleep intervention strategies can have a mutual benefit for sleep and mental health outcomes (164). Furthermore, there is a dose-response relationship between improvements in sleep and mental health, where improvements in sleep health are reflected in similar improvements in mental health (164).

Insomnia is a significant predictor for the development and onset of depression, anxiety, alcohol abuse, post-traumatic stress disorder and psychosis (165). Depression and sleep problems are closely linked in both directions (166), and it is thought that some of the biology behind sleep and depression are shared. Sleep disturbances are part of the diagnostic criteria for several mental health conditions, including depression, and 'poor mood' is one of the possible daytime symptoms of sleep disorders such as insomnia (154). Furthermore, up to 90% of people experiencing depression also report comorbid sleep disturbances, including 75% who report trouble with falling or staying asleep and 10-40% who report hypersomnia symptoms (i.e. long sleeping duration or excessive daytime sleepiness) ((166–169).

Historically, sleep disturbance has been viewed as a 'secondary symptom' when occurring in the presence of mental health disorders, however, this view is not supported by scientific evidence. In fact, insomnia symptoms are among the most consistent risk factors for the development of depression (170), untreated insomnia can reduce treatment-response to depression therapy (171) and persistent insomnia is the most common residual depression symptom and a predictor of depression relapse (172).

Treating insomnia with behavioural therapies not only improves sleep but also consistently improves depression symptoms (173,174). Furthermore, certain treatments for OSA have also been shown to improve symptoms of depression (175,176).

6.2.4 Suicidal ideation and behaviour risk

Short or disrupted sleep has been identified as a risk factor and warning sign for suicide behaviours (100–102). A range of sleep disturbances and sleep disorders have been shown to be related to suicide behaviours, including insomnia, hypersomnia, parasomnias, nightmares and non-specific disturbances. Sleep disturbance is linked with more active suicidal ideation the following day (177) as well as increased risk of suicide over a medium to long-term follow-up duration (178).

A review of the evidence supports an independent relationship between sleep disturbances and suicide risk (179) while noting that psychiatric disorders may contribute to this relationship. An earlier study identified that short sleep duration is associated with both suicidal ideation and suicide attempts and that this relationship exists separately from any mental illness (180). Sleep disturbance may indicate the worsening of an existing mental health concern but may also precede or be entirely separate from mental illness. This relationship between sleep disturbance and suicidality may be

explained by biological factors, such as disruption to serotonin systems. These are chemical compounds in the body associated with regulating mood, cognition, learning and memory. Disrupted sleep can lead to over-arousal or disruption of emotional regulation and/or executive control (178,181,182).

To summarise the complex changes in biological signalling and thus, behaviour, that result from sleep disturbance, Tubbs et al. (183) have put forward a theory titled 'Mind After Midnight', suggesting that psychological and biological factors, including chronotype, intersect with nocturnal wakefulness to create conditions of poor mood and impaired judgement, which may be linked to increased risk of suicide at night (183).

Evidence indicates there is also a relationship between sleep disturbance and suicide among adolescents (184). The risk of experiencing suicidal ideation is 1.35 times greater for adolescents who do not attain sufficient sleep duration on an average school night than those who do (184). This is particularly relevant given that suicide is a leading cause of death among Australian young people (185).

A review of coronial records of deaths by suicide in Australia through the year 2017 showed significantly higher than expected rates of suicide overnight which were associated with nocturnal wakefulness. The authors concluded that this may provide nocturnal wakefulness as a modifiable risk factor for reducing suicide events (186). It is evident that sleep is a critical prevention and intervention target in suicide prevention.

6.2.5 Injury and accident risk

Insufficient sleep duration, sleep disorders and driving at night when the circadian and homeostatic propensity for sleep is high, are all associated with increased risk of both workplace injuries and motor vehicle accidents (MVAs) (187). A 2017 Deloitte Access Economics report estimated that people experiencing poor sleep or living with a sleep disorder are 1.4-2.5 times more likely to suffer a workplace injury or accident and 1.5-2.4 times more likely to be in a MVA (28). Inadequate or poor sleep is estimated to contribute to 25.8% of workplace injuries and 23% of MVAs in Australia (28).

US data suggest that physically active people who had no more than four or five hours of sleep a night were more than twice as likely to report a musculoskeletal injury in the past 12 months as those who slept eight hours or longer (188). However, a recent review of 12 prospective cohort studies found limited evidence supporting an association between various indicators of poor sleep and injury in adult athletic populations (189).

6.3 Social and environmental factors affecting sleep health

6.3.1 Education and employment

Education attainment and employment status have an association with sleep health. Compared to tertiary education attainment, a lower education level i.e. secondary school completion is associated with poor sleep (190). Employment status has a complex association with sleep health. People who are unemployed are more likely to have poor sleep compared to people who are employed, but people who work longer hours (>30hrs per week) are more likely to have poor sleep than those who work fewer hours (<30hr per week) (158,190). The type of employment also influences sleep quality. People

who work as labourers, machinery operators and drivers, community and personal service workers, technicians and trade workers and clerical and administrative workers are more likely to have poor sleep (158). Shift work also has a high association with poor sleep (191). The effects of unemployment and education appear to be primarily driven by psychological distress (150).

6.3.2 Health literacy

Health literacy is defined as "how people access, understand and use health information in ways that benefit their health" (192). Health literacy is influenced by many factors including education, disability, age, gender, digital literacy, culture, language and wider determinants of health. Many systemic barriers to health literacy including access to credible and reliable sources of information also exist (193). People who have obstructive sleep apnoea (OSA) often have lower health literacy (194). Poor sleep in children is associated with lower parental health literacy (195).

6.3.3 Environmental factors

Environmental factors can have an impact on the sleep quality of an individual. In terms of sleeping environment, artificial lighting, elevated bedroom temperature, poor ventilation, overcrowding, lack of access to a safe sleeping environment/homelessness, and industrial and urban noise can affect the quality and quantity of sleep (196). A sleep 'microclimate', including bedding and sleepwear can also impact sleep quality (197). Importantly, some environmental factors can be behavioural, such as exposure to screen light from technology (e.g., mobile phones, television) before bedtime (198).

6.3.4 Insomnogenic environment

Like the characteristics of an obesogenic environment, that is, an environment that promotes obesity via neighbourhood characteristics, food policies, etc. (199), modern living has also shaped an 'insomnogenic' environment. As with other behavioural and health risk factors (e.g., physical activity, diet), sleep is modified by the social, physical and built environments in which we live. For example, aspects of modern life and a '24/7 society' including long work hours (200), extended commute times (201), the extension of business hours (54), technology use (202) and patterns of evening socialisation (Coveney, 2014) are all environmental factors enabling behaviours that contribute to individual adverse sleep outcomes. Additionally, social and physical features of society such as family and social cohesion, safety, noise, light and walkability can also influence sleep and sleep disorders (203). These environmental factors contribute to cumulative chronic stress which has a negative impact on sleep (204). Sleep health is affected by and interacts with complex, multi-level influences that are within the scope of non-health policies such as urban planning and environmental regulations.

6.3.5 Psychological factors

Bedtime procrastination has been recognised as a psychological response to a range of causes, including daytime stresses and habitual behaviours such as late-night screen viewing and online activities, despite its subsequent impact of inadequate or poor sleep and fatigue the following day (205,206). Poor sleep patterns for individuals are also associated with delayed bedtime, with stress associated with difficulties going to sleep leading to deferring attempting to do so (207). Staying up late has been reported as being associated with symptoms of depression and anxiety, lower sleep quality and a higher risk of insomnia (208). The term *Revenge Bedtime Procrastination* has developed in the past decade to describe an individual's choice to stay up late in order to have some control over

daily life (209). This behaviour can be associated with work stress, long hours of work or other daily stress that leads to an individual choosing to sleep less in order to have time for themselves.

6.3.6 Equity factors

Research shows that there is a 'sleep disparity' across social strata, where at-risk individuals and those experiencing social disadvantage achieve less quality sleep (54) and experience sleep patterns that are linked with poorer health outcomes (210). Disparities in sleep and poor sleep among minority groups are a reflection of a range of social and environmental factors, such as proximity to green space, neighbourhood noise and level of neighbourhood disadvantage (203). Higher levels of stress due to daily challenges experienced by disadvantaged groups (e.g. financial insecurity, racism, poor mental health) also contribute to poorer sleep (210,211). As sleep is a risk factor for chronic diseases, sleep disparities across the social gradient can also widen health inequities (212).

Socioeconomically disadvantaged groups, including communities in rural, regional and remote areas of Australia, also experience additional barriers to seeing a general practitioner about sleep issues such as lack of access or cost (213).

First Nations Australians people experience poorer sleep and more access barriers to sleep health services than do others in the population (214). This is similar to other indigenous populations globally. For example, insufficient sleep is more common in Māori adults in New Zealand compared to non-Māori adults (215).

Also, different beliefs about sleep among population groups, including the normalising of poor sleep and sleep disorders or poor sleep behaviours, can serve as barriers to healthy sleep or to seeking care for a sleep concern (210).

Caring responsibilities, typically undertaken by women, also affect sleep. Interrupted sleep from attending to night-time needs, light sleep from anticipating night-time needs, difficulty sleeping from worry, anxiety and emotional labour at night and ongoing, disruptive night-time behaviour and surveillance all contribute to poor sleep of caregivers (216,217).

Groups experiencing disadvantage may be at risk of more health problems and also have a harder time identifying sleep problems and seeking care. Strategies to improve sleep health in individuals and throughout the population would need to consider these factors and use targeted approaches to make addressing sleep health accessible across the social gradient.

6.4 Population groups and individuals at greater risk of poor sleep

6.4.1 Workforce – physically and/or mentally demanding occupations

Fatigue is considered an issue in physically and mentally demanding occupations. Fatigue is described as a transient reduction in the physiological capacity to perform activities. Physical fatigue refers to a reduced capacity to perform muscle-based activity and mental fatigue refers to a reduced capacity to be cognitively alert (218). Fatigue can result from exertion as well as sleep loss, altered sleep patterns and extended time awake. Inadequate sleep and fatigue have become established industrial and workplace safety concerns in industries that involve long hours of work, physically and/or cognitively demanding tasks and consistently stressful environments (219). It is important to note that fatigue and sleepiness are separate constructs. Sleepiness refers to a person's likelihood of falling asleep in

different situations and is the direct result of inadequate sleep. Sleepiness may be an increasing workplace issue arising from contemporary factors adversely influencing sleep health (80).

Historically, physical fatigue was the main concern of reduced work productivity and safety due to the predominance of physical labour (219). However, in present-day work settings, mental fatigue is considered to be a much more widespread and pervasive issue (220,221). While physical fatigue is moderated by the interplay of work time and break time, mental fatigue in the workplace is also affected by extra factors including wakefulness, prior sleep, personal or emotional stress, the time of day and high levels of concentration on particular tasks (219). Mental fatigue can be further exacerbated by long work hours, long commute times, multiple jobs, caregiving responsibilities, the casualisation of the workforce and social commitments (222). Mental fatigue is connected with several risks. In the short term, risks include reduced productivity, increased errors, absenteeism, poor teamwork, reduced motivation, unethical behaviour, workplace incidents and injuries. Additionally, there are long-term effects on health and wellbeing for the individual as well as economic implications. Shift work is associated with sleep disorders such as insomnia as well as chronic conditions such as obesity, diabetes, cardiovascular disorders, mental disorders and cancer (191,223,224).

6.4.2 Shift workers

The modern 24-hour economy has meant that more people are working atypical work hours. Atypical hours or shift work refers to non-standard work patterns, commonly outside of the general daily working hours. General working hours are variously described as starting between 7 and 9 am and concluding around 6pm. Shift work can include those working rotating shifts, split shifts, irregular work time (described as occurring outside of 7am and 6pm), compressed working weeks, night shifts and roster work (225).

Shift workers are at increased risk of having poor sleep, with shift work affecting all three domains of sleep health. The quantity of sleep obtained by night shift workers before their first night shift and between night shifts can be as few as 2-4 hours. The quality of sleep of shift workers is also impacted by increased awakenings during sleep (episodes per sleep where they are awake for more than 5 minutes) and poor sleep efficiency (percentage of time in bed spent asleep). Consistency of sleep is also affected as shift workers often sleep or try to sleep at times misaligned to their circadian rhythm (225). These effects on the quantity, quality and consistency of sleep produces inherent issues of fatigue and fatigue-associated risks, such as reduced productivity, errors, incidents and injuries among others as discussed above in section 7.4.1.

Shift work disorder (SWD) is a condition established by the American Academy of Sleep Medicine (AASM) and included in the International Classification of Sleep Disorders-Second Edition (ICSD-2) (226). It is characterised by insomnia and excessive sleepiness related to shift work and is one of the most common health problems in shift workers. SWD is identified as causing insomnia, fatigue, worse work performance, an increased likelihood of workplace incidents ('accidents') and a poor quality of life. A 2021 cross-sectional analysis of Australian workers identified probable shift work disorder (pSWD) in 10.5% of workers with non-standard work schedules (227). People with pSWD were more likely to report depression/bipolar disorder and/or work errors due to sleep problems (227).

Some high-risk industries operate with shift-based schedules. These include but are not limited to the hospital workforce, emergency services, policing and law enforcement and transport including road,

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rail and sky. Fatigue in these industries presents significant risks beyond the loss of productivity with health, injury and mortality risks to the individual worker and others as discussed in section 7.4.1. Many of these have industry-specific fatigue-management regulations to counteract these risks. These regulations detail the maximum work and minimum rest requirements including rest time both within a shift and between shifts. Section 8.4.2 provides examples of fatigue management in industries. Addressing employment policies to safeguard healthy sleep is beyond the scope of this paper.

6.4.3 Children and young people

Good sleep is important for children's health, development and well-being. Sleep can have effects on their cognition, mental health and physical health (228,229). Good quality sleep of sufficient duration is important for memory- both declarative (conscious recollection of facts and events) and non-declarative (nonconscious learning such as usual tasks), cognition and school performance (229). Mental health and emotional regulation are strongly linked to sleep with a bi-directional relationship between depression and anxiety and sleep. Restricted sleep is associated with low attention and hyperactivity whereas emotional regulation is better with adequate sleep (228,229). Inadequate sleep is also associated with physical health issues such as current and future risk of obesity and cardiometabolic risk (230). When considering the effect of sleep on health, particularly the physical health of children, sleep should not be viewed in isolation, but rather as part of a 24-hour day, with physical activity and sedentary behaviour included. The Australian 24-hour movement guidelines for children (refer to section 8.1) provide recommendations for physical activity, sedentary behaviour and sleep (63).

Risk factors associated with poor sleep in children include:

- low socioeconomic status;
- bedroom internet access;
- >5hr per week of homework;
- obesity;
- caffeine intake;
- inconsistent sleep schedule; and
- mental health concerns (228).

The amount of sleep required varies across the lifespan and within childhood years. In general, children require less sleep as they age. The guidelines for sleep duration for children are detailed in section 8.1. According to the 2018 Longitudinal Study of Australian Children, while only 12% of children 6-11 years old did not meet the minimum guidelines on school nights, a quarter of 12-13 years olds and half of 16–17 year-olds were not meeting the minimum sleep guidelines on school nights. In contrast, on non-school nights, younger children are less likely to meet minimum sleep guidelines but older children are more likely to 'catch-up' sleep and sleep longer (228). The pattern of under-sleeping on school nights and over-sleeping on non-school nights for older children is a form of social jetlag. A temporary relief from fatigue is in contradiction of the recommended regular sleep time and wake-up time (228). Such catch up sleep when needed is considered better than chronic sleep deprivation, however consistent sleep and wake times are optimal where achievable. When most adolescents enter puberty, they experience a 'phase-delay' in their sleep-wake cycle – later sleep onset and wake times. This phase-shift is moderated by a delay in melatonin secretion at night time and an altered

sleep drive whereby the homeostatic pressure to fall asleep occurs more slowly (231). This shift, along with academic and social pressures, means the average secondary school student does not fall asleep until late in the evening, around 11pm, with associated optimal wake time 8-10 hours later, between 7am-9am (231,232). Early school start times, with associated commute times, mean that many students are not getting adequate time for sleep.

