Prevalence and comorbidity of sleep conditions in Australian adults: 2016 Sleep Health Foundation national survey

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Objective: To determine the prevalence of sleep conditions (obstructive sleep apnea [OSA], insomnia symptoms, simple snoring, and restless legs) and their associated burden of chronic conditions in a community sample.

Design: Cross-sectional national adult online survey.

Setting: Community-based sample.

Participants: Australian adults ≥18 years, N = 1011.

Measurements: A cross-sectional national online survey assessed diagnosed OSA, OSA symptoms, insomnia symptoms, sleep problems, excessive daytime sleepiness (Epworth Sleepiness Scale ≥11), and physician-diagnosed health conditions (heart disease, diabetes, hypertension, reflux disease, lung disease, depression, anxiety/panic disorder, arthritis). Possible undiagnosed OSA was estimated using self-reported frequent loud snoring and witness apneas. International Criteria for Sleep Disorders-3 criteria identified insomnia symptoms. Logistic regression models adjusted for age, sex, obesity, and smoking determined correlates of sleep disorders.

Results: Comorbid sleep conditions were common, with 56% of participants demonstrating ≥1 condition. Reporting ≥1 mental health condition (depression and/or anxiety) was independently associated with diagnosed OSA (odds ratio [95% confidence interval (CI)]: 6.6 [3.2-13.6]), undiagnosed OSA (3.2 [1.8-5.8]), simple snoring (2.4 [1.2-4.5]), insomnia symptoms (4.3 [2.5-7.3]), and restless legs (1.9 [1.2-3.1]). Diagnosed OSA was significantly associated with ≥1 cardiometabolic condition (2.9 [1.4-6.0]) and arthritis (3.6 [1.8-7.2]). ESS ≥11 was associated with diagnosed (3.1 [1.4-6.8]) and undiagnosed OSA (6.2 [3.4-11.4]), insomnia symptoms (2.6 [1.4-4.9]), and restless legs (2.3 [1.4-4.0]), and these sleep conditions were also significantly associated with ≥2 diagnosed medical problems.

Conclusion: Strategies to facilitate the diagnosis and management of often comorbid sleep disorders in primary care are required to reduce the significant sleep-related disparities in cardiometabolic and mental health.

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only 2.2% with an estimated clinical prevalence of sleep disturbance of 3.9%.

These published data suggest an underrecognition of sleep disorders in Australia despite the reported adverse effects of shortened sleep on metabolic health through changes in the activity of neuroendocrine systems. OSA shows associations with cardiovascular disease, depression, cognitive impairment, and mortality risk, whereas OSA symptoms (snoring with breathing pauses) have also been associated with increased risk of heart disease. Insomnia symptoms have been associated with increased risks of mortality and incident hypertension. Some investigators recommend that the detection and diagnosis of insomnia should become the target of public health policy given its high population prevalence and "the widespread misconception as a disorder of the worried well."

It is likely that there has been an increase in sleep-related problems since the 2010 Sleep Health Foundation survey. The aim of this study was to therefore to obtain contemporary estimates of the prevalence of self-reported sleep conditions in Australia (OSA, insomnia symptoms, and snoring) and determine associations with diagnosed chronic health conditions. We also assessed the prevalence of symptoms in those with OSA to estimate how it persists as a complex medical syndrome despite diagnosis and possible treatment.

**Methods**

The survey was conducted in March 2016 in a national sample of Australian adults aged 18 years and over as previously described. The survey questions are taken largely from the 2002 US National Sleep Foundation Sleep in Adults survey with additional questions from the Australian 2010 survey. The survey was conducted online by the Survey Sampling International (SSI) research organization from a panel of more than 220,000 Australians who are invited to complete surveys. We aimed for a sample size of 1000 which provides estimates of proportions to within ±2.5% and of means of ±1%. Participants are selected from SSI’s online sample blend, a consistently managed, diverse, and large frame.

To minimize the risk of bias, SSI uses a 3-stage randomization process in matching a participant with a survey they are likely to be able to complete. First, participants are randomly selected from SSI's panels to be invited to take a survey, and these participants are combined with others entering SSI's Dynamix sampling platform after responding to online messaging. A set of profiling questions is randomly selected for them to answer (these are methodologically correct questions, never affirmation questions), and upon completion, participants are matched with a survey they are likely to be able to take (i.e., the sleep survey) using a further element of randomization. Invitations to participate include e-mail invitations, telephone alerts, banners, and messaging on SSI panel community sites. The messages themselves are varied, and include invitations to give your opinion or let your voice be heard. A diversity of motivation contributes to high-quality sample. To avoid self-selection bias, participants are invited to “take a survey,” and no specific project details are included in the invitation. The details are disclosed later, when a survey has been selected within the system. The survey was approved by The University of Adelaide Office of Research Ethics, Compliance, and Integrity (H-2016-029). Consent was implicitly granted by the participants’ completion of the survey.

