Public health implications of sleep loss: the community burden

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MJA 2013; 199: S7–S10
doi: 10.5694/mja13.10620

Summary

- Poor sleep imparts a significant personal and societal burden. Therefore, it is important to have accurate estimates of its causes, prevalence and costs to inform health policy.
- A recent evaluation of the sleep habits of Australians demonstrates that frequent (daily or near daily) sleep difficulties (initiating and maintaining sleep, and experiencing inadequate sleep), daytime fatigue, sleepiness and irritability are highly prevalent (20%–35%). These difficulties are generally more prevalent among females, with the exception of snoring and related difficulties. While about half of these problems are likely to be attributable to specific sleep disorders, the balance appears attributable to poor sleep habits or choices to limit sleep opportunity.
- Study of the economic impact of sleep disorders demonstrates financial costs to Australia of $5.1 billion per year. This comprises $270 million for health care costs for the conditions themselves, $540 million for care of associated medical conditions attributable to sleep disorders, and about $4.3 billion largely attributable to associated productivity losses and non-medical costs resulting from sleep loss-related accidents. Loss of life quality added a substantial further non-financial cost.
- While large, these costs were for sleep disorders alone. Additional costs relating to inadequate sleep from poor sleep habits in people without sleep disorders were not considered. Based on the high prevalence of such problems and the known impacts of sleep loss in all its forms on health, productivity and safety, it is likely that these poor sleep habits would add substantially to the costs from sleep disorders alone.

Sleep is a basic and necessary biological process that demands to be satisfied as much as our need for food and drink. Inadequate sleep can occur if insufficient time is allowed for it or if a disorder is present that disturbs sleep quality. It is only recently that we have begun to understand the scale of the health and social consequences of insufficient sleep and sleep disorders. Sleep loss from these problems is associated with disturbances in cognitive and psychomotor function including mood, thinking, concentration, memory, learning, vigilance and reaction times.[1,2] These disturbances have adverse effects on wellbeing, productivity and safety. Insufficient sleep is a direct contributor to injury and death from motor vehicle and workplace accidents.[3] Further, relationships have been demonstrated between shortened sleep and a range of health problems including hypertension,[4] type 2 diabetes,[5] obesity,[6] cardiovascular disease[7,8] and total mortality risk.[9] Specific sleep disorders such as insomnia,[10] obstructive sleep apnoea (OSA)[11] and restless leg syndrome[12] have also been associated with increased morbidity and mortality. These sleep-related problems incur financial costs relating to health and other expenditures and non-financial costs relating to loss of quality of life. This article considers the prevalence and economic impacts of sleep problems in Australia.

Prevalence of sleep problems

There have been very few studies of the prevalence of disturbed sleep in Australia. A small survey ($n = 216$) of sleeping difficulties, daytime sleepiness and hypnotic medication use was conducted in Adelaide more than 20 years ago.[13] A larger survey ($n = 535$) was conducted in Newcastle, New South Wales, in 1996 but was limited to a question about insomnia and hypnotic medications.[14] Another small survey ($n = 267$) in rural Victoria among Australian day workers was heavily weighted to men.[15] More recently, a large NSW mail survey ($n = 3300$) reported that 18.4% of participants slept less than 6.5 hours a night and 11.7% complained of chronic sleepiness.[16] A recent study of the insomnia burden suggested a prevalence of 5.6%, with increased use of health care.[17]

To further characterise sleep quality in a large representative sample of Australians, in 2010, the Sleep Health Foundation (www.sleephealthfoundation.org.au) commissioned a national survey of sleeping difficulties and negative daytime consequences of poor sleep. It was modelled on the Sleep in America surveys conducted by the National Sleep Foundation, in part to allow international comparisons. A national polling organisation (Roy Morgan Research) was commissioned to perform the work. It conducted a national landline telephone survey of adolescents and adults (14 to > 70 years of age) across successive weekend evenings. The survey contained 14 questions about sleep: five about sleeping difficulty, two about snoring and OSA, one about restless legs, one about sleeping medication, three about daytime impairments usually associated with sleep disturbance, and two about nocturnal sleep duration (weekdays and weekends) (Box 1). There were 1512 respondents from all states and territories, both urban and rural, with sampling proportionate to the populations of those areas, sex and age.