Interventions for sleep health in children include education for both parents and children about the importance of sleep and how to best support sleep, including avoiding or reducing risk factors and promoting good sleep behaviours. Education for teachers and the education sector around how school activities and homework responsibilities can affect sleep and how best to support students' sleep could also be considered.

Delaying school start time is an emerging policy option for addressing sleep in several countries. In the USA, the American Academy of Pediatrics, the American Medical Association and the American Academy of Sleep Medicine have all recommended that middle and high school start times be no earlier than 8:30am (233). In 2019, California legislated later school start times. The laws that came into effect in July 2022 stated that school could start no earlier than 8:30 am for high school and 8:00 am for middle school (234). In Australia, secondary school start times are commonly not before 8.30am (i.e. NSW public schools typically begin at 8.45am) (235).

6.4.4 First Nations Australians

Aboriginal and Torres Strait Islander peoples (hereafter respectfully referred to as First Nations Australians) experience disproportionately higher rates of sleep problems than non-Indigenous Australians (214). A systematic review of sleep health in First Nations Australians found that First Nations Australians were more likely to report 'unhealthy sleep' – defined in the review as short sleep, difficulty initiating and/or maintaining sleep disrupted/restless sleep or excessive sleepiness (214). The clinic-based studies on OSA included in the review reported a higher proportion of First Nations Australians in the 'severe' range than non-Indigenous Australians. First Nations Australians are also more likely to experience access and availability barriers to services than non-Indigenous Australians. A 2020 report on sleep health in First Nations Australians by the Australasian Sleep Association detailed that sleep problems in First Nations Australians have "strong and causal associations with secondary deficits in daytime performance, sleepiness levels, academic performance, attention and learning, emotional regulation, behaviour and mood regulation, with increased likelihood of obesity, diabetes, high blood, pressure, somatic health, cardiovascular disease and general psychological health" (236).

6.4.5 Women

The Australian Longitudinal Study on Women's Health (ALSWH) has included sleep health in the study since its inception in 1996. A submission to the Parliamentary Inquiry said that women report sleep difficulties during pregnancy and motherhood, the menopause transition and older age. Sleep difficulties are often persistent and have significant consequences for women's wellbeing including being associated with poor mental health, disease, falls and accidents (237).

Pregnancy and post-partum

During pregnancy, women experience inadequate sleep or disrupted sleep including frequent night-time awakenings, daytime sleepiness and symptoms of sleep disorders (238). Short sleep and later sleep midpoint, the middle time point between going to bed and waking up (239), is associated with a risk of gestational diabetes (240) and subjective declining sleep quality during pregnancy is a risk factor for perinatal depression (242). A higher risk of RSL is associated with pregnancy (243) and weight gain associated with pregnancy increases the risk of OSA (244). There is often an increase in contact with healthcare professionals during pregnancy which provides an opportunity for prevention and intervention. Post-partum women are also at risk of poor sleep. In the period after birth mothers' sleep can be impacted by nighttime feeds and the challenges of infant care. Poor sleep in this period also has a bidirectional relationship with factors like anxiety and post-natal depression (245,246).

Menopause

Menopause, which is the cessation of menstruation, is associated with poorer sleep than would be expected with aging alone (247). The prevalence of women who report sleep disturbances during the menopausal transition is high, between 40%-60% (247). Menopause is associated with significant hormonal changes, which can have direct and indirect impacts on sleep. For example, vasomotor symptoms such as hot flashes or night sweats can be disruptive to sleep (248). Menopause is also associated with changes in mood as well as the presence or exacerbation of other chronic symptoms that impact sleep quality (248). Compared with pre-menopausal women, perimenopausal and postmenopausal women are at increased risk of sleep disturbances (249). Beyond self-reported sleep disturbances, menopause has also been linked to an increase in sleep disorders including insomnia, RLS and OSA (250). OSA risk is generally much higher for men but by the time a woman is in menopause her risk of OSA is approximately the same as that for a male (251). Poor sleep during menopause can impact physical and mental health and quality of life and hormonal treatments or other interventions may be combined with sleep support to address poor sleep during this transition (252).

6.4.6 Older people

Sleep requirements change with age where older people require less sleep than younger people. However, disrupted sleep is common in older adults (>65years). In older people, sleep architecture changes and they typically experience less slow-wave sleep, less rapid eye movement (REM) sleep, reduced sleep efficiency and elongated sleep latency. A phase advance in their circadian rhythm, that is going to bed earlier and waking up earlier, is common for older people. Sleep disturbances also increase the risk of falls in older persons in addition to common potential health consequences like increased risk of chronic disease (253).

7 Sleep in health information, policy and practice

Australian and other government health information services include the significance of sleep as a health issue. The Australian government *healthdirect* online information service (254) provides advice on the importance of adequate sleep and what people can do to improve their sleep. Healthdirect discusses shift work as working against an individual's natural circadian rhythm and information for shift workers on how to establish healthy sleep habits is included in the information (254). Sleep is a topic in the Victorian *Better Health Channel* online information service which includes advice on sleep stages, disorders and where to find help (255). The South Australian Health Agency (SA Health) describes getting enough sleep as one of the most important contributors to health and wellbeing and important in reducing individual risk for ill-health (42).

7.1 Movement guidelines for children and young people

The Australian Government Department of Health has established national 24 hour movement guidelines for children and young people aged 0-17 that include recommendations on time spent asleep and awake as well as time spent in physical activity and sedentary behaviour (63,64). Canada was first to develop 24-hour movement guidelines and the detailed development process of the Canadian guidelines was leveraged by Australia in their process to adapt the existing guidelines while taking local context into account (256,257)

The guidelines for early years (0-4yo) and for children and adolescents (5-17yo) were developed in 2017 and 2018 respectively and were an evolution of the Australian National Physical Activity Guidelines for children and adolescents. These were first introduced in 2004 and updated to include separate recommendations for sedentary behaviour in 2012 (256). The 2017/18 updates recognised the co-dependent nature of behaviours such as physical activity, sedentary behaviour and sleep and that these could not be viewed in isolation due to the natural time constraint of the 24-hour day. The guidelines state that "all children and young people should get the right mix of physical activity, inactivity and sleep in each 24-hour period" (63,64). Getting enough good quality sleep is described as essential to healthy growth and the guidelines recommend that children aged 5 to 13 years should have 9 to 11 hours of uninterrupted sleep each night and that young people 14 to 17 years of age should have 8 to 10 hours of uninterrupted sleep. Having a consistent bedtime and wake-up time; avoiding screen time for 1 hour before sleep and keeping screens out of the bedroom are recommended behaviours to establish and maintain healthy sleep patterns.

Table 2 outlines the 24-hour movement recommendations for children and young people.

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TABLE 2: 24 HOUR MOVEMENT GUIDELINES 0-17YEARS (63,64)

Age	Physical Activity	Sedentary activities	Sleep
0-1 years	Being physically active several times a day in a variety of ways	Not being restrained for more than 1hour at a time or sitting for extended periods. Sedentary screen time is not recommended	14-17hours (0-3months) 12-16hours (4-11months) Of good quality sleep including naps
1-2 years	At least 180minutes spent in a variety of physical activities including energetic play	Not being restrained for more than 1 hour at a time or sitting for extended periods. Sedentary screen time: • not recommended for 1 year olds • 2 year old no more than 1 hour	11-14 hours of good quality sleep • Including naps • Consistent sleep and wake-up times
3-5 years	At least 180minutes spent in a variety of physical activities of which at least 60minutes is energetic play	Not being restrained for more than 1hour at a time or sitting for extended periods. Sedentary screen time of less than 1 hour	10-13 hours of good quality sleep • May include a nap • Consistent sleep and wake-up times
5-13 years	At least 60 minutes of moderate to vigorous physical activity per day	Sedentary recreational screen time should be limited to 2 hours per day	9-11 hours of uninterrupted sleep per night • Consistent routine (try not to vary bedtime and wake-up time by more than 30mins) • Avoid screens one hour before bed and make bedrooms a screen-free zone
14-17 years	At least 60 minutes of moderate to vigorous physical activity per day	Sedentary recreational screen time should be limited to 2 hours per day	8-10 hours of uninterrupted sleep per night • Consistent routine (try not to vary bedtime and wake-up time by more than 30mins) • Avoid screens one hour before bed and make bedrooms a screen-free zone

National Physical Activity Guidelines exist for adults 18+, but these do not include sleep recommendations. The Australian 24 Hour Movement Guidelines for Adults are currently in development after inclusion in the March 2022 Federal Budget (258). Given the importance of sleep both separately as a health issue and in interaction with physical activity and diet for individual health and wellbeing, separate and/or complementary guidelines for each are warranted.

7.2 Sleep in preventive health policy

Preventive health has become a national policy priority. The National Preventive Health Strategy 2021 – 2030 (the NPHS) sets out a series of policy achievements throughout this decade to establish a prevention system, to address the increasing burden of disease in the Australian population and to reduce health inequity among the population. The NPHS identifies and acknowledges the wider determinants of health that affect a person's overall state of health. These include social, environmental, structural, economic, cultural, biomedical, commercial and digital environments (193). The NPHS aims to improve the health and wellbeing of all Australians at all stages of life through prevention including by improving the prevention of risk factors for chronic conditions, injuries and infectious disease as well as improving protective factors in childhood that are critical to creating strong foundations for later in life (193).

Consultations for the NPHS heard that "getting enough sleep" is an important component of health for people in the community (193). The NPHS states that achieving adequate sleep and being physically active are essential components of preventing poor physical health and for establishing and maintaining strong mental health and wellbeing. It recognises that:

- poor sleep affects the capacity of people to undertake sufficient physical activity for health (193);
- the duration of sleep affects the ability of individuals to regulate appetite and metabolism (193);and
- the length and quality of sleep (are among) many protective factors that contribute to positive mental health and wellbeing (193).

A report in April (17) by the Australian Parliament House of Representatives Standing Committee on Health, Aged Care and Sport, Bedtime Reading, was intended to bring attention to the central function of sleep to overall health and wellbeing in the Australian population and to increase the focus placed on sleep among policy makers and the broader community. The Committee report considered the available evidence on poor sleep among Australians, the prevalence of sleep disorders and common factors that contribute to poor sleep, including the extent to which children have disrupted sleep because of increased use of smartphones and other online devices. The Committee recommended that the Australian Government establish sleep health as a national priority and recognise its importance to health and wellbeing alongside fitness and nutrition (Recommendation 1). The Committee also recommended that a national sleep education and awareness campaign should be undertaken in partnership by the Australian government with state and territory governments and key stakeholder groups (Recommendation 8). Other Recommendations covered shift work guidelines; working hours and policies; funding for access to sleep health services; medication provision; medical education, training and registration and research (17). A government response was published in August 2023 which supports recommendation 1, notes recommendation 6 regarding monitoring of the CPAP industry and supports in principle all other recommendations (259).

7.3 Sleep in health practice

The National Mental Health Commission (NMHC), in a submission to the 2019 Parliamentary Inquiry, said that disordered sleep is both a causal factor and a symptom of mental illness; that sleep

deprivation can further contribute to the development of mental illness and that sleep problems can be a consequence of pharmacological treatments for mental illness. The NMHC submission said a growing body of research indicates a strong correlation between sleep disturbances and suicidal ideation and behaviours. The NMHC said research indicated that sleep complaints may be a key risk factor and warning sign and provide an avenue for early intervention and prevention, emphasising the "critical need to address sleep health and sleep disorders in primary care" (31).

The Royal Australian College of General Practitioners (RACGP), in its publication *Guidelines for preventive activities in general practice,* identifies the importance of healthy sleep as part of children's health checks and as a health assessment issue for adolescents (14-19 years of age). It identifies physical activity among older adults as improving sleep among other health benefits (260). The RACGP Healthy Habits group has been funded to include sleep health assessment and interventions into the Healthy Habits program.

7.4 Sleep in other public policy

Sleep as a risk factor for health and/or safety is relevant in other public policies. Poor or disrupted sleep is recognised as a risk factor for road and workplace accidents and injuries and the significant influence of sleep on the developing brain means sleep has a place within employment/labour (occupational health and safety) policy, road safety policy and education policy.

7.4.1 Employment/work hours

Various laws, standards and regulations exist both in Australia and internationally to regulate work hours and timing of work. In Australia, each state and territory legislates and regulates occupational health and safety separately and the Australian Government Fair Work Ombudsman has National Employment Standards that relate to the maximum hours of weekly work hours (261). Full-time employees are permitted to work up to 38 hours per week, unless additional hours are considered reasonable in terms of minimal risk to the employee, adequate notice and compensation (262).

Safe Work Australia has a guide for managing the risk of fatigue which includes a fatigue checklist and guidelines for shift design (e.g. minimising night shifts, and assigning rest periods) (221). Additionally, several industry-specific fatigue-management regulations exist. These regulations detail the maximum work and minimum rest requirements including rest time both within a shift and between shifts. Some of these specifically refer to the management of fatigue in the workplace and arise from factors such as irregular work hours. Importantly, evidence among university students suggests that the terms 'sleepy', 'fatigued', 'tired' and 'drowsy' have unique meanings and should not be used interchangeably. This has implications for how fatigue is measured and reported among employees (263).

7.4.2 High-risk industries

There are national, state and territory arrangements that separately regulate occupational health and safety with some including provisions relating to fatigue management relevant to the workplace, particularly in high-risk industries such as train, road and air transport. Table 3 provides a summary of some of the relevant national workplace provisions.

TABLE 3: HIGH-RISK INDUSTRY AND FATIGUE MANAGEMENT

Industry body	E.g. Regulation, Law, Code of practice, standard, guidelines	Summary
National Transport Commission: Heavy Vehicle National Law	Heavy Vehicle (Fatigue Management) National Regulation 2018	• Maximum work requirements and minimum rest requirements • Work diary requirements
National Transport Commission: Rail Safety National Law	Rail Safety National Law National Regulations 2012	Details and requirements for the development of a fatigue risk management program • Maximum shift requirements • Break requirements • Maximum days worked in 14 day period
Civil Aviation Safety Authority	Civil Aviation Order 48.1 Instrument 2019	Prescriptive approach: • Set flight and duty time limits • Fatigue risk management • Flexible but complex FRMS using a data-driven approach
Australian Medical Association (AMA)	National code of practice- hours of work, shift work and rostering for hospital doctors 2016	Tool for identifying unsafe working hours and reduce risks. • No hard limits on maximum hours, rest periods or shift work but includes recommendations and risks.
Australian Nursing & Midwifery Federation (AMNF)	AMNF Fatigue Prevention Policy (2019)	The AMNF Policy aims to support the prevention of work-related fatigue amongst nurses, midwives and assistants in nursing. The policy addresses work-related fatigue factors including: Roster patterns, length and timing of shifts, recovery time between shifts, shift rotation and working night duty shifts in an unsafe pattern of meal and rest breaks, long periods awake and mentally and/or physically demanding work.

Commercial Passenger Vehicles Victoria	CPV Victoria Fatigue Management Guidelines	Guidelines for recognising fatigue and how to reduce risks including recommended maximum work hours and minimum rest periods.
Emergency Services	National Council for Fire and Emergency Services – Managing Fatigue in Emergency Response by Workplace Health and Safety Technical Group 2022	"to assist emergency service organisations to develop consistent, yet organisationally specific, procedures and practices to mitigate the risks posed by fatigue at work"
Mining	NSW Resources Regulator Fatigue management Guide	guidance on how to prevent worker fatigue and its associated risks

There is increasing recognition that prescriptive regulations for maximum hours worked and minimum rest periods are not adequate for fatigue management. In fact, adherence to these regulations in many industries does not create a decrease in risk. The American Academy of Sleep Medicine and the Sleep Research Society have published guiding principles for determining work shift duration (219). These guiding principles reflect the risks of fatigue, the countermeasures to fatigue and decision-making about shift duration.

Several industries have been transitioning to use Fatigue Risk Management Systems (FRMS) as an alternative to prescriptive regulations. In general, FRMS sets out standards for standard work hours, guides scheduling and mandatory rest periods, includes fatigue training for staff and calculates risks or safety breaches based on fatigue-based activities and periods of work. Using the aviation industry as an example, The International Civil Aviation Organization (ICAO) define FRMS as:

"A data-driven means of continuously monitoring and managing fatigue-related safety risks, based on scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness"

ICAO (264)

The New Zealand Civil Aviation Authority regulations have allowed the use of FRMS principles since the 90s (265) and the ICAO has had guidelines for the use of an FRMS in its international Standards and Recommended Practices (SARPs) (266). An FRMS uses risk, rather than compliance to identify workplace fatigue hazards. They allow a roster to work dynamically to respond to risk factors. The Australian Civil Aviation Safety Authority (CASA) has standards, based on those from ICAO, for adopting an FRMS approach (267). The Royal Flying Doctor Service (RFDS) service of Australia Western Operations was the first Australian aircraft operator to receive full approval of an FRMS after a 2-year trial period in 2019 (268).