**Clinical sleep conditions**

Sleep problems were determined with specific questions about participants’ sleep over the past month. A “yes” response to “Have you been diagnosed with sleep apnoea with an overnight sleep study?” determined diagnosed OSA. In participants responding “no” or “don’t know,” possible undiagnosed OSA was defined as (1) witnessed breathing pauses ≥ times per week or (2) witnessed breathing pauses ≥ times per month with loud snoring ≥ times per week. Simple snorers were identified by loud snoring ≥ times per week without witnessed breathing pauses. Insomnia symptoms were identified with the International Classification for Sleep Disorders-3 (ICSD-3) criteria: (1) sleep initiation or maintenance problems at least 3 times per week (≥ of difficulty falling asleep, waking a lot during the night, waking too early, cannot get back to sleep); (2) adequate opportunity and circumstances to sleep (“Does your current work schedule or typical weekday routine, including your duties at home, allow you to get enough sleep?”); and (3) daytime consequences at least 3 times per week (≥ of sleepiness interfered with activities, felt fatigue or exhaustion, felt irritable or moody). The insomnia-symptoms group as reported in the present analyses excluded those with other primary sleep problems, that is, diagnosed OSA, probable OSA, or simple snorers. A restless legs–only group included those who reported unpleasant, tingling, or restless feelings in the legs at least a few times per month. Those categorized with diagnosed OSA, probable OSA, or simple snorers could also have insomnia and/or restless legs (Table 1). We also identified participants with comorbid insomnia symptoms and sleep apnea (COMISA) defined as insomnia (ICSD-3) with diagnosed OSA or possible undiagnosed OSA. Treatment for sleep apnea was also

**Table 1**

<table>
<thead>
<tr>
<th>Sleep characteristics of participants (% [n]) with sleep conditions</th>
<th>No disorder</th>
<th>Diagnosed OSA</th>
<th>Possible undiagnosed OSA</th>
<th>Simple snorer</th>
<th>Insomnia</th>
<th>Restless legs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSA (diagnosed, possible undiagnosed)</td>
<td>n = 444</td>
<td>n = 84</td>
<td>n = 110</td>
<td>n = 83</td>
<td>n = 114</td>
<td>n = 176</td>
<td>N = 1011</td>
</tr>
<tr>
<td>≥0</td>
<td>0.0 (0)</td>
<td>100.0 (84)</td>
<td>100.0 (110)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>19.2 (194)</td>
</tr>
<tr>
<td>Loud snoring ≥3 times/wk</td>
<td>0.0 (0)</td>
<td>41.7 (15)</td>
<td>78.2 (86)</td>
<td>100.0 (83)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>20.2 (204)</td>
</tr>
<tr>
<td>Insomnia (ICSD-3)</td>
<td>0.0 (0)</td>
<td>31.0 (26)</td>
<td>34.5 (38)</td>
<td>28.9 (24)</td>
<td>100.0 (114)</td>
<td>0.0 (0)</td>
<td>20.0 (202)</td>
</tr>
<tr>
<td>Restless legs ≥3 times/mo</td>
<td>0.0 (0)</td>
<td>56.0 (47)</td>
<td>68.2 (75)</td>
<td>33.7 (28)</td>
<td>46.5 (53)</td>
<td>100.0 (117)</td>
<td>37.5 (279)</td>
</tr>
<tr>
<td>Restless legs ≥3 times/wk</td>
<td>0.0 (0)</td>
<td>34.5 (29)</td>
<td>43.7 (48)</td>
<td>12.0 (10)</td>
<td>28.1 (32)</td>
<td>33.5 (59)</td>
<td>17.6 (178)</td>
</tr>
<tr>
<td>Sleep hours prior to workdays, h</td>
<td>6–9</td>
<td>82.5 (344)</td>
<td>63.7 (51)</td>
<td>68.3 (69)</td>
<td>80.3 (57)</td>
<td>67.6 (69)</td>
<td>74.5 (123)</td>
</tr>
<tr>
<td>≥0</td>
<td>6.0 (25)</td>
<td>15.0 (12)</td>
<td>7.9 (8)</td>
<td>5.6 (4)</td>
<td>11.8 (12)</td>
<td>8.5 (14)</td>
<td>8.0 (75)</td>
</tr>
<tr>
<td>≥11</td>
<td>10.1 (45)</td>
<td>33.3 (28)</td>
<td>38.2 (42)</td>
<td>18.1 (15)</td>
<td>21.9 (25)</td>
<td>21.6 (38)</td>
<td>19.1 (193)</td>
</tr>
<tr>
<td>≥16</td>
<td>0.7 (3)</td>
<td>10.7 (9)</td>
<td>13.6 (7)</td>
<td>6.0 (4)</td>
<td>7.9 (6)</td>
<td>4.5 (8)</td>
<td>4.8 (49)</td>
</tr>
<tr>
<td>Prescribed sleep medication ≥3 times/wk</td>
<td>1.1 (8)</td>
<td>16.7 (14)</td>
<td>30.9 (34)</td>
<td>7.2 (6)</td>
<td>11.4 (13)</td>
<td>10.8 (19)</td>
<td>9.3 (94)</td>
</tr>
</tbody>
</table>

ICSD-3<sup>a</sup>: (1) sleep initiation or maintenance problems ≥ times per week, (2) adequate opportunity and circumstances to sleep, and (3) daytime consequences ≥ times per week.

<sup>a</sup> Pearson χ2 P across clinical sleep condition categories <.05.

<sup>b</sup> Insomnia without OSA or snoring.
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