Box 1 shows the proportions of respondents reporting current sleep difficulties and daytime impairments at least a few times per week (indicative of significant problem), as well as average self-reported sleep duration for the population overall, for males and females, and for each age group. The results illustrate that a considerable proportion of Australians report frequent sleeping difficulties. Overall, 20% of respondents had frequent difficulty falling asleep, which was more prevalent among females and younger age groups. Frequent waking during the night was reported by 35% overall, again more commonly among females but increasing with age. Thirty-five per cent reported waking unrefreshed and 24% reported inadequate sleep. Daytime sleepiness, fatigue/exhaustion and irritability were common issues (19%–24%).

Symptoms were examined to determine likely prevalence of insomnia by selecting those with specific self-

Online first 17/10/13

1 Proportions of survey respondents experiencing sleep difficulties, sleep disorder symptoms and daytime impairments a few times a week or more (often), overall and by sex and age group

		Sex		Age group					
Difficulty experienced often	Overall	Male	Female	14–17 years	18–24 years	25–34 years	35–49 years	50–64 years	⩾ 65 years
Weighted proportion of total	100%	49.4%	50.6%	6.4%	11.7%	17.4%	26.0%	21.9%	16.5%
Sleeping difficulty									
Difficulty falling asleep	19.6%	16.9%	22.4%*	33.6%†	32.2%†	17.6%	20.0%	14.6%	13.5%
Waking a lot during night	34.9%	30.4%	39.3%†	21.2%	28.1%	32.6%	42.6%†	31.8%	39.5%†
Waking up too early	25.3%	22.9%	27.7%*	19.5%	23.4%	20.3%	29.1%*	25.5%	27.9%*
Waking feeling unrefreshed	34.7%	31.8%	37.6%*	38.1%†	44.0%†	42.0%†	39.8%†	28.5%	19.3%
Did not get adequate sleep	23.7%	17.9%	29.4%†	24.9%†	29.3%†	25.3%†	24.5%†	21.4%	19.3%
Snoring, obstructed breathing									
Frequent or loud snoring‡	21.2%	26.4%†	12.1%	8.4%	8.6%	21.7%†	23.5%†	20.0%†	20.0%†
Pauses in breathing in sleep‡	6.6%	6.2%	5.1%	2.9%	4.4%	3.8%	4.6%	7.8%*	8.4%*
Restless legs	9.4%	8.6%	10.3%	4.0%	5.3%	11.2%†	7.2%	10.7%†	14.5%†
Prescribed sleep medication use	3.6%	4.0%	3.1%	3.5%	2.5%	1.8%	2.4%	5.8%†	5.4%†
Daytime symptoms									
Daytime sleepiness	19.0%	15.7%	22.3%*	24.6%†	26.2%†	21.1%†	22.4%†	13.6%	11.4%
Fatigue or exhaustion	23.5%	20.0%	27.0%†	22.8%	27.7%†	27.7%†	29.1%†	18.8%	14.2%
Irritable or moody	18.8%	18.2%	19.3%	18.8%	19.2%	27.9%†	22.9%†	12.9%	9.8%
Sleep duration									
Weeknights (Sunday–Thursday), h	7.16	7.15	7.17	8.24†	7.49*	7.18	6.86	7.01	7.14*
Weekend nights (Friday, Saturday), h	7.37	7.37	7.37	8.45†	7.37	7.54	7.19	7.29	7.14
Overall, h	7.22	7.21	7.23	8.30†	7.46*	7.28	6.95	7.09	7.14*
Sleep disorder estimates									
Severe clinical insomnia§	6.9%	5.0%	8.7%*	2.0%	11.3%*	4.2%	10.1%*	6.9%	3.8%
Sleep apnoea‡,¶	4.9%	6.3%*	3.6%	0	2.2%	2.1%	4.7%	7.7%*	7.0%*

* $P < 0.05$. † $P < 0.001$. ‡ Adjusted for the 10%–11% who "can't say". § Estimated Insomnia Severity Index > 14, derived from data for sleeping difficulty and daytime symptoms. ¶ Estimates derived from data for frequent breathing pauses and loud snoring. ◆

reported sleep difficulties plus daytime impairment[18] to derive a score that very closely simulates the Insomnia Severity Index, a highly reliable and valid tool to identify clinical insomnia.[19] This suggested an overall presence of severe insomnia (Insomnia Severity Index, > 14) of 6.9%, 8.7% in women and 5% in men (Box 1).