A 2022 review of FRMS system effectiveness by Sprajcer et al. (269) concluded that, while there are few studies for FRMS effectiveness as a whole, the evidence of improved key metrics of safety and fatigue suggests it is likely to be effective for safety outcomes. The authors propose that the success of an FRMS would depend on the safety culture and resources of the implementing organisation.

There have been incidences where corporations have removed fatigue-related safety provisions, which has received criticism from sleep experts. For example, in 2017 CSX Corporation forbid controlled napping for train engineers and conductors (270). This goes against evidence to support napping as a fatigue risk reduction strategy in the face of irregular work schedules that make adequate sleep challenging (271). Elimination of such fatigue risk management strategy poses a risk to their employees and the public (270).

7.4.3 Road safety

There is some overlap between occupational health and safety and road safety where industries use roads, particularly the heavy vehicle industry. The National Road Safety Strategy 2021-2030 (NRSS), which aims to reduce the burden from road crashes and develop a safer, sustainable transport system, refers to fatigue including "supporting fatigue management through investment in heavy vehicle stops" and increasing "community understanding of risky road use" where a high-risk behaviour is "driving while fatigued" (272).

7.4.4 Daylight savings

Daylight Savings Time (DST) is not uniformly observed in Australia with New South Wales, Victoria, South Australia, Tasmania, ACT and Norfolk Island all implementing DST while Queensland, Northern Territory, WA, Christmas Island and the Cocos (Keeling) Islands do not.

In the United States, several sleep-related organisations such as the Sleep Research Society (273) and the American Academy of Sleep Medicine (274) have called for the elimination of DST. Adopting a permanent standard time is proposed to protect health, sleep and circadian biology (275).

Evidence for or against DST may vary based on the outcome measure. For example, a study of 22,000 European elementary students identified no significant test score differences in math, science and reading in the week following the time change (276). Additionally, a systematic review of the impact of DST on traffic collisions found inconsistent short-term results (277). In 2020, an analysis of health insurance data from over 150 million people in the US and Sweden identified four modestly elevated risk clusters following daylight savings shift, including cardiovascular disease, injuries, mental and behavioural disorders and immune-related disorders (278). This is supported by a meta-analysis published in 2019, which identified a small but significant increase in the risk of myocardial infarctions following DST transitions (279). Daylight savings have been shown to cause acute sleep loss across the week of the change, and DST can affect sleep and neurological function in the short term after the change and throughout the period of DST (280). Overall, experts such as members of the Society for Research on Biological Rhythms published a position paper to argue that the benefits of permanent standard time outweigh those of DST (281).

It is however important to note that the benefits and harms of DST are not restricted to sleep/circadian rhythm and therefore a public conversation to address all the factors is needed.

7.4.5 Education

There is emerging evidence that education policies and practices can affect the sleep health of adolescents. As discussed earlier, as adolescents enter puberty they may experience a 'phase-delay' in their sleep-wake cycle with their sleep patterns changing to later sleep onset and wake times (231). Academic and social pressure coupled with school start times and associated commute times, mean

many students are not getting adequate sleep. Insufficient sleep in children and young people is associated with impairments of mood, memory, emotional regulation, mental health problems and physical health issues (228,229,231). Some countries have introduced later school start times to account for this, as detailed in section 7.4.3.

The national school curriculum does not currently include education about sleep (282). There is some evidence to support the impact of sleep education on improving sleep behaviours and outcomes among school-aged kids. For example, a randomised controlled trial in year 7 students from two urban schools found that students who underwent a Sleep Smart program had greater sleep health efficacy, improved sleep hygiene, more time in bed and earlier bedtimes compared to the control group (283). Other studies however have shown that changes to sleep patterns are difficult to achieve through education (284), but while the longer-term impacts of sleep education on sleep habits are unknown, there is broad agreement by researchers, parents, students and clinicians that sleep education should be included in general health education (285). This may support embedding sleep education into existing health curricula in schools to support sleep and related learning and education outcomes but not overload curricula.

7.4.6 Urban planning/light pollution

A series of Australian Standards and Technical Specifications guide local governments and other authorities (e.g. road, traffic) on how to design safe and effective lighting (286). For example, AS/NZS 1158 series specifies lighting for roads and public spaces, AS/NZS 4282 for Outdoor Lighting Obtrusive effects and AS/NZS 4282 sets guidelines for control of obstructive effects of outdoor lighting and gives recommended lighting limits so that the effects of light are tolerable (287). This standard is most relevant to new lighting installations and all new developments must comply with these standards.

These standards are implemented at a town or council level. For example, the City of Melbourne also has lighting guidelines that follow the key design principles present across these standards and include controlling lighting levels, minimising lighting spill, moderating glare and colour of lighting (288). The Victorian roads authority, VicRoads, also has guidelines for street lighting design which covers lighting in areas such as pedestrian facilities, airports, railway crossings, etc. (289). Lighting guidelines and design principles are primarily centred around safety, orientation and animal welfare (290). Although a submission to the Inquiry into Sleep Health Awareness in Australia highlights the impact of artificial light at night on sleep, sleep is not explicitly mentioned or targeted by existing lighting guidelines (291). Incorporating sleep as a consideration for designing outdoor lighting may become a planning policy consideration to improve population sleep quality. The UK House of Lords has conducted an inquiry into the effects of light and noise pollution on human health (292). The Inquiry reported that poorly regulated pollutants were affecting population-wide health and quality of life and that light and noise pollution were neglected pollutants that are causing significant health impacts. (293).

Chair of the House of Lords Science and Technology Committee, Baroness Brown said that the Inquiry had found that light and noise had substantial impacts on the population (294):

> *"Not only can they cause annoyance, impacting quality of life, but through the disruption of sleep and circadian rhythms, both noise and light pollution can contribute to heart disease and premature death."*

8 Measuring and monitoring sleep health

Sleep health should be measured and monitored across the population, as it is an important marker of social, mental and physical health and wellbeing (295). Validated sleep health measures and regular population-level data collection are essential to provide an accurate picture of sleep health in Australia. Currently, there is a lack of robust, comprehensive population-level data regarding the sleep health of Australians (296). The sleep data that does exist is drawn together from a patchwork of self-reported longitudinal surveys, academic research and cross-sectional cohort studies, and outdated Australian Health Survey data. There are various notable limitations associated with sleep data in Australia (296), including:

- Reliance on self-reported data – the majority of Australian sleep health data are based on self-report survey responses. Although self-report data is the standard to determine the presence of some sleep disorders (e.g. insomnia), reliance on solely self-report data to measure population sleep health may reduce data reliability and increase data bias, as many people may find it difficult to accurately estimate the quantity, quality and consistency of their sleep (296). When sleep is measured objectively with actigraphy (i.e. via a wearable, usually wrist-worn device), self-reported data has been found to underestimate sleep duration by up to one hour (297,298). Sleep health issues may also be underreported and underdiagnosed in certain populations, either due to a lack of knowledge and/or health literacy, or because respondents' misjudge the adequacy of their sleep (27,228,299).
- Different sleep health measures used in different studies – a wide variety of tools, indicators and metrics can be used to measure sleep health. This can make it difficult to compare data collected in different surveys due to a lack of consistency in how sleep is measured. These differences potentially contribute to discrepancies in prevalence estimates between data sources. For example, self-reported insomnia prevalence data estimates range from 5.4% when responding to the question 'I slept in short bursts only and was awake most the night' (150), to 33% when measured based on self-reported difficulty initiating and maintaining sleep (300).
- Prevalence estimates are largely extrapolated from research studies with non-nationally representative samples (either geographically or demographically) (296).
- Lack of Australian data on the relationship between sleep health issues and chronic conditions. The data that have been published regarding the complex and bi-directional interactions between sleep health and different chronic conditions are dated and limited in scope (295,296).
- Data is narrowly focused on sleep disorder prevalence, rather than on population sleep health across the entire sleep health spectrum (301).

Given these limitations and the lack of comprehensive, population-level Australian sleep health data, the actual prevalence and range of issues across the sleep health spectrum is difficult to ascertain.

Improved monitoring and improved surveillance of sleep health in Australia would provide reliable information for public health decision-making and planning. This would include data and statistics on:

- sleep health issues and associated health outcomes across the sleep health spectrum;

- modifiable sleep behaviours;
- reliable data on the prevalence of sleep disorders;
- risk factors and social and economic determinants for poor sleep;
- access to health care and support for individuals with poor sleep; and
- the estimated economic and social costs associated with poor sleep in the community (295).

Improved measuring and monitoring of sleep health would also inform public health information, reinforce the importance of sleep to overall health and wellbeing and enable policy and planning to respond to sleep health issues both in the population and in sub-population groups and communities.

8.1 Sleep health indicators and assessment

Sleep health is more than the absence of a sleep disorder or inadequate sleep (302). In keeping with this, emphasis needs to be placed on the positive role of sleep for health rather than just on the identification and treatment of disorders (19). Sleep health indicators and assessment tools should reflect this to ensure that sleep health data are comprehensive and robust.

Sleep health indicators are essential to track both sleep health and sleep disorder prevalence in the population to inform health policy, investment and service provision. The various dimensions and indicators of sleep health outlined in the sleep health conceptual framework (see *Figure 2* in section 5.2) provide relevant measures for both population health and primary care purposes.

Sleep health and habitual sleep patterns can be assessed through a variety of objective and subjective (i.e. self-report) methods (303). Commonly used sleep health assessment methods include:

- **Sleep diaries:** A sleep diary is a self-reported record of an individual's sleep habits and patterns that can be completed each morning after getting out of bed. It typically includes information such as bedtime, wake time, sleep duration, quality of sleep, and any factors that may have influenced sleep, such as caffeine consumption, sleeping pill use or exercise (303).
- **Sleep health and sleep disorder assessment tools:** There are various sleep health assessment tools available and in use in both clinical and research settings. These tools are used to evaluate particular aspects of an individual's overall sleep health (i.e. quantity, quality and consistency) and/or to assess the presence of possible sleep disorders. They are generally self-reported questionnaires that examine sleep disturbances and one or more dimensions of sleep health over a set time period. Some common assessment tools are discussed below and in the sections of this paper that follow (303).
- **Polysomnography (PSG):** PSG is a comprehensive sleep study conducted in a sleep laboratory or specialised clinic, or set up at home. It involves monitoring various physiological parameters during sleep, including brain activity (electroencephalography), eye movements (electrooculography), muscle tone, heart rate, and respiratory activity. PSG is considered the gold standard for diagnosing most sleep disorders and provides detailed information about sleep architecture and disturbances (11).
- **Actigraphy:** Involves the use of a usually wrist-worn device for measuring movement, which provides objective data that can be used to estimate sleep-wake patterns, sleep efficiency, and total sleep time. This includes consumer devices such as Fitbits, Garmins and Apple Watches. Some devices also capture light exposure and heart rate, providing further data for

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assessing sleep. Historically, actigraphy has been used mostly in research settings or as a complement to other clinical assessment methods. However, with consumer devices becoming more common and accessible, they could play a bigger role in population health data in the future. Actigraphy is not as rigorous as PSG, but it provides an inexpensive, portable, readily accessible and simple-to-use method of obtaining multi-night, objective, biometric data for sleep health assessment and monitoring (304).

Several survey scales or suites of indicators have been developed to measure or assess sleep health. The RuSATED scale is a self-report scale measuring sleep health using six dimensions of sleep. These are (302):

- **R**egularity: Do you go to bed and get out of bed at about the same times (within one hour) every day?
- **S**atisfaction: Are you satisfied with your sleep?
- **A**lertness: Do you stay awake all day without dozing?
- **T**iming: Are you asleep (or in bed) between 2:00 am and 4.00 am?
- **E**fficiency: Do you spend less than 30 minutes awake at night? This includes the time it takes to fall asleep plus awakenings during sleep.
- **D**uration: Do you sleep between 7 and 9 hours per day?

The Pittsburgh Sleep Quality Index was developed and validated for use in adults 18+ (305). An abbreviated form of this index assesses bedtime, sleep latency, sleep duration, sleep disturbances, use of sleep medication, daytime sleepiness and the presence of a bedpartner. A pitfall of this questionnaire (and many others) is that it does not distinguish between sleep on work/school days and non-work/school days, which are likely to differ.

Similarly, assessment tools have been developed to assess sleep hygiene or healthy sleep behaviours such as screen time in the 2-3 hours before bed, light exposure during the day and at night and the frequency of behaviours (nights per week). Existing assessment tools appropriate for use in adults include the Sleep Hygiene Index and the Pre-Bed Behaviour Questionnaire (307). For assessment of sleep hygiene in adolescents, available tools include the Adolescent Sleep Hygiene Scale (308) or children, the Children's Sleep Health Questionnaire assesses sleep health holistically, including items related to habitual sleep patterns, healthy sleep behaviours and symptoms of potential sleep disorders (309).

8.2 Sleep health data in Australia

Regular, routine collection and reporting of health indicators identifies trends over time in health risks and conditions in the population and health care needs and informs policymakers, practitioners, communities and organisations of the health pressures and concerns that are evident.

8.2.1 Existing data sources

While there is a lack of comprehensive data concerning sleep health in Australia, some data has been collected in several research studies. These include the:

- Australian Health Survey 2011-13 (310);
- Sleep Health Foundation Survey of Australian Adults (2016) (32);

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- Australian Longitudinal Study on Women's Health (237);
- Australian Longitudinal Study on Male Health (Ten to Men) (311);
- Household Income and Labour Dynamics in Australia Survey (158);
- 45 and Up Study (NSW) (312);
- 2017 National Social Survey (190);
- Men Androgen Inflammation Lifestyle Environment and Stress (MAILES) Study (313);
- Tasmanian Longitudinal Health Study (314);
- Australian arm of Burden of Obstructive Lung Disease (BOLD) Study (315);
- West Australian Pregnancy Cohort (Raine) Study (316); and
- Busselton Health Study (317).

Further details regarding these Australian studies that include data on sleep are in Appendix 2.

The Australian Institute of Health and Welfare (AIHW) referenced these and several single studies of sleep health in Australia in a 2021 report on sleep problems as a risk factor for chronic conditions (296). The 2019 Parliamentary Inquiry (17) also listed these studies as principal data sources on sleep in Australia.

Other governmental sources of sleep data that could be explored for the development of a comprehensive and coordinated sleep health data strategy include:

- Medical Benefits Schedule (MBS) data related to sleep;
- Pharmaceutical Benefits Schedule (PBS) data related to medications prescribed to treat insomnia and other sleep disorders; and
- diagnostic and procedure codes in hospital admissions data and outpatient data related to sleep disorders and poor sleep.

8.2.2 Population health data for public health information and planning

Population health surveillance provides a regular, detailed oversight of the health of all Australians. The Australian Institute of Health and Welfare (AIHW) provides regular reports on a range of health conditions including arthritis and back problems, asthma, cancer, chronic disease, chronic musculoskeletal conditions, respiratory conditions, dementia, dental and oral health, diabetes, eye health, heart, stroke and vascular diseases, mental health and osteoporosis (318). Data is also reported on population groups and on prevention and determinants of health, including factors that are relevant to sleep health such as alcohol consumption and physical activity; overweight and obesity. Currently, sleep health does not feature in Australia's major national health and social surveys. Population surveillance is particularly important for understanding the sleep behaviours and habits of vulnerable populations such as First Nations Australians, those living in rural and regional areas, those from culturally and linguistically diverse backgrounds, and those experiencing socioeconomic disadvantage.

The largest and most comprehensive health study to be undertaken in Australia, the Intergenerational Health and Mental Health Study (IHMHS) is currently being conducted by the Australian Bureau of Statistics (ABS) (319). The survey comprises seven component studies and is being undertaken over four years to 2024. A National Nutrition and Physical Activity Survey, underway through 2023, will collect information on health conditions, food intake, physical activity and the impact of sleep from

12,000 survey participants (320). Data from this study may provide national data on sleep that could be collected regularly through National Health Surveys (NHS). These surveys are usually conducted at intervals of three to four years and provide health statistics on long-term health conditions, mental wellbeing and health risk factors. These surveys, to date, have not included sleep health. The most recent NHS was conducted in 2020-21 (321).

8.2.3 Consumer devices and wearables – biometric data

Technology and wearables are increasingly important in the monitoring and diagnosis of sleep disorders. Wearable technology for consumer activity tracking is fast gaining popularity and many wrist-worn fitness trackers now have sleep tracking capabilities. A 2021 survey and report of Digital Consumer Trends conducted by Deloitte, an international consulting firm, reported that 58% of survey respondents tracked their fitness with a smartwatch, smartphone or fitness band and 25% of respondents used their device to track sleeping patterns (322).

While there may be potential benefits to individuals tracking their sleep, such as increased awareness and the potential to use personally collected data in health care and in health research, algorithm variability from device to device means the accuracy of the data individuals can provide is inconsistent. A recent study comparing commercially available devices to actigraphy against polysomnography showed that, many but not all commercial devices performed as well if not better than actigraphy at detecting sleep and wake times. However, the detection of sleep stages by these devices was often inaccurate (323). As well, without evidence-based information about sleep health, increased awareness could also contribute to individual anxiety about sleep. Orthosomnia is a term to describe an obsession with tracking sleep and being preoccupied with it in the pursuit of the best night sleep (324). Research has also shown that sleep feedback biases an individual's daytime symptoms associated with sleep (325).

8.2.4 Sleep health data in primary care

Effective health services planning and management depends on comprehensive health information about population health and the health needs of people.

The AIHW National Primary Health Care Data Collections are to 'fill a long-standing gap (…) in primary health care data for population health monitoring, research, policy and planning" (326). Data for these collections are provided through Medicare subsidy data for services provided by general practitioners, allied health and specialist health care providers and through other primary health care data collection.

The inclusion of measures across the sleep health spectrum, including sleep disorder diagnoses and treatments, in primary care data, would provide for regular reporting on sleep health concerns in Australia and would fill a substantial gap in contemporary information on this widespread health issue. It would also indicate the contribution of poor sleep to healthcare demand and to the burden of disease in the population and provide regular, timely data for health service policy and planning.

The three domains of the conceptual framework for sleep health discussed in section 5.2 – quantity, quality and consistency – provide high-level sleep measures for general sleep assessment in primary care. Routine collection of these sleep health measures and their indicators with respect to relevant

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patient concerns or clinical indicators would provide information on the pattern in primary health care of poor sleep presentations and of the links between poor sleep and other health conditions and of the volume of sleep disorder assessments and diagnoses.

Primary health care data collection should be based on standard and validated tools, such as the RuSATED scale or the Sleep Disorders Symptom Checklist-25 (SDS-CL 25) (327) which is designed to screen for sleep disorders in primary care. Data should be digitally linked to patient records for clinical purposes and de-identified and aggregated to fill the sleep health data gap in population health monitoring.

Similarly, data from the MBS and the PBS could provide information about the identification and treatment of sleep health issues in general practice and on the prescription of sleep medications.

8.3 Existing recommendations for sleep data

The 2019 Parliamentary Inquiry heard that there was limited funding support for studies on sleep to be undertaken on the data that had already been collected in a wide range of individual health studies (refer to section 9.2.1) (17). This means that potentially valuable insights into sleep health in the population and in particular population groups are unrealised.

The Inquiry also heard that there is a need for questions on sleep to be included in health services administrative datasets and that without this epidemiological studies on sleep were difficult to undertake in Australia. The Australian Epidemiological Association (AEA) submission to the Inquiry proposed that sleep health indicators should be included in routinely conducted population surveys to track the sleep health of the community. The AEA also urged data to be collected routinely on sleep behaviours as these are modifiable risk factors. Existing labour and social surveys that collect data on shift work should additionally monitor sleep behaviours and practices to provide national and occupation-specific information on current practice.

Specific data on the sleep of First Nations Australians and the sleep of children could be collected as part of national health surveys such as the Australian Bureau of Statistics' (ABS) National Nutrition and Physical Activity Survey and the National Aboriginal and Torres Strait Islander Health Survey (36).

Funding of a Sleep Health Monitoring Centre to provide cross-sectional and longitudinal data on sleep health and sleep disorders in Australia was recommended to the Parliamentary Inquiry. This could be similar to the Australian Centre for Asthma Monitoring (ACAM), a collaborating unit of the AIHW that was established in 2002 to establish a national system to track the prevalence and impact of asthma (328).

The Australasian Sleep Association and the Sleep Health Foundation have proposed that key data for effective population health surveillance of sleep health comprise (329):

- habitual sleep patterns;
- sleep hygiene or healthy sleep behaviours; and
- common sleep disorders and their symptoms.

9 Improving sleep health: population health and primary care approaches

Sleep health can be adversely affected by a wide range of factors, such as personal, social/study/work circumstances and/or by other social and economic aspects of a person's health and wellbeing (330). These factors can indicate risks for poor sleep and subsequently point to the most appropriate interventions that can be applied – either by individuals, through medical or non-clinical measures, or through health and other public policies and approaches that address environmental factors relevant to sleep health.

Whereas sleep health approaches have been and still are largely focussed on behaviours and risk factors related to individuals, both the underlying determinants of sleep health as well as the large population prevalence of poor sleep and its causes require a population and primary care focus.

9.1 Making sleep a population health priority

The extent to which healthy sleep is disrupted by societal and environmental changes and conditions is now being recognised, in workplaces and employment policies in particular (259). The lack of healthy sleep for growing proportions of the population is an increasing health issue. The evidence of the impact of poor sleep on the health of individuals and the evidence that poor sleep can often be prevented and healthy sleep can be better understood; makes it clear that poor sleep is a public health issue requiring a population health approach.

Consistent with increasing emphasis on the prevention of chronic health conditions, prevention of poor sleep and promotion of healthy sleep should become a focus. This would align with investments in reducing physical inactivity in the population and promoting the importance of physical activity for mental and physical health, social and economic participation (193) and with policy efforts to improve nutrition through Australian Dietary Guidelines and a national food standards code (331).

A public health approach to the prevention of poor sleep requires specific approaches for at-risk population groups (engagement of high-risk populations in sleep health information and support for engagement in healthy sleep behaviours) as well as promotion of sleep health as a preventive health measure through tailored health information and awareness raising strategies.

There is evidence that sleep is also a contributor to health inequalities (332) and could provide an opportunity for public health approaches that address health equity (333). Given the significance of sleep health for a range of health conditions and diseases, and the interaction of individual, social and contextual influences on sleep health, the application of a socioecological model to identify and address socioeconomic and other impacts on sleep health has been proposed with the potential to contribute positively towards improvement in overall health equities within populations. The authors of a recent paper propose the model in response to two significant developments in sleep science – evidence that substantial inequities in sleep parallel other racial, ethnic and socioeconomic disparities in other health outcomes and that determinants of sleep health go beyond the individual, encompassing socio-environmental influences as well. The authors propose that the potential for multiple levels of public health interventions, from targeting individual awareness and education,

demographically tailored strategies, through family or group specific interventions to community and societal strategies (*Figure 6*) (333).
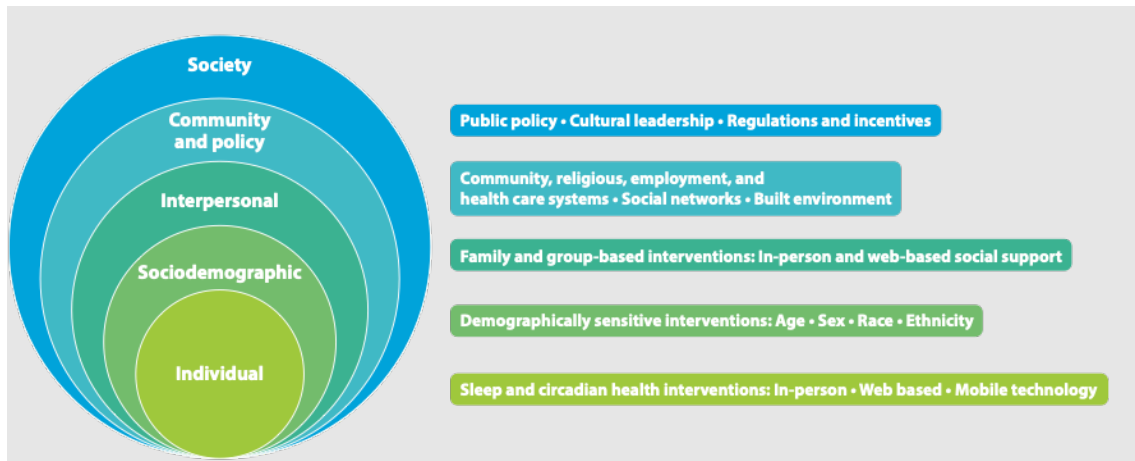
FIGURE 6: THE SOCIOECOLOGICAL MODEL OF SLEEP AND CIRCADIAN HEALTH WITH CORRESPONDING MULTILEVEL INTERVENTION STRATEGIES. (333)

9.1.1 Public awareness, information and education

Australia has a strong and long record of public health awareness campaigns that have successfully informed and influenced the awareness and consequent behaviours of a majority of Australians in response to evidence of significant health risks. These have included national campaigns to reduce sun exposure and sun-exposure-related cancers, campaigns to reduce tobacco consumption and others to prevent and reduce exposure to infectious diseases such as HIV-AIDS. Tailored and co-designed campaigns to raise awareness and engagement in priority population groups have been shown to be effective (334).

A national campaign to improve public awareness of the importance of healthy sleep to health and wellbeing was recommended by the 2019 Parliamentary Inquiry into Sleep Health Awareness in Australia (17). The Inquiry proposed that a campaign be undertaken to:

- promote sleep as foundational to positive health and wellbeing
- provide information and education about:
    o sleep hygiene and healthy sleep practices;
    o the relationship between sleep health and reduction in risk for preventable health conditions, impaired judgement and mental functioning, decreased productivity and performance; and
    o common sleep disorders and treatments.

The Australasian Sleep Association (ASA) and the Sleep Health Foundation (SHF) provided a detailed pre-Budget submission to the 2020-21 Australian Government Budget process proposing a national sleep health awareness and behaviour change campaign campaign (335). This proposed a five-year staged national campaign included several public awareness priorities including the need to:

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- Promote awareness of normal sleep requirements, including the variable needs between individuals across age groups and the consequences of inadequate sleep on wellbeing, mood, relationships, productivity and safety;
- enhance knowledge of the causes of inadequate sleep, including issues related to inadequate duration of sleep, inappropriate timing of sleep and quality of sleep;
- improve understanding of the nature of circadian misalignment and common sleep disorders such as obstructive sleep apnoea and insomnia, with emphasis on their mental health, cognitive and cardio-metabolic consequences;
- develop healthy sleep habits amongst Australian children and adolescents to optimise their emotional wellbeing, with a particular focus on mental health impacts and risk of suicide;
- support healthy sleep in older Australians, including the identification of sleep disorders, to improve physical and mental health and reduce rates of cognitive decline; and
- refine strategies to meet the challenges of shift work and associated mental, metabolic, physical and performance consequences (335).

9.1.2 Sleep health guidelines for individuals

Sleep health guidelines in this context are recommendations that aim to help people improve their sleep quality, duration and consistency. There are a number of guidelines that have been developed and disseminated by several agencies interested in promoting good sleep.

The guidance and advice generally provide similar recommendations, particularly for behavioural changes to improve sleep habits, for action to reduce modifiable risk factors adversely impacting sleep and advice to create good pro-sleep habits during the daytime (Table 4). The target population for these recommendations are individuals. For people with clinical sleep disorders, these recommendations are still good as an adjunct to their treatment but not sufficient on their own. Unfortunately, the evidence behind each individual sleep health recommendation is highly dependent on the population studied and is still quite limited.

TABLE 4: HEALTHY SLEEPING RECOMMENDATIONS HIGHLIGHTED IN A SELECTION OF ONLINE RESOURCES FROM ESTABLISHED HEALTH AGENCIES

Online Resource for sleep health information	Overview/inclusions
Sleep Health Foundation - Sleep Hygiene: Good Sleep Habits (113)	Advice including bedroom environment, light exposure, noise exposure, temperature regulation, sleep duration, sleep schedule, relaxation, electronic advice, diet, physical activity, food and beverage consumption, nicotine use, medication use
American Academy of Sleep Medicine – Sleep Education: Healthy Sleep Habits (336)	Advice including bedroom environment, light exposure, noise exposure, temperature regulation, sleep duration, sleep schedule, relaxation, electronic advice, diet, physical activity, food and beverage consumption, nicotine use

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CDC: Tips for Better Sleep (337)	Advice including bedroom environment, electronic exposure, food and drink avoidance and exercise
Mayo Clinic - Sleep tips: 6 steps to better sleep (338)	Advice including sleep schedule, relaxation, physical activity, bedroom environments, food and beverage, napping
Healthline: 17 Proven Tips to Sleep Better at Night (339)	Advice including light exposure, food and beverage consumption, nap advice, sleep schedule, supplement advice, bedroom environment, relaxation, physical activity,
Sleep Foundation (USA): 20 Tips for How to Sleep Better (340)	Advice including bedroom environment, light exposure, noise exposure, temperature regulation, sleep duration, sleep schedule, naps, relaxation, electronic advice, physical activity, food and beverage consumption, nicotine use,
HelpGuide: How to Fall Asleep Fast and Sleep Better (341)	Advice including circadian rhythm, sleep schedules, naps, diet, light exposure, electronic use, physical activity, food and beverage consumption, nicotine use, bedroom environment, temperature regulation, relaxation

In an umbrella review, Albakri et al. (111) documented what non-pharmacological sleep health interventions have been evaluated among healthy populations and described the target groups, settings, and the effectiveness of interventions tested to improve sleep quality and duration (111).

The researchers reviewed eleven intervention types including both population health level and individual interventions. These were:

- sleep education, behaviour change methods, relaxation techniques, physical exercise, mind–body exercise, aromatherapy and/or massage, psychotherapy, environmental interventions and later school start times.

Some of the studies reviewed also incorporated multiple interventions, making it difficult to isolate and attribute any observable sleep health improvements to a specific intervention type. For example, many interventions contain elements of sleep education that address factors in the sleep environment and reduce risk factors as part of a behavioural change program.

Of the intervention types reviewed by Albakri et al. (111), three provided the most evidence of effectively improving sleep:

- later school start times,
- behaviour change methods, and
- mind–body exercise.

Other interventions, such as sleep education, relaxation techniques, physical exercise, aromatherapy, massage, psychotherapy and environmental interventions also showed promising but inconsistent or limited results due to less rigorous study designs or the narrowness of selected target groups.

The National Health and Medical Research Council (NHMRC) supports the development of guidelines for clinical practice and public health among others. Public health guidelines are evidence-based and

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developed with the engagement of relevant stakeholders and are "intended to promote health, prevent harm and encourage best practice" (342).

At present, sleep is recognised in the 24-Hour Movement Guidelines for children and young people aged 0-17 years. This includes recommendations on time in hours spent asleep as well as time spent in physical activity and sedentary behaviour, recognising the co-dependent and time-based nature of physical activity, sedentary behaviour and sleep. The guidelines separately note that children should have:

- a consistent bedtime and wake-up time;
- avoid screen time for 1 hour before sleep; and
- not have screens in bedrooms to establish and maintain healthy sleep patterns (63,64).

The 2022-23 federal government budget (343) included provision for the development of 24-hour movement guidelines for adults and older Australians, integrating physical activity, sedentary behaviour and sleep. At present there are National Physical Activity Guidelines for adults 18+ years, but these do not include sleep recommendations and do not refer to priority populations or those with specific sleep-related needs. These 24-hour movement guidelines for adults 18+ are currently in development.

Whilst movement guidelines for adults as well as children would go some way to address the lack of attention to sleep in public health policy, the evidence summarised in this paper makes it clear that sleep should be recognised as the third pillar of good health, alongside physical activity and diet. Sleep health, diet and physical activity are closely interrelated and influence each other in various complex ways. Further research is required to better understand these interrelationships sleep, diet and exercise are central to overall health and wellbeing (78).