Prevalence of sleep apnoea was derived by determining the proportion of respondents who snored loudly at least a few times a week and had observed breathing pauses during sleep at least a few times a month. An overall prevalence of 4.9% was noted, but in this case, prevalence was higher among males (6.4%) than females (3.6%).

While these prevalences of specific sleep disorders were derived from combinations of questionnaire responses, they are similar to the prevalences determined from other population-based studies.[10,20] These findings suggest that specific sleep disorders may account for about half of the complaints of daytime sleepiness and fatigue and exhaustion noted in our survey. While other health problems can disturb sleep, particularly in older patients, much of the balance may be due to insufficient sleep duration by choice or through circumstances that result in sleep being given a lower priority than work, social or family activities. Sleep duration estimates are significantly below the putative average adolescent sleep requirement of 9 hours a night and adult sleep requirement of 7.5–8 hours a night for both men and women, particularly among those between the ages of 35 and 65 years.[21] Insufficient sleep at least a few times a week was reported by 23.7% of the sample, more frequently by females, and more commonly in the younger to middle-aged groups. Perhaps relevant to this, a study of young adults has shown that those with shorter habitual sleep patterns carried the highest sleep debt, suggesting self-selected sleep restriction.[22]

The general point that emerges from these data is that inadequate sleep (duration or quality) and its daytime consequences are widely prevalent in Australians, either because of a specific sleep-related disorder or from voluntarily shortened sleep through choice or circumstance. Although there are limitations with telephone surveys (eg, low response rates to landline phone calls), the results are very comparable with those observed in similar surveys conducted elsewhere, such as the 2008 Centers for Disease Control and Prevention study, which reported that 28% of United States adults had insufficient sleep or rest (< 7 h/night) on most nights over a 30-day survey period.[23]

Economic impact

Poor sleep and its consequences result in significant costs to the community. Although there have been no detailed economic evaluations of the costs associated with insufficient sleep in otherwise healthy individuals, analyses have been undertaken for those with sleep disorders.[24,25] OSA provides an example of a widely prevalent sleep disorder with significant comorbidities, including impaired daytime alertness, increased accident risk, hypertension, vascular

2 Summary of the annual costs of sleep disorders and associated conditions, 2010[21]

Variable	AUD (million)
Direct health care cost	
Sleep disorders	274
Associated conditions*	544
Indirect financial cost	
Productivity	3132
Informal care for accident victims	129
Other cost of motor vehicle accidents	465
Other cost of workplace accidents	53
Deadweight loss to taxation system	472
Total financial cost	5069
Non-financial cost	
Loss of disability-adjusted life-years	31 350
Total economic cost	36 419

* Hypertension, vascular disease, depression, motor vehicle injuries and workplace injuries. ◆

disease and depression.[20] The associated costs include the direct care-related health costs of the sleep disorder itself and the costs of medical conditions occurring as a result of them. In addition, there are substantial indirect financial and non-financial costs. Other financial costs include the non-health costs of work-related injuries, motor vehicle accidents and productivity losses — all common consequences of insufficient sleep. Non-financial costs derive from loss of quality of life and premature death.[24]