9.1.3 Sleep hygiene information and public education

Given the importance of sleep to health, concerns have been raised that insufficient sleep duration or quantity is not only pervasive but also increasing and inevitable in today's 24-hour society (344). Continual mass uptake of technologies relevant to sleep health, including artificial lighting, television, personal computers, smartphones and other screen-based devices, are all considered to contribute to poorer sleep (345,346).

Sleep hygiene as a set of recommended behavioural and environmental factors to promote healthy sleep could provide an information and actions 'tool-kit' for individuals and for the public for how to understand and enhance one's own sleep. Better Health Channel Victoria describes sleep hygiene as "healthy habits, behaviours and environmental factors that can be adjusted to help you have a good night's sleep" (21).

Promotion of sleep hygiene education as a public health prevention strategy would align with current preventive health objectives and has the potential to improve public awareness of the importance of sleep to health and wellbeing and address the growing public health concern about poor sleep in the general population. Investment in research to develop and evaluate a standard set of sleep hygiene recommendations could facilitate the use of sleep hygiene recommendations in Australian public health information and awareness strategies.

A review by Irish et al. (114) assessed the evidence to support the use of common sleep hygiene recommendations in public information and awareness of healthy sleep. The sleep hygiene recommendations investigated included common behavioural and environmental influences on sleep such as caffeine consumption, smoking, alcohol use, exercise, stress, noise, sleep timing, and daytime napping. The researchers found that each recommendation was supported by 'plausible physiological and psychosocial mechanisms" (114). A summary table of the findings from the review is in Appendix 3.

Multiple factors affect the prevalence, nature and impact of sleep-disrupting behaviours including age, gender, genetics, education, co-morbid health conditions, and social or occupational demand. For sleep hygiene recommendations to be used more broadly as a standard and comprehensive set of recommendations for the general population, research is required to identify behaviours that are most likely to benefit or inhibit an individual's sleep health and the influencing factors enabling or inhibiting those behaviours. This is especially important given the potential for sleep hygiene education to be a cost-effective, accessible and easily disseminated public health information resource (114). However, sleep hygiene information is not a sufficient stand-alone treatment for clinical sleep disorders, which are common in individuals experiencing poor sleep health. Consequently, the effective identification of individuals with clinical sleep disorders within the population is also critical, to ensure the provision of disorder-specific evidence-based treatments, with standardised sleep hygiene advice as a possible adjunct treatment. Activities aimed at improving population awareness of sleep disorders and their symptoms and how to access appropriate diagnostic services could also be effective.

9.1.4 Population sleep health surveillance and data requirements

Population health data that include both cross-sectional and longitudinal data provide evidence for appropriate policy responses and health programs that are effective at helping people stay healthy (347). Given the evidence that sleep is one of the three most significant influences on good health and a key contributor to poor health and preventable disease, it is evident that sleep should be included in routine population health data collections, particularly National Health Surveys.

Questions in a National Health Survey should reflect the three domains of sleep health – quantity, quality, consistency – and sleep disorders prevalence. The potential focus areas and example survey questions for a minimum recommended dataset for the population surveillance of sleep, which align with the three domains of sleep health, are outlined below:

1. Sleep quantity/ duration – How much sleep (in hours) do you usually get a night?
2. Sleep quality – How would you rate the quality of your sleep overall? Very good, good, average, poor or very poor.
3. Sleep consistency:
   - Sleep timing – What time do you usually go to bed and what time do you usually wake up?
   - Sleep regularity – Do you go to bed and get out of bed at about the same times (within one hour) every day?

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Policy evidence review. Mitchell Institute, September 2023.

Further information could also be sought on sleep hygiene and bedtime behaviours, previously diagnosed sleep disorders, napping frequency (particularly for population groups at increased risk for poor sleep) and sleep patterns broken down by work/school days versus free days (weekends).

Biometric data on sleep should be included in biometric surveys such as the most recent National Health Measures Survey. This could be undertaken by including the provision of validated biometric tools such as actigraphic wearable devices and/or the provision of data by survey respondents from personal devices such as smartphones, smart watches or other appropriate personal electronic devices.

The establishment of a National Sleep Health Monitoring Centre would enable more effective use of existing data on sleep, currently collected through a range of longitudinal health and wellbeing surveys in Australia and would enable integration of existing data sources to improve monitoring of the prevalence and impact of sleep health and sleep disorders.

9.2 Improving sleep health through primary health care

Primary health care, as the entry-level to health care, encompasses a broad range of health services, from health promotion and prevention to treatment and management of acute and chronic conditions (348). Primary care includes general practice, community health centres, maternal and child health services, community pharmacy, community mental health services, oral health and allied health services, Aboriginal community-controlled health services and drug and alcohol treatment services (349).

Prevention is an important activity in primary health care, especially general practice because the partnership between general practitioners (GPs) and their patients can help people improve their health and reduce preventable chronic health conditions. Preventive primary health care is also crucial in addressing the health disparities experienced by vulnerable population groups. Preventive health care includes "the prevention of illness, the early detection of specific disease, and the promotion and maintenance of health" (260).

The role of primary health care in preventive health care and illness care was dramatically emphasised through the COVID-19 pandemic and preventive health activities through primary health care were central to the national response (350). The symptoms, causes and effects of sleep health concerns are broad and the prevalence of poor sleep and sleep disorders in the population is high – with 65.9% of adult survey participants having reported at least one sleep symptom such as trouble falling asleep or staying asleep, affecting their health and wellbeing (95). This indicates the need for a strong preventive health and early intervention focus in primary care, especially general practice, on sleep health and particularly on the risk factors for poor sleep in high-risk population groups and the risk factors arising from poor sleep for other health conditions.

This section on primary care will focus primarily on general practice and the opportunities and responsibility for the identification and management of sleep health issues. However, other areas of primary care could and do have a role in sleep health (351,352).

9.2.1   Sleep as a health issue in primary care

A number of recognised risk factors for preventable chronic disease are also risk factors for sleep problems - these include being overweight or obese; being physically inactive; drinking too much alcohol and smoking (353,354). Known as modifiable risk factors – that is, risk factors that are capable of being modified through early interventions and support – routine assessment of sleep health in response to these risk factors could be effective in enabling early intervention for poor sleep as well as for other health conditions. Regular health checks for adults are recommended for modifiable risk factors for broader disease prevention and better health (e.g., diet, weight, physical activity, alcohol use, smoking) (355). These checks are to identify current or emerging medical problems, assess the risk of future medical issues and prompt individuals to maintain a healthy lifestyle. Current advice regarding health checks does not include sleep as a risk factor for poor health and preventable disease (355). A Medicare rebate is provided for a GP health assessment for people aged 45-49 years who are at risk of developing chronic disease with the risk factors including lifestyle risk factors such as smoking, physical inactivity, poor nutrition or alcohol use (356).   Given the evidence of the contribution of sleep health to preventable chronic disease, poor sleep should be included as a risk factor in these health assessments.

A life-course approach to the prevention of chronic disease is promoted by the World Health Organisation (WHO) as it provides the opportunity to prevent diseases at key stages of life from preconception through pregnancy, infancy, childhood and adolescence, to adulthood (357). The recognition within Australian primary health care services and practices of healthy sleep as an important part of infancy, early childhood and development through adolescence as well as for ageing adults makes the absence of concern for sleep health in adulthood somewhat of an anomaly.

9.2.2   Prevention and early intervention in primary care

The Royal Australian College of General Practitioners (RACGP) promotes and supports evidence-based preventive health care in general practice through the Red Book, *Guidelines for preventive activities in general practice*, which also notes that this approach remains underused. Integrating a preventive health approach into primary care was identified as a priority to ensure the continuity of care for chronic health conditions within the *National Strategic Framework for Chronic Conditions* (358). It is recognised as effective in preventing disease not only amongst individuals but within whole local communities, reducing healthcare costs and improving the health and productivity of the population (359).

Evidence-based prevention through risk factor management is supported by the RACGP Smoking, Nutrition, Alcohol, Physical Activity (SNAP) guide, a resource to 'assist GPs and practice staff (the GP practice team) to work with patients on (these) lifestyle risk factors' (360). The SNAP guide provides a 5-step model of health care, the 5As, for GPs to: ask, assess, advise, assist and arrange; for detecting, assessing and managing risk factors (360). The SNAP guide does not currently include sleep.

The Healthy Habits website and mobile application is an initiative by the RACGP in partnership with the Australian Government Department of Health and Aged Care. It is an evidence-based behaviour change intervention that uses the same 5As model as the SNAP guide above. This contains 'information, programs, guidelines and training opportunities on physical activity, nutrition and other factors that impact these behaviours such as sleep, mental wellbeing, alcohol consumption, and

chronic conditions' (361). The program has received additional funding and is presently being expanded to include information on sleep and its relationship to physical activity and nutrition.

Supporting prevention

In Australia, most preventive activities in primary health care are 'opportunistic', that is, patients present for a reason that is not connected to the preventive health activity which is then 'added on'. The RACGP suggests that GPs should provide both opportunistic and proactive preventive care at a range of levels, including primary (i.e., preventing the initial occurrence of a disorder) and secondary prevention (i.e., identification of and intervention in established risk factors and early disease (362).

Contemporary evidence of the prevalence of poor sleep in the population makes it clear that poor sleep health in adults should be included in the suite of modifiable risk factors for preventable chronic diseases, in the RACGP SNAP guide as well as the Healthy Habits website and mobile app. Assessment of at-risk individuals for sleep health risk and sleep disorders in primary care, with relevant treatment options and referral pathways, could improve population sleep health, reduce preventable sleep disorders and improve health outcomes in established sleep disorders.

The capacity of general practice and general practitioners to identify and intervene in poor sleep health would be enhanced through the provision of sleep health resources together with education and awareness-raising strategies. These would provide GPs and general practices with contemporary evidence on sleep health, risk factors for poor sleep and poor sleep risk for other health conditions and high-risk behaviours together with information on management options and referral pathways.

The current outreach GP education activities associated with projects delivered by the National Centre for Research Excellence (CRE) at the National Centre for Sleep Health Services Research provide evidence of the benefit of GP education in sleep health and a formal GP outreach program with investment should be considered (363).

9.3 Assessment for sleep health risks and for at-risk population groups

Potential risk factors for poor sleep include individual characteristics such as age, gender; lifestyle factors, medication/medical factors and sleep health/sleep environment factors (364). These risk factors could also be used as indicators, in the primary care setting, that assessment of a person's sleep health as a contributor to their overall health, could be considered (refer Appendix 4). For example, lifestyle-related risk factors for a possible sleep disorder include high BMI, smoking and alcohol consumption and also have been shown to include consumption of caffeine after 3pm (364). Other indicators of risk of sleep problems include medications that impact sleep directly or as a side effect, treatment for depression, diabetes, cardiovascular disease or rhinitis/sinusitis (364). Specific occupations, co-morbidities and life stages can present risks for sleep problems. Older age and male gender are risk factors for Obstructive Sleep Apnoea (OSA) (365). The presence of these risk factors could be used to indicate subsequent assessment of an individual's sleep health. As discussed elsewhere, groups such as shift workers, women experiencing menopause, pregnancy, children and young people and individuals with depression are particularly at risk for sleep concerns and people in these groups should be considered for routine assessment of their sleep health.

9.3.1 Sleep health risk factors

Specific sleep-related issues include trouble falling or staying asleep, snoring or gasping when waking or experiencing abnormal events during sleep (366,367) and should prompt further investigation. People with a history of sedative-hypnotic use (e.g., benzodiazepines, "z-drugs", melatonin, etc.) on medical records could be investigated for symptoms of insomnia.

Importantly, poor sleep and its consequences can also manifest as a result of other health conditions. For example, conditions such as thyroid dysfunction or anaemia can disrupt sleep (368,369). While some sleep problems can be side-effects of other health conditions, they should be investigated in their own right as co-morbid sleep problems (370).

Individual variability in sleep needs and behaviours can mean that individuals with poor sleep may not present with typical risk factors. Reliance on specific indicators to trigger assessment may fail to capture sleep concerns at an early stage. Routine assessment in primary care of at-risk groups and people with known risk factors for sleep health may be most appropriate (371). Issues not directly sleep-related such as impaired attention, mood disturbances, headaches and worsening of a comorbid illness (186) may also indicate a potential need for assessment for a sleep disorder. Importantly, there is significant overlap between risks for sleep health/symptoms of poor sleep and other clinical conditions, particularly depression where up to 90% of people with depression report sleeping difficulties (167). These sleeping difficulties can be effectively treated with behavioural therapies such as Cognitive Behavioural Therapy for Insomnia (CBTi), discussed below in section 10.3.3.1.1. Treatment of sleeping difficulties through CBTi can also improve depressive symptoms (171).

Routine assessment in general practice would be based on the use of a validated tool assessing sleep duration, sleep quality, sleep consistency and daytime alertness, such as RuSATED, and the absence of a sleep disorder in individuals (302). The use of an assessment tool and initial conversations around sleep quantity, quality and consistency could identify sleep problems that may be transient or persistent sleep disturbances and sleep concerns that require further follow-up investigations for sleep disorders such as OSA or chronic insomnia.

The RuSATED tool, explained in section 9.1, is a validated instrument for the assessment of sleep health among adults (302). The conceptual framework of quality, quantity, consistency and associated dimensions presented in section 5.2 is an extension of the RuSATED tool.

9.3.2 Sub-clinical sleep concerns and risk factors – options for intervention

When an individual is expressing transient or persistent sleep disturbances that do not meet diagnostic criteria for a sleep disorder, options for intervention include patient information and education about sleep hygiene to promote healthy sleep. If transient or persistent sleep disturbances are caused by an obvious trigger, for example, acute pain, stress at work or bereavement, sleep usually returns to normal after the trigger has subsided. Identification and management of this trigger, if necessary, can help to alleviate transient sleep problems. In a small number of cases, the symptoms can persist and become maintained by sleep-related behavioural and psychological perpetuating factors.

The insomnia 3P model, a framework to describe the development and maintenance of insomnia using the predisposing, precipitating and perpetuating factors of insomnia, discussed in detail in 10.3.3.1, is

a useful, transferable framework for practitioners to understand the predisposing, precipitating and perpetuating factors in persisting sleep symptoms. In these cases, and if the symptoms meet the threshold for insomnia diagnosis, non-pharmacological treatments, including CBTi and Brief Behavioural Therapy for insomnia (BBTi) can be appropriate. These are discussed in section 9.3.3.1.1. Identification of other sleep disorders should involve appropriate management and referral as indicated in clinical guidelines.

Sleep hygiene assessment and education may be an appropriate resource in response to transient sleep disorders. Sleep hygiene education includes information about the impacts of a person's sleep environment and behaviours on sleep. Sleep hygiene advice, from a GP or other health professional, can include:

- prioritising sleep;
- reducing caffeine and alcohol consumption;
- avoiding electronics and bright lights in the hours before bed;
- establishing a consistent sleep/wake cycle;
- creating a nighttime routine to wind down;
- being physically active;
- having plenty of exposure to natural light during the day; and
- creating a bedroom environment conducive to sleep i.e. cool temperature, comfortable bedding and low or no noise (372).

However, individual beliefs, emotional stress and willingness to change need to be considered and sleep hygiene recommendations should be tailored to individual needs (373).

For individual patients with transient insomnia that is causing significant distress or daytime impairment, over-the-counter (OTC) medications are considered adequate for dealing with occasional episodes of sleeplessness, but not suitable for long-term use (i.e., not recommended for >4 weeks, including intermittent use). Most OTC medications contain antihistamines which, in addition to potentially resulting in grogginess, dry mouth or feeling unwell the next day, can result in the development of a tolerance making them ineffective to aid sleep over time. A synthetic version of Melatonin, the hormone that plays a role in the body's circadian rhythm, is used to treat jetlag, delayed sleep-wake phase disorder and some sleep disorders in children but is not considered to have enough evidence of effectiveness or safety to be used (372). Melatonin, commonly sold as Circadin in Australia, is available OTC for people aged over 55 and by prescription for those younger (374). As an exception, evidence supports the use of melatonin in young people with Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) as a safe and acceptable sleep support for neurodiverse young people (57,375).

Available evidence indicates that prescription of sedative-hypnotics for people complaining of sleep disturbances is high, with 90% of those reporting sleep disturbances in recent years being given a prescription for a 'sleeping pill' (376), suggesting that there are barriers to provision of or access to other forms of evidence-based prevention and early intervention measures.

9.3.2.1 Potential referral options for sub-clinical sleep health concerns

Some interventions showing potential to improve sleep health could be provided through other primary care settings. The intervention types reviewed by Albakri et al. (111) which provided the most evidence of effectively improving sleep health, particularly behaviour change methods and mind–body exercise, could be accessed through referral to other primary care or community-level providers. Community pharmacy is one example of a potential referral option for the management of sleep issues. Other options for referral pathways for sleep health concerns that are possible but not yet readily accessible in Australia include social prescribing and health coaching.

Community pharmacy

Community pharmacies and pharmacists provide easily accessible health services for many individuals and are well-placed the provide prevention and management of health risk factors and chronic diseases. A systematic review examining the role of pharmacists in supporting sleep health and managing sleep disorders found that pharmacists can have a role in 'deprescribing' or managing and tapering medications, collaborating with other health professionals in team care arrangements and educating patients (377). The review found that this could result in quicker access to treatment for patients, decreased health expenditure and increased patient awareness of sleep disorders (377). One Australian study that looked at GP attitudes to embedding non-dispensing pharmacists in general practice found overall willingness by GPs to utilise pharmacists in insomnia management, although barriers to this include infrastructure, funding and perceived patient attitudes (378).

Social prescribing is a referral network that bridges the clinical and community sectors by connecting patients from primary care to non-clinical services that meet social, practical or other needs that affect their health and wellbeing (379). Social prescribing is being developed systematically in the UK and Ireland as a component of health care (380,381). In Europe and the USA, it is developing in some communities and health services through local leadership and initiatives. Social prescribing programs in Australia are limited and are either local initiatives in communities or health services or limited state government pilot programs. In the context of sleep and preventive health, social prescribing could be considered as a means to provide individuals with access to services in their local area that could help with risk factors affecting their sleep.

Health coaches use tailored health education and health promotion to improve an individual's health and well-being and help them achieve health-related goals. Health coaching takes into account an individual's stage of change to support them in building self-confidence and self-efficacy for change as well as education about the right changes to make. This approach is based on the Transtheoretical Model (TTM) of change, also known as the Stages of Change Model, a theoretical framework developed by psychologists James Prochaska and Carlo DiClemente to describe the process of behaviour change. Health coaching is a component of lifestyle medicine, a relatively new approach to prevention and management of chronic health conditions (382). Health Coaches Australia and New Zealand Association (HCANZA) is a membership association aiming to advance health coaching in the region. HCANZA accredits health coaching courses/programs and advocates for the development of standards accepted by the government, the medical field and universities and other training providers. As of 2020, there were only 40 HCANZA-qualified health coaches in Australia (383) limiting their impact on a larger scale.

9.3.3 Sleep disorders

When a GP has determined that an individual requires further investigation of sleep health and for the presence of a sleep disorder, various assessment tools are available. The <u>Sleep Health Primary Care Resources website</u> was launched by the Australasian Sleep Association (ASA) in December 2022. The website was developed as part of the funding from the National Health and Medical Research Council (NHMRC) for the National Centre for Sleep Health Services Research (NCSHSR): Centre for Research Excellence's (CRE). The website hosts "evidence-based information to assist primary care practitioners involved in the assessment and management of adult patients with obstructive sleep apnoea and chronic insomnia/insomnia disorder" (384).

When assessment indicates that an individual has a sleep disorder, there are a number of clinical pathways for further diagnosis, treatment and management options. These will vary depending on the individual, the potential disorder and any underlying or co-morbid conditions.
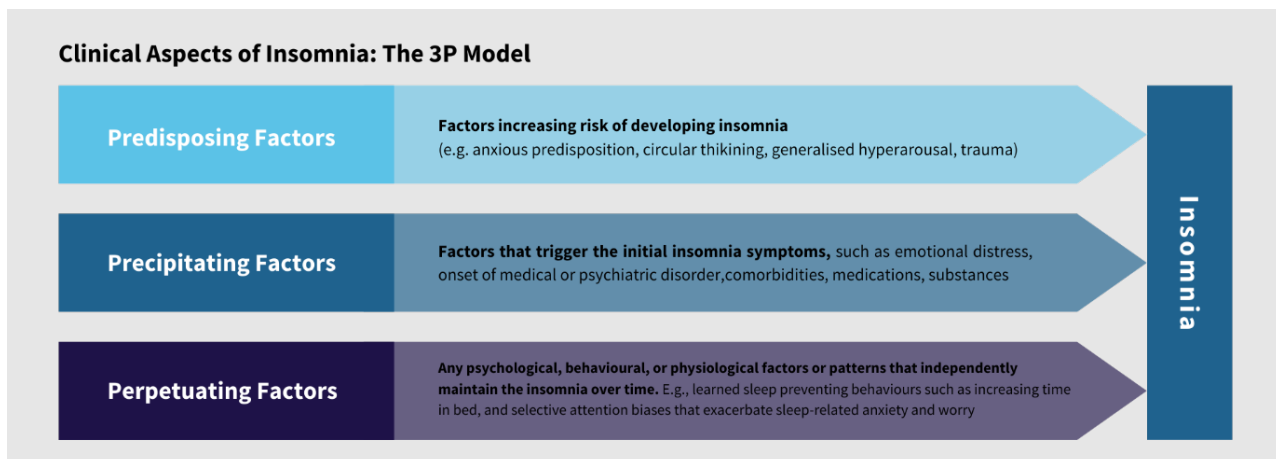
9.3.3.1 Chronic Insomnia assessment and treatment

Chronic Insomnia has both night-time and day-time features and is characterised by complaints about sleep quality and/or duration such as trouble falling asleep, staying asleep or frequent waking (84). Chronic Insomnia is a complex sleep disorder that is diagnosed by a combination of history and questionnaires, i.e. it is a subjective assessment. The Sleep Primary Care Resources website of the Australian Sleep Association recommends several insomnia questionnaires. These include:

- Insomnia Severity Index (ISI);
- Dysfunctional Beliefs and Attitudes About Sleep (DBAS) Scale;
- Pittsburgh Sleep Quality Index (PSQI) which is useful for sleep health and disorder symptoms;
- Sleep Condition Indicator (SCI);
- Daytime Insomnia Symptom Scale (DISS); and
- Flinders Fatigue Scale.

Chronic Insomnia can be managed in general practice or an individual with insomnia can be referred for psychological therapy. Chronic insomnia is listed in the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), the guide for diagnostic criteria of mental disorders. Diagnosis of insomnia therefore meets eligibility criteria for Medicare subsidised referral to a psychologist under the Better Access Initiative (385,386).

The 3P Model of insomnia (*Figure 7*) was first described by Spielman et al. in 1987 (387). Also known as the behavioural model, the predisposing, precipitating and perpetuating factors (i.e. 3Ps) have been used to describe the development and maintenance of insomnia. Predisposing factors refer to long-standing genetic, environmental, social or psychological factors that predispose to insomnia. Precipitating factors describe the specific event or situations (i.e. stress, grief etc.) that lead to the onset of initial symptoms. Perpetuating factors describe the maladaptive behaviours such as daytime napping, drinking excess caffeine or catastrophising which, over time, are counterproductive to sleep and maintain insomnia independently of the initial precipitant (146).

Clinical Aspects of Insomnia: The 3P Model

Predisposing Factors — Factors increasing risk of developing insomnia (e.g. anxious predisposition, circular thikining, generalised hyperarousal, trauma)

Precipitating Factors — Factors that trigger the initial insomnia symptoms, such as emotional distress, onset of medical or psychiatric disorder,comorbidities, medications, substances

Perpetuating Factors — Any psychological, behavioural, or physiological factors or patterns that independently maintain the insomnia over time. E.g., learned sleep preventing behaviours such as increasing time in bed, and selective attention biases that exacerbate sleep-related anxiety and worry

Insomnia

FIGURE 7: 3P MODEL OF INSOMNIA (ADAPTED BY KHULLAR, 2020)

Treatment and management options for chronic insomnia include (372,389):

- Cognitive Behavioural Therapy for Insomnia (CBTi), the recommended 'first line' treatment for insomnia that is generally provided by a psychologist with specialist training.
- Brief Behavioural Therapy for Insomnia (BBTi), a short form of CBTi that may be provided by a general practitioner or primary care nurse with appropriate training.
- Digital CBTi (dCBTi) programs, self-guided interactive online programs that allow people to self-administer CBTi through mobile/computer devices, may be an appropriate way to scale access to CBTi as additional clinicians are being trained.
- Pharmacological treatment - for a short-term, with consideration of risks/dependence profile, with a cessation plan in place, and only if CBTi is not available or has been attempted and is not effective.
- Adjunct therapies that include stress reduction, changing sleep habits, addressing underlying medical conditions and bright light therapy can be used in addition to CBTi.

9.3.3.1.1 COGNITIVE BEHAVIOURAL THERAPY FOR INSOMNIA (CBTI)

Cognitive behavioural therapy for insomnia (CBTi) is an evidence-based non-pharmacological treatment for insomnia. It uses a structured approach to identify and address thoughts and behaviours that maintain insomnia. The program is generally delivered by a psychologist with specialist training over 6-10 weeks. The therapeutic components focus on targeting specific attitudes and beliefs that promote dysfunctional sleep (390).

CBTi provided by a specialist psychologist is recognised as the 'gold standard' treatment for insomnia. CBTi is supported by hundreds of clinical trials, more than 30 meta-analyses, and evidence-based guidelines from leading sleep, primary care, and medical organisations worldwide (391–393). Despite this evidence, only approximately 1% of Australian adults with insomnia currently access this treatment (376). While CBTi is considered first-line treatment, pharmacological treatment, mainly sedative-hypnotics, are also used. These are recognised as having a range of side effects and to have addictive properties (Miller et al., 2017).

Brief behavioural therapy for Insomnia (BBTi) is a short-term (4-5 session) treatment program that has been proposed as an intervention in Australian general practice. It is a distilled version of CBTi that

can be delivered by GPs or practice nurses with minimal additional training. It includes general sleep education, bedtime restriction therapy and stimulus control therapy (394). Sweetman et al. (168) have developed a step-by-step model for BBTi delivery by GPs in the Australian context.

dCBTi programs are online self-guided resources that are a translation of therapist-delivered CBTi. dCBTi has the potential to rapidly scale access to this evidence-based treatment for insomnia throughout Australia, while additional clinicians are being trained. Various forms of dCBTi are available, some as a stand-alone treatment and others as a supplement to practitioner-delivered CBTi. Some programs are generic and others are interactive (tailored to each patient's presenting symptoms).

CBT-I Coach is a generic, free app designed to supplement face-to-face-CBTi. Generic (static) online programs such as This Way Up's *Insomnia Program* and A Mindful Way are designed to be administered with or without clinician support.

Interactive self-guided digital CBTi programs, such as Sleepio and Somryst, tailor treatment recommendations to each patient's presenting symptoms and changes in symptoms during treatment but are not available in Australia.

CBTi programs, including BBTi and dCBTi, are most suitable for patients with insomnia symptoms that are maintained by sleep-specific psychological and behavioural perpetuating factors (168). For example, patients who spend more time in bed than is necessary in the hopes of acquiring more sleep may unintentionally reinforce patterns of 'conditioned insomnia', in which the bed/bedroom environment becomes a stimulus for wakefulness, alertness, and anxiety. Sleep-specific anxiety/avoidant behaviours, strongly held maladaptive beliefs, or safety behaviours (e.g., cancelling daytime obligations after a poor night of sleep) are all perpetuating factors of insomnia that may indicate treatment with CBTi (146).

Treatment options for the management of insomnia in general practice are currently limited. Although a full 6-8 session CBTi program is the most effective treatment for insomnia, the required program of weekly 30-60 minute sessions makes it incompatible with current general practice arrangements (395). Upskilling of practice nurses and other allied health professionals to deliver insomnia treatments such as BBTi and CBTi and appropriate pathways and remuneration options for patients to access these are needed.

Psychologists are well-placed to deliver CBTi. The Better Access Initiative, a Commonwealth program that gives eligible people Medicare-subsidised access to mental health care, provides for GPs to refer patients to psychologists and other allied health professionals for the management of insomnia under a Mental Health Treatment (396). This referral option is limited for some patients by the common requirement for a further gap payment, in addition to the subsidy, to the provider. Similarly, a Chronic Disease GP Management Plan and Team Care Arrangement can provide an individual with up to five allied health services. Like the Better Access Initiative, services often require a further gap payment. First Nations Australians are eligible for a Health Assessment from their GP which may provide a further five subsidised allied health services (397). Five sessions (or ten with a Health Assessment) with an allied health provider may not be adequate to deliver a CBTi or similar intervention for insomnia or other sleep issue.

These referral options are also limited by the number and distribution of psychologists who are trained in the provision of CBTi. In 2021-22, the Australasian Sleep Association (ASA) audited the number of psychologists trained in sleep therapy in Australia and found fewer than 70 psychologists who specialise in the delivery of CBTi. Most of these psychologists reported they spend part of their time conducting research, leading to an estimate that there are approximately 30 full-time equivalent psychologists providing sleep therapy in Australia. There is presently no formal recognition of psychologists who specialise in sleep therapy.

Since 2015, the Australian Psychological Society (APS) has provided a 32-hour text-based online education program for psychologists on sleep health and sleep disorders. The ASA and the APS are working collaboratively to develop CBTi education resources and programs for psychologists (398), including the development of an online CBTi education training program, with the aim of having 200 psychologists complete the training each year (399). This work is supported by the ASA through a Federal government health peak bodies grant and is part of an initiative of the National Centre for Sleep Health Services Research (NCSHSR) in collaboration with the Sax Institute, Sydney to improve access to CBTi throughout Australia (399). In addition to CBTi training for psychologists, the program aims to develop a pathway for Australians to access an evidence-based digital CBTi (dCBTi) program, Bedtime Window, and to provide training for GPs in identifying, assessing insomnia and managing/referring patients for CBTi. Bedtime Window is currently being tested in three Randomised Controlled Trials throughout Australia with promising early results.

Policy and funding recognition of CBTi and related interventions, as a routine treatment for a common health problem that has significant physical and mental health implications, would facilitate greater uptake of this treatment option. These options would include: funding provision for access to self-guided digital CBTi programs for sleep health,

- funding provision for access to self-guided digital CBTi programs for sleep health;
- explicit inclusion of CBTi for sleep health in referral options under the Better Access Initiative. This would improve access to services for individuals and would support growth in the clinical workforce that is trained and qualified to deliver CBTi therapy for sleep health; and
- MBS support for the delivery of BBTi for sleep health in the general practice setting through a health care plan.

9.3.3.2 Obstructive Sleep Apnoea (OSA) assessment and treatment

Obstructive Sleep Apnoea is defined by the presence of recurring episodes of partial or complete collapse of the upper airway while sleeping, which results in reduced or absent airflow for at least 10 seconds and is linked with cortical arousal and/or a fall in blood oxygen (400).

The 9th edition of the RACGP Guidelines for preventative activities in general practice — 'Red Book' (260) — removed recommendations for screening for OSA in asymptomatic people due to its unproven benefit in the general population (401). However, a 2021 qualitative analysis explored the attitudes and experiences of Australian GPs on primary care management of OSA and found that GPs are integral to recognising OSA symptoms and facilitating diagnosis and management by specialists (402).

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The Sleep Primary Care Resources website recommends various questionnaires for assessing an individual's risk of OSA. These include:

- Epworth sleepiness scale (ESS)
- OSA50 Questionnaire
- STOP-BANG Questionnaire

A score of eight or more out of 24 on the ESS and either five or more out of ten on the OSA50 or three or more out of eight on the STOP-BANG qualifies a patient for a Medicare rebate for home-based or laboratory-based study and/or referral to a sleep disorders specialist physician (403). Home-based and lab-based polysomnography (PSG) studies assess brain, ocular, muscle and cardiac electrical activity with respiratory markers like blood oxygen levels, airflow and respiratory effort while sleeping to diagnose sleep disorders including OSA (Rundo & Downey, 2019).

OSA is primarily managed by a sleep specialist. However, access to sleep specialists for OSA assessment and management is difficult with long waiting lists, some out-of-pocket costs and a lack of local services particularly in rural and remote areas (Grivell et al., 2021).