In 2011, the Sleep Health Foundation commissioned Deloitte Access Economics, a national economics consultancy with a strong health economics background, to undertake an analysis of the direct and indirect costs associated with sleep disorders for the 2010 calendar year.[25] The methods used were similar to those that they had used in a previous evaluation.[24] Such an analysis requires robust data relating to the prevalence of the sleep disorder under consideration, the prevalences and costs associated with conditions with which it has a causal relationship, and the risk ratios describing the strength of these relationships. Using these data, the proportion of each condition attributable to the sleep disorder (the attributable fraction) can be derived. Specifying the prevalences and odds ratios used to calculate attributable fractions imparts transparency to the assumptions involved in calculating them. The fraction can then be used to derive the share of the costs associated with that condition that is attributable to the particular sleep disorder under consideration. Using these methods, Deloitte Access Economics examined costs associated with the three most common sleep disorders — OSA, primary insomnia and restless legs syndrome — as the robust data required for analysis were available.[25] It estimated total health care costs of $818 million per year for these conditions, comprising $274 million for the costs of caring for the disorders themselves and $544 million for conditions associated with them. Of these costs, $657 million per year related to OSA: $248 million for OSA itself and $409 million for the health costs of conditions attributable to OSA. These conditions include hypertension, vascular disease, depression, and motor vehicle and workplace accidents. The analysis suggested that 10.1% of depression, 5.3% of stroke, 4.5% of workplace injuries and 4.3% of motor vehicle accidents are attributable to a sleep disorder.

The indirect financial and non-financial costs associated with sleep disorders are much greater than the direct costs. The indirect financial costs were estimated to be $4.3 billion in 2010. These included $3.1 billion in lost productivity and $650 million in informal care and other indirect costs resulting from motor vehicle and workplace accidents. Of these indirect costs, OSA accounted for 61% ($2.6 billion), primary insomnia for 36% ($1.5 billion) and restless leg syndrome for 3% ($115 million).

The report also estimated the effect of sleep disorders on loss of quality of life in terms of disability-adjusted life-years. These costs were calculated using the proportion of total national health costs attributable to sleep disorders to proxy the proportionality of the total national disease burden attributable to these problems. A dollar cost was calculated from the product of these years lost (190 000) and the value of a statistical life-year ($165 000). This added a further non-financial cost of $31.4 billion to the total economic cost of sleep disorders (Box 2). The non-financial nature of this cost gave it less tangibility than financial costs, but the calculation does draw attention to the substantial burden associated with the loss of quality of life resulting from sleep disorders.

As large as they are, these costs are likely to significantly underestimate the total cost to the community of sleep-related problems. Deloitte Access Economics evaluated costs associated with common sleep disorders. The costs of accidents and illnesses associated with sleep loss resulting from poor sleep habits from personal choice and/or from conflicting priorities such as work, social or family activities were not considered as they are difficult to estimate. Further, the analysis used conservative estimates of the prevalence of sleep disorders. For example, the base prevalence of OSA used was 4.7%, which is below the proportion of moderate OSA observed in many contemporary studies, a proportion which is likely to increase further as the population ages and becomes more obese.[20] The prevalence of insomnia used in the analysis was also low at 3%, a figure based on primary insomnia estimates.[26] Secondary insomnias resulting from other causes were not considered. Our own estimate including all insomnia from a representative Australian sample (Box 1) was closer to 7%. Potential comorbidities of sleep disorders, even if reasonable evidence for an association existed (such as metabolic disorders in the case of OSA), were also excluded from consideration. Finally, the analysis did not cost some aspects of the known comorbidities of sleep disorders, such as the impact of presenteeism (being present at work but operating suboptimally) on productivity and safety. The reason for this omission was the difficulty in reliably quantifying its effects.

Conclusion

Poor or inadequate sleep is very common among Australian adolescents and adults, affecting over 20% on a daily or near-daily basis. Epidemiological studies suggest about

half of this problem can be attributable to common sleep disorders such as OSA and insomnia, as together they affect about 10% of the community. The balance appears likely to be the result of inadequate sleep arising from other health problems or issues such as poor sleep habits or sleep loss because of competing demands on time from work, social or family activities. Economic estimates demonstrate that sleep disorders are associated with large financial and non-financial costs. Given that the greatest financial costs appear to be non-medical costs related to loss of productivity and accident risk, it is likely that inclusion of the effects of sleep restriction from poor sleep habits or choice could add considerably to these already substantial amounts.

Competing interests: No relevant disclosures.

Provenance: Commissioned by supplement editors; externally peer reviewed.

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