Treatment and management options of OSA include (372):

Within primary care:

- weight reduction
- positional therapy (aids, like pillows or alarms to keep someone sleeping on their side)

By referral to specialist care:

- Positive airway pressure devices (e.g. continuous positive airway pressure (CPAP))
- Oral appliances (mandibular splints)
- Positional therapy
- Surgery
- Neuro-stimulation therapy
- Pharmacological treatment

9.4 Primary care pressures and capacity to improve sleep health

Primary care, particularly general practice, is experiencing unsustainable pressures in Australia. The COVID pandemic has accentuated both health care demand and workforce and service capacity pressures on the overall health system and particularly on primary care. Deloitte Access Economics has forecast a GP shortfall of 11,392 by 2032 (Deloitte Access Economics, 2022).

Management of sleep disorders by GPs is additionally constrained. A 2021 qualitative analysis explored the attitudes and experiences of Australian GPs on primary care management of OSA (Grivell et al., 2021). It found that, while GPs are integral to recognising OSA symptoms and facilitating diagnosis and management by specialists, the lack of available services, pathways and the added cost to the patient, particularly in rural or low socio-economic areas meant many could not access the appropriate care. Additionally, GPs also see their role in managing OSA as limited (Grivell et al., 2021).

A 2021 qualitative analysis by the same group on primary care management of chronic insomnia by Australian GPs highlighted the funding and time constraints for appropriately managing chronic

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insomnia in the primary care setting (Haycock et al., 2021). GPs reported very limited access to CBTi treatment/referral options. Despite CBTi being the recommended 'first line' treatment for insomnia, only 1% of general practice patients with insomnia were found to have had access to CBTi from a psychologist (Miller et al., 2017) while pharmacological intervention is the most common insomnia management tool by General Practice. Between 2000-2015, 90% of those complaining of sleep disturbances were prescribed medication, suggesting an over-prescription of pharmacological interventions (376,404).

Healthcare provider education on sleep within training programs is limited. A coordinated sleep health education program for healthcare provider training programs, continuing professional education and clinical guidelines of evidence-based practice has been proposed (405).

Inclusion of sleep in the RACGP SNAP guidelines, together with a strong platform of GP information and resources on sleep health and sleep disorders, will support general practitioners to address sleep health as a core component of preventive health care and a prevalent health concern for a majority of the adult population.

The potential to better detect and manage sleep health in primary care could be developed through targeted funding support for:

- a multidisciplinary team, including primary health care nurses, pharmacists, psychologists and other allied health, within primary care could provide practice-based care such as BBTi
- improved access to CBTi through growth in the psychologist workforce trained in CBTi and funding support for GP referrals of patients to adequate CBTi therapy
- access to community supports such as socially prescribed interventions, to health coaches and to digital self-guided CBTi programs

9.5 Primary care data requirements

Routine identification of sleep health and sleep issues in primary care within usual health data information collection at the PHN level and nationally would provide essential clinical information to better inform policy and practice.

In individuals considered at risk of poor sleep, or presenting with symptoms of poor sleep, data would be collected through a validated assessment of the three domains of sleep health: quantity, quality, and consistency. Data should also be collected through sleep disorders assessment, to provide accurate prevalence data over time including data on treatment and outcomes. National Primary Health Care Data Collections should be expanded to include collection of primary care sleep health incidence and treatment data.

Additionally, updates to the SNAP guide, Healthy Habits and RACGP Red book sleep recommendations should reflect and complement the data requirements for identification of sleep health and sleep issues in primary care.

10 Policy recommendations

These recommendations are based on analysis of the evidence in academic and other literature and developed by curation and application of this and available Australian data to answer the question:

> *"Why is sleep health becoming a population and health care problem and what can be done to prevent poor sleep and improve sleep health in the Australian population?"*

The increasing evidence of poor sleep within the adult population and of particular sleep health concerns in specific population groups warrants a comprehensive approach to public awareness and health policy and to health professional attention to the importance of sleep health for health and wellbeing and for prevention and treatment of sleep-related health conditions.

The evidence compiled in this paper supports and provides policy and practice options for a comprehensive improvement in sleep health throughout the population, in identification and early intervention in poor sleep and for optimal interventions in the prevention and treatment of sleep disorders.

A 10 year National Strategy for Sleep Health would provide a coherent implementation framework for service enhancements and investments in improving population sleep health, in alignment with national health and wellbeing objectives (193,406) and with the Federal Government commitment to improving the capacity of primary care to support all Australians to be healthy and well and to enable access to the health care people need when they need it

The National Sleep Strategy would set overarching objectives for improved population sleep health and for improved access to sleep health care. It would take account of the wider public policy environment influencing sleep health and sleep awareness in the community and it would inform targeted and coordinated action at the national and jurisdictional levels to address the increasing incidence and health, social and economic consequences of poor sleep in specific population groups and communities as well as the wider population. The Strategy would address services capacity, health professional and workforce development and capacity to deliver on the overarching objective.

In addition to the importance of a national and strategic approach to sleep health, as recommended, it is clear that a lack of awareness of the impact of sleep health on overall health and wellbeing, both physical and mental, is an urgent issue to be addressed. To do so, National Sleep Guidelines are proposed to provide guidance to the general public, health care providers, health professionals and policymakers on the recommended quantity, quality and consistency of sleep for optimal health. This is a leading recommendation that addresses a fundamental gap in the understanding and application of contemporary evidence, of the importance of sleep health and modern risks for poor sleep health, in health policy and practice and throughout the population.

Improving population awareness through health information campaigns, using all forms of communications, in particular social media, is recommended because of the evidence that this is the most effective method to lift population health literacy about particular health risks that potentially affect all or most individuals in the population.

Supporting primary care, particularly general practice, to meet sleep health needs; contributing to individual patient awareness and understanding of the importance of sleep to health and wellbeing

(health literacy); and to treat and manage poor sleep in the community is an obvious priority. Primary health care is failing to cope with current health care demand and the Australian Government is committed to Strengthening Medicare, the policy and funding system that supports primary health care across Australia. The government's commitment is to Strengthen Medicare to ensure Australians can have the primary health care they need. Enabling people living with sleep disorders and experiencing poor sleep to access health care that will improve their health and reduce the further risks that arise from poor sleep will lift health outcomes for many in the population and contribute to the government's objectives. In particular, enabling general practice to provide a multi-disciplinary response to sleep health issues in the community will recognise the evidence of the benefit of a diverse range of therapies for sleep health improvement and the capacity of nurses and allied health workers to contribute to sleep health care and prevention.

Monitoring the sleep health of the population, and the patterns and extent of poor sleep and sleep disorders in the population, is essential if health services are to be supported to meet health needs and to aid the design of health policy initiatives and practice improvements that will prevent and reduce the prevalence of these in the population.

Other public policy areas are significant contributors to good or poor sleep health. Application of the evidence curated in this paper in other public policy sectors and particular industries could contribute to improved sleep health in some at-risk population groups. Health policies should emphasise the relevance and impact on population sleep health of other public policies.

Recommendation 1: Establish a 10-year National Sleep Health Strategy

Preventive health action is now a health policy and funding priority. This is in recognition of the extent to which people in Australia now live an average of almost eleven years in poor health because of increasingly high rates of chronic disease. The Australian Institute of Health and Welfare (AIHW) has estimated that 38% of the disease burden could be prevented through a reduction in modifiable risk factors such as overweight and obesity, physical activity and alcohol, tobacco and other drug use. These are all modifiable risk factors for poor sleep health. Improving the physical activity levels, nutrition status and sleep health of as many in the population as possible could achieve a healthier Australia in the coming years.

This paper has brought together the evidence of the extent and impact of poor sleep in the Australian population. As with other significant health issues affecting the health and wellbeing and social and economic participation of individuals, sleep health issues also impose a substantial demand and burden on health services and health expenditure. Establishment of a national strategy on sleep health in Australia would provide the leadership and policy commitment necessary to improve population sleep health progressively over the coming decade.

In alignment with national health and wellbeing policy objectives, a National Sleep Health Strategy with a ten year implementation plan would aim to build coherent leadership and engagement in sleep health as a core pillar of physical and mental health. A strategy would raise public and health professional awareness and engagement in sleep health through public health initiatives and through targeted support for service provision for a neglected and increasingly significant health issue that is a core component of good health and wellbeing for the Australian population.

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Proposes aims and objectives for the 10-year National Sleep Health Strategy, based on the evidence presented in this Policy Evidence Review, would be to:

i. Provide a national policy framework for specific attention to sleep health in health policy, health services and funding and other relevant public policies.;

ii. Promote and support effective population health strategies and sleep health treatment and care nationally, in states and territories and local communities.

iii. Develop widespread recognition and understanding of sleep health across the life cycle and specifically the importance of appropriate sleep quantity, quality and consistency to health and wellbeing. This should be recognised in health and other public policies and include both awareness raising initiatives for the general population and targeted initiatives aimed at health services, health professionals and population groups at high-risk of experiencing poor sleep health. in health and other public policies;

iv. Enhance primary care capacity to identify poor sleep, provide evidence-based information, support and early intervention for sleep health and to refer people with sleep disorders to accessible and appropriate specialist treatment.

v. Provide at-risk population groups (e.g. children and young people, shift workers, women during pregnancy and menopause, First Nations Australians and older adults) and disadvantaged communities with co-designed, tailored sleep health information and resources, and appropriate early intervention, referral and treatment services.

vi. Inform and support the development of policies, which directly or indirectly affect sleep health, at all levels of government and within specific industries. Policies should be guided by the best available evidence and aim to promote sleep health in their populations and areas of responsibility.

vii. Establish routine and comprehensive population sleep health data collections and monitoring mechanisms to inform and evaluate the Strategy, develop target population health initiatives for high-risk population groups and support policy development and service design related to sleep health.

viii. Support research into the interrelationships between sleep health, physical activity, nutrition and overall health and wellbeing to inform the provision of health care and preventive health policy activities.

The establishment of a national sleep health strategy would address a neglected and increasingly significant health issue, align with other national health priorities and complement other national strategies developed for comparable health issues, including the:

- National Suicide Prevention Strategy 2020
- Closing the Gap National Agreement
- National Injury Prevention Strategy 2020-2030
- National Women's Health Strategy 2020-2030
- National Men's Health Strategy 2020-2030
- National Preventive Health Strategy 2021 – 2030
- National Obesity Strategy 2022 - 2032

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The Strategy should inform and support other public policy areas relevant to sleep health including road safety, workplace and employment policies, education and environmental and town planning.

Recommendation 2: Establish National Sleep Guidelines

The Federal government budget of 2022-23 (258) included provision for the development of 24-hour movement guidelines for adults and older Australians, integrating physical activity, sedentary behaviour and sleep. These are currently in development.

Whilst movement guidelines for adults as well as children would go some way to address the lack of attention to sleep in public health policy, the evidence summarised in this evidence brief and the accompanying Policy Evidence Review (407) makes it clear that sleep should be recognised as the third pillar of good health, alongside physical activity and diet.

> *Diet, exercise, and sleep influence one another in complex and innumerable ways. Learning about how these activities affect one another is an important part of understanding why research has shown that the more of these lifestyle behaviours you improve, the better your well-being.*

(78)

The establishment of separate and complementary national guidelines for sleep, physical activity and nutrition is warranted.

RECOMMENDATIONS:

I. Australian National Sleep Guidelines for children and young people, for adults (18 to 64) and older adults should be commissioned and implemented in alignment with national health and wellbeing policy aims and objectives.
II. National Guidelines on Sleep, Physical Activity and Nutrition should be separate and complementary and make explicit the inter-relationship of each of these lifestyle factors in health and wellbeing.

Recommendation 3: Implement a national sleep health awareness campaign

Poor sleep and sleep disorders are prevalent among Australians. However, public awareness of contributing factors and consequences of poor sleep is low (17).

The accumulation of evidence on the significant association of poor sleep with preventable chronic disease and serious health conditions and of the elevated risk of suicide in association with nocturnal wakefulness makes it clear this is a pressing public health concern. Investment in a national public awareness campaign to improve health knowledge and literacy of the importance of sleep to health and wellbeing is an obvious strategy and a well-recognised, effective means to increase public awareness of a significant population health issue. A national and sustained public awareness campaign on sleep health would contribute to national health and wellbeing policy objectives.(193).

A national campaign to improve public awareness of the importance of healthy sleep to health and wellbeing was recommended by the 2019 Parliamentary Inquiry into sleep health awareness in Australia. The Inquiry proposed that a campaign be undertaken to promote sleep as the foundation of positive health and wellbeing in combination with nutrition and exercise; provide information and

education about sleep hygiene and healthy sleep practices, information on sleep disorders and treatments and the relationship between sleep health and reduction in risk for preventable health conditions, impaired judgement and mental functioning and decreased productivity and performance (Parliament of the Commonwealth of Australia, 2019, p. 129). Investment in research to develop and evaluate a standard set of sleep hygiene recommendations for the population and for particular age groups would enable evidence-based recommendations for use in Australian public health information and awareness strategies (334).

Public awareness strategies have demonstrated their effectiveness in reducing preventable disease and death. Tailored and co-designed campaigns to raise awareness and engagement in priority population groups, particularly First Nations Australians, the LGBTQI+ community, rural and regional communities and socioeconomically disadvantaged communities have been shown to be effective (334).

RECOMMENDATION:

i.   A comprehensive and multi-focal sleep health public awareness campaign should be undertaken in alignment and within the life of the National Preventive Health Strategy. The campaign should be conducted over several years with evidence-based and consumer-informed approaches for both the general public and for priority and high-risk population groups including those affected by irregular work hours and specific industry employment.

Recommendation 4: Monitor population sleep health

A combination of regularly collected population-level self-reported data and representative sample biometric data related to sleep would provide reliable information on sleep health and the impacts of poor sleep in Australia.

National Health Surveys should routinely include questions on sleep health that reflect the three domains of sleep health – quantity, quality, consistency – and the prevalence of sleep disorders.

Biometric data on sleep should be included in biometric surveys such as the most recent National Health Measures Survey, using validated biometric tools and/or provision of data by survey respondents from personal devices.

Inclusion of data on sleep health in the National Primary Health Care Data Collections would address the existing gap in information on the prevalence of poor sleep and sleep disorders and their impact on individual health and wellbeing and on health service demand.

Establishment of a National Sleep Health Monitoring Centre would enable more effective use of existing data on sleep.

RECOMMENDATIONS:

i.   National Health Surveys and other large surveys related to physical and mental health should include questions on sleep health that are capable of:

    a.   monitoring population sleep health;

b. indicating the impact of sleep on other aspects of physical and mental health; and

c. informing health policy, service provision and interventions.

ii. National Health Measures Surveys should include the regular collection of biometric sleep data using actigraphy or other objective assessment methods to assess sleep health.

iii. National Primary Health Care Data Collections should be expanded to include collection of primary care sleep health incidence and treatment data.

iv. A coordinated data strategy and National Sleep Health Monitoring Centre should be established to monitor and report on the prevalence and impact of poor sleep and sleep disorders. This should include utilsing and anlysing existing data sets relevant to sleep health.

Recommendation 5: Support primary care capacity for early intervention and risk reduction

Policy and funding recognition of the importance and complexity of identifying and managing sleep health risks and needs in primary care is essential if primary care services are to adequately meet the evident population burden and prevalence of poor sleep and sleep disorders.

Appropriate clinical guidelines and inclusion of sleep in the RACGP SNAP (smoking, nutrition, alcohol and physical activity) guide would resource and support general practitioners in engaging with, recognising and addressing poor sleep and sleep disorders in their patient population. Guidelines need to emphasise the significant relationship between disrupted sleep and suicide risk particularly for at-risk adolescents and adults.

The provision of brief interventions in poor sleep and at the primary care level is supported by contemporary evidence. The capacity of general practice and general practitioners to identify, treat and manage poor sleep health and sleep disorders would be enhanced through the provision of resources together with education and awareness-raising strategies. These would provide GPs and general practices with up-to-date evidence on sleep health, risk factors for poor sleep, poor sleep risk for other health conditions and high-risk behaviours together with information on management options and referral pathways for poor sleep and sleep disorders. The current outreach GP education activities associated with projects delivered by the National Centre for Research Excellence (CRE) at the National Centre for Sleep Health Services Research provide evidence of the benefit of GP education in sleep health and a formal GP outreach program with investment should be considered.

Enabling the available primary care workforce to work to their full scope of practice is a current national health policy priority. To improve access and reduce fee barriers for eligible patients, qualified practice nurses could deliver BBTi within general practice in line with existing provisions for alcohol and other drugs practice nurse services.

The role of primary care in responding to the prevalence of insomnia in the Australian population has been recognised (408). Providing access to patients diagnosed with insomnia to Cognitive Behavioural Therapy for Insomnia (CBTi) from a specialised psychologist or Brief Behavioural Therapy for Insomnia (BBTi) through a health care plan and referral to eligible allied health practitioners should be considered. Policy and funding recognition of CBTi as a routine treatment for a common health problem that has significant physical and mental health implications together with social and economic consequences, would promote uptake and facilitate access to CBTi and related

interventions for people with persistent sleep disturbance and insomnia. An expanded trained workforce to provide these interventions is essential to cope with increasing demand.

RECOMMENDATIONS:

i. The RACGP SNAP guidelines for lifestyle risk factors in primary care should be further developed to include sleep health in addition to smoking, nutrition, alcohol and physical activity (SNAP) guidelines.

ii. A GP sleep health engagement, awareness and support strategy, consistent with the RACGP Alcohol and Other Drugs (AOD) strategy, should be funded to strengthen GP capacity to address poor sleep and sleep disorders in the community setting including through inclusion of sleep in routine health checks.

iii. Policy should recognise and support the capacity of primary care to respond to the significance and complexity of detecting and managing poor sleep health. This should include policy and funding support for:

    a. The multidisciplinary team required to enable evidence-based, primary care provided identification and early intervention of sleep problems.

    b. Interventions for insomnia and other common sleep health problems, such as Brief Behavioural Therapy for Insomnia (BBTi), digital Cognitive Behavioural Therapy (dCBTi) and Cognitive Behavioural Therapy (CBTi).

    c. Education and training programs to increase the number of psychologists with specialist expertise in CBTi for sleep health. Incentive funding to promote sleep disorder/insomnia education in University postgraduate psychology courses, such as Masters of Clinical Psychology, should be considered.

These recommendations are in alignment with and reliant on the recommendations of the Strengthening Medicare Taskforce that include:

- Introducing voluntary patient registration;
- funding for longer consultations;
- increased investment to support multidisciplinary teams;
- blended funding models to go beyond fee-for-service;
- investment in research; and
- better use of data and digital technology.

Recommendation 6: Assess and improve attention to sleep health in other public policy

Even though the economic cost of sleep disorders is significant (28), there has been limited policy attention to the importance of sleep for everyday life other than in some health policies (409). Whilst fatigue has been recognised as a risk factor in industry, its corollary, sleep health, has not been widely recognised as important to the health and safety of workers.

The multiple ways sleep health can be negatively affected either directly or indirectly by a range of factors including work and education arrangements, community environments and social and economic influences makes it apparent that sleep health should be recognised as a significant

component of education and employment, town and community planning and other relevant public policy sectors.

Recognition of the influence of public policy on health and wellbeing and specifically on population sleep health is desirable. One approach to improve the recognition of sleep health in public policy could be to focus on the cumulative effect of policies on how people use their time. There is a growing understanding that how we use our time affects our well-being. Whilst this has not attracted policymakers' attention outside health, the 'side effects' of other public policies should be identified and addressed to improve population sleep health.

Additionally, assessment of the impacts and benefits of public policy on population sleep health, with particular attention to the risk factors for and incidence of poor sleep health outcomes, should be considered as governments have a legitimate interest in protecting public health and specifically occupational health and safety. Policy attention to the measurable consequences of poor sleep such as drowsiness, particularly in populations and occupational groups that can be identified as being more likely to be affected by these risks (410) would enable more effective efforts to manage the risks associated with poor sleep in law and policy.

Another approach is to review and improve the impact of specific industries, work, education, road transport and other public policies relevant to known risks for poor sleep health outcomes in particular population groups. This should include industry-specific policies for industries at increased risk of poor sleep and policies related to road safety, education and town and community planning.

RECOMMENDATIONS:

i.   Health policy actions should emphasise the relevance and impact of sleep health in other public policy areas, with a particular focus on industry/workforce-specific, road safety, education and community planning policies.
ii. Health policy should consider and address the cumulative effect of other public policies on sleep health and associated physical and mental health outcomes.

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11 Appendices

11.1 Appendix 1: Prevalence

TABLE 5: PREVALENCE OF A SELECTION OF RISK FACTORS FOR POOR SLEEP

Risk factors for poor sleep	
Risk factor	% prevalence
Harmful Alcohol use	25.8% of Australians over 18 exceed the Australian Adult Alcohol Guidelines in 2020-21 (411)
Tobacco use	10.7% of Australian adults are daily smokers in 2020-21 (412)
Physical Inactivity	72.8% of Australians aged 15 years and over did not meet the physical activity guidelines in 2020-21 (413)
Dietary risks	Only 6.1% of adults ate the recommended amount of fruit and vegetables (414), discretionary foods contribute to 38.1% of the total dietary energy available in 2020-21 (415)
Obesity	2 in 3 Australians (67%) aged 18 and over were overweight or obese in 2017-18 (416)
Anxiety	16.4% of Australians had a 12-month Anxiety disorder (417)
Employment	Unemployment rate 3.5% Underemployment rate 5.9% (418)

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11.2 Appendix 2: Sources of sleep data: Australia

Data source/ survey name	Description	Sleep health metrics/ questions included
Australian Health Survey 2011-13	The Australian Health Survey (AHS) is the largest, most comprehensive health survey ever conducted in Australia. It combines the existing ABS National Health Survey (NHS) and the National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) together with two new elements - a National Nutrition and Physical Activity Survey (NNPAS) and a National Health Measures Survey.	Previous night's sleep duration and whether this was a 'typical night's sleep' for respondents.
Sleep Health Foundation Survey: 2016 Sleep Health Survey of Australian Adults	The survey was conducted in March 2016 on behalf of the Sleep Health Foundation among 1,011 adults aged over 18 years across Australia, with representativeness for age, sex, location and an indicator of socio-economic status. Researchers from The University of Adelaide were responsible for the survey design and analysis. The study objective was to assess the scale of the health and social consequences of insufficient sleep and sleep disorders in Australia. The survey aimed to measure the prevalence and economic impacts of sleep problems in Australia, including sleep loss, insufficient sleep, and common sleep disorders.	The survey included questions related to: sleep difficulties and clinical sleep conditions, chronic illness and sleep, burden of sleep problems in relation to sleep disorders, activities done in the hour before bed, sleep habits and environmental influences, causes of sleep disturbance, the effect of sleep problems on work and social activities and the effect of sleep habits and routine on sleep quality and daytime functioning.
The Household, Income and Labour Dynamics in Australia Survey (HILDA): Selected Findings from Waves 1 to 17 (2019)	The Household, Income and Labour Dynamics in Australia (HILDA) Survey is a household-based panel study that collects valuable information about economic and personal wellbeing, labour market dynamics and family life. It aims to tell the stories of the same group of Australians over the course of their lives. Started in 2001, the HILDA Survey provides policy-makers with unique insights about Australia, enabling them to make informed decisions across a range of policy areas, including health, education and social services. The HILDA Survey follows the lives of more than 17,000 Australians each year, collecting information on household and family relationships, income and employment, and health and education.	The HILDA Survey has collected information on sleep quality in the self-completion questionnaire in Waves 13 and 17. Respondents were asked about the frequency of each of five specific sleep problems: trouble sleeping because of not getting to sleep within 30 minutes; trouble sleeping because of waking in the middle of the night or early in the morning; trouble sleeping due to coughing or snoring; taking medicine to help sleep; and trouble staying awake while driving, eating meals or engaging in social activity. Respondents were then asked to assess overall sleep quality over the past month.
2017 National Social Survey	The National Social Survey (NSS) 2017 is an Australian cross-sectional telephone survey undertaken by the Population Research Laboratory at Central Queensland University, Australia. It comprises items assessing participant demographic information, health	Items were devised to directly align to NSF sleep duration recommendations and quality indicators. Separate items assessed sleep duration on weekdays and/or workdays (hours) and weekends and/or non-workdays (hours). Measures

	behaviours, chronic disease status, and quality of life. The NSS 2017 included 1265 respondents.	of sleep quality included the following: sleep onset latency (minutes); number and duration (minutes) of awakenings throughout the night; frequency (days per week), number (per day) and duration (minutes) of naps; and sleep efficiency All questions asked participants to consider their sleep and related behaviour on an average day or week. Items related to sleep assessment and sleep care provided by health professionals were also included.
The Australian Longitudinal Study on Women's Health (1996-2018)	The Australian Longitudinal Study on Women's Health is a national research resource for the development of policy and practice related to women's health and health services. It tracks the health and wellbeing of over 57,000 women across four generations including their sleep health. The study's data are freely available to collaborating researchers and policymakers.	Since its inception in 1996, the study data have been used to assess sleep health in Australian women and gain insight into the prevalence, determinants, and consequences of sleep difficulties.
Australian Longitudinal Study on Male's Health (Ten to Men)	The Australian Longitudinal Study on Male Health (Ten to Men) was established in 2011 to build the evidence base on male health to inform policy and program development. It is a national longitudinal study, funded by the Australian Government Department of Health, with a stratified multi-stage cluster random sample design and oversampling in rural and regional areas. A household recruitment method was used, and recruitment took place from September 2013 to July 2014. 16,021 males aged 10-55 were recruited. The survey content was structured around six key domains relevant to male health: physical health, mental health, health-related behaviours, social and environmental determinants of health, health literacy/knowledge, and health service use. The study is 'longitudinal' with repeat waves every 2 to 3 years so we can understand how changing life stages and circumstances might affect health and wellbeing over time.	

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11.3 Appendix 3: Summary of key findings and future directions for the application of sleep hygiene to the general population (114)

Sleep hygiene recommendation	Summary of Findings	Directions for future research
Avoid caffeine	• Caffeine administration close to bedtime disrupts sleep • Effects of caffeine on sleep show a dose-response relationship • The impact of morning and afternoon caffeine use is less clear • Harmful effects of caffeine on sleep may be limited to caffeine-sensitive individuals • Tolerance to caffeine's effects on sleep develops within days	• Morning and afternoon caffeine use • Intermittent caffeine use and the importance of day-to-day variation • Tolerance and habituation • Identification and targeting of caffeine-sensitive individuals
Avoid nicotine	• Acute and chronic nicotine administration/smoking disrupts sleep • Arousals increase temporarily during acute nicotine withdrawal • Few/limited studies suggest sleep problems associated with smoking can be resolved after cessation and withdrawal	• Longitidunal assessments of change in sleep from pre- to post-cessation • Threshold for occasional and/or light use to impact sleep • Extent to which passive smoking disrupts sleep
Avoid alcohol	• Acute alcohol administration before bed decreases SOL but increases arousal during second half of night • The effects of alcohol on sleep are dose-dependent • Tolerance to alcohol's effects on sleep occurs within days • Sleep problems increase during acute withdrawal of dependent users • Despite modest improvement, long-term sleep problems persist in abstinent former users	• Longitudinal assessments of change in sleep during use and abstinence for dependent users • Direct tests of alcohol avoidance effects on sleep in nondependent useres • The impact of afternoon and evening use on sleep • The effect of non-dependent use patterns (e.g., light/occasional, habitual weekend use) • Combined effects of alcohol

Sleep hygiene recommendation	Summary of Findings	Directions for future research
Avoid caffeine	• Caffeine administration close to bedtime disrupts sleep • Effects of caffeine on sleep show a dose-response relationship • The impact of morning and afternoon caffeine use is less clear • Harmful effects of caffeine on sleep may be limited to caffeine-sensitive individuals • Tolerance to caffeine's effects on sleep develops within days	• Morning and afternoon caffeine use • Intermittent caffeine use and the importance of day-to-day variation • Tolerance and habituation • Identification and targeting of caffeine-sensitive individuals
		with nicotine and caffeine on sleep
Exercise regularly	• Regular and/or acute bouts of exercise produce modest improvements in sleep for individuals with and without sleep complaints (though impact of exercise training on PSG-assessed sleep is less consistent) • Current evidence does not support the claim that late-night exercise disrupts sleep	• Extent to which different types, duration, and intensity level of exercise can be specified for optimal sleep improvement • Moderating effects of age, gender, and fitness level on the impact of exercise on sleep
Manage stress	• Psychosocial stress is associated with increased pre-sleep arousal and impaired sleep • Various stress management strategies have been shown to reduce pre-sleep arousal and improve sleep (most often self-reported sleep) • Individual differences influence perception of stress and coping style	• Identify patterns in individual differences to predict those whose sleep is most affected by stress • Examine the isolated benefit of stress management beyond reduction in physiological arousal • Develop process by which individuals can evaluate their own stressors and identify the most appropriate stress management technique for their needs

Sleep hygiene recommendation	Summary of Findings	Directions for future research
Avoid caffeine	• Caffeine administration close to bedtime disrupts sleep • Effects of caffeine on sleep show a dose-response relationship • The impact of morning and afternoon caffeine use is less clear • Harmful effects of caffeine on sleep may be limited to caffeine-sensitive individuals • Tolerance to caffeine's effects on sleep develops within days	• Morning and afternoon caffeine use • Intermittent caffeine use and the importance of day-to-day variation • Tolerance and habituation • Identification and targeting of caffeine-sensitive individuals
Reduce bedroom noise	• Nighttime noise increases arousals • Habituation to noises occurs, but EEG arousals persist • Specific noise reduction strategies have been shown to improve sleep in some environments (most often in ICU patients)	• Further test noise-attenuating strategies in home environments using objective sleep assessments • Identify individual-level factors (e.g., age) that influence preference and efficacy of specific strategies
Sleep timing regularity	• Clinical sleep treatments encourage regularity only in wake time, which is counter to some sleep hygiene recommendations to adopt regular bed- and wake-times • Irregular sleep schedules have been associated with poor sleep, but assigning regular sleep schedules to nonclinical adults has shown limited effects on sleep improvement	• Relative importance of bed- vs. wake-time regularity in nonclinical samples • Influence of moderating factors (e.g., chronotype, age) • Threshold for schedule regularity required to promote good sleep
Avoid daytime naps	• Most research suggests that daytime naps do not have a substantial impact on subjective or objective nocturnal sleep, despite sleep hygiene recommendations to avoid naps • Nap duration and timing seem to have limited effects on the relationship between napping and nocturnal sleep	• Impact of nap elimination on nocturnal sleep in habitual nappers with poor sleep • Examination of naps in the home environment rather than laboratory • Moderating effect of age

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Note. EEG=electroencephalography; ICU=Intensive Care Unit; PSG=polysomnography; SOL=sleep onset latency.

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11.4 Appendix 4: risk factors and influences for sleep health

Risk factors and influences for sleep health					
Lifestyle	Environment	Stage of life	Type of work	Clinical/pathology indicator	Patient symptoms
Australian lifestyle - typical weekday routine (190) Activities in the hour before bed - work, internet use (R. Adams et al., 2017)(Adams et al., 2017)(31)(24) Alcohol consumption Work hours, sedentary behaviour smoking, physical inactivity, Stress Nutrition (31,43–46,69,202)(31,42–45,68,199) * High caffeine intake (27)	Artificial lighting, bedroom temperature industrial and urban noise (27)	Puberty Older adults Perimenopause (420)	Non-regular hours (191) Irregular/insecure/unemployed (190) High-pressure/long hours (158) Transport (421) Labourers Machinery operators and drivers Community and personal service workers Technicians Trade workers and clerical and administrative workers (158)	Use of medication (422) Obesity (BMI >30); overweight (106,107,158) Waist:hip ratio (423) High blood pressure (424,425) Reduced pupillary reflex reaction (426) Elevated lipid profile (423) Impaired glycaemic control (353,427)	Daytime sleepiness (353,419,428,429) Reduced energy (353,428,429) Impaired concentration / 'brain fog'/poor memory (60,229,430) Mental/emotional stress /anxiety and/or depression (27,108) Nocturia/polyuria (431) Increased appetite (432) sugar cravings (353) Weight gain (428) High alcohol use/alcohol dependency (20) Rhinitis /allergies (419)

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