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Sociodemographic and behavioral correlates of insufficient sleep in Australian adults

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ABSTRACT

Objectives: Insufficient sleep is being increasingly recognized as a public health issue. There is a need to identify correlates of insufficient sleep to guide future preventative health interventions. This study aims to determine the sociodemographic and behavioral correlates of frequent perceived insufficient sleep in the Australian population.
Design: Pooled analyses of two cross-sectional, self-report national telephone surveys were conducted in 2015 (July–August) and 2016 (June–August).
Setting: Adults living in Australia.
Participants: Data from participants (age 18 years and over) of both surveys were pooled for analysis (2015 n = 1041; 2016 n = 1170), with 2211 participants being included in the current study.
Measurements: Participants self-reported their age, gender, education and employment level, language spoken at home, urbanization, chronic disease, and height and weight to calculate BMI. Self-reported physical activity, sitting time, smoking, and consumption of fruit, vegetables, fast food, alcohol and frequency of perceived insufficient sleep were also assessed. Binary logistic regression analysis examined the relationship between insufficient sleep (≥14 days out of 30), sociodemographic and behavioral variables.
Results: The overall prevalence of insufficient sleep was 24%. Female gender, obesity, >8 h/d sitting time, smoking, and frequent consumption of fast food were positively associated with frequent insufficient sleep ($P < .05$). Higher levels of physical activity and being aged 51 years or older were negatively associated with frequent insufficient sleep ($P < .05$).
Conclusions: The sociodemographic and behavioral characteristics associated with frequent perceived insufficient sleep can be used to guide the development of future interventions to reduce sleep insufficiency.

Background

Sleep plays an important role in promoting and maintaining good health, allowing for physiologic restoration and recovery, and is crucial in the memory consolidation process.[1] Good sleep health is increasingly recognized as being important from a public health perspective and can be conceptualized as a duration, quality, efficiency and timing of sleep that leaves a person satisfied with their sleep and enables sustained alertness during the day.[2] Indicators of poor sleep health include sleep durations shorter or longer than recommended (for adults aged 18–64 the recommended duration is 7–9 h/d),[3] disrupted sleep, poor quality sleep, irregular sleep and wake times, falling asleep, even briefly, during daytime activities or dissatisfaction with sleep.[4] The components of sleep health are associated with poorer cardiometabolic health, mental health status, quality of life and increased mortality risk.[4] The frequency of perceived insufficient sleep, defined as the number days a participant felt they did not obtain enough sleep or rest in the last 30 days, is also used to monitor sleep in population-based studies.[5,6]

In Australian and US adults, the prevalence of frequent perceived insufficient sleep (≥14 days) is 29.8% to 27.4%, respectively.[7,8] Frequent insufficient sleep is associated with diabetes, coronary heart disease, stroke, asthma, high cholesterol, hypertension, frequent mental distress.[7,9] Sleep is influenced by sleep hygiene behaviors and also a broader range of individual, social and environmental factors.[6,10,11] In a sample of US adults, the socio-demographic characteristics that were the most influential correlates of more frequent

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insufficient sleep were younger age, Caucasian and multi-ethnic ethnicities, living in a household with more members, higher income, being employed, a student or unable to work.[6] The most influential behavioral and health characteristics associated with more frequent insufficient sleep were being a current smoker, higher alcohol intakes, lower physical activity levels, poorer self-rated health, physical and mental health.[6] In Australian adults, a greater variability and later bed times, and earlier rise times were associated with more frequent insufficient sleep, although the broader socio-demographic and behavioral correlates of insufficient sleep in Australian adults is unknown. However, relatively few studies have examined a range of sociodemographic and behavioral factors that may influence insufficient sleep in the Australian context. Better understanding of these factors is necessary to gain clearer understanding of the factors that influence sleep at the population level, or which population groups are in greatest need of intervention.[5,6] Therefore, the aim of this study is to identify the socio-demographic and behavioral correlates of frequent perceived insufficient sleep in Australian adults.

Methods

Study design and population

The National Social Survey (NSS) is a cross-sectional survey conducted annually by the Population Research Laboratory at CQUniversity (CQU). All states and territories were sampled using randomly selected landlines from an Australian database and random digit dialing of mobile phones to conduct *Computer-Assisted-Telephone-Interviewing* (CATI). Eligible participants were aged 18 years and over and resided in Australia during the project and all participants provided verbal informed consent prior to the start of the interview. This study uses data from the 2015 and 2016 NSS, which were collected between July and August in 2015, and June and August in 2016, respectively.

Measures

Sociodemographic factors assessed included gender, age in years, which was subsequently collapsed into four categories: 18–34 years, 35–50 years, 51–64 years, ≥65 years; and highest level of educational attainment: primary/secondary school, TAFE/technical college, university. Occupational level was assessed by asking participants to indicate the level at which they worked and was subsequently classified into: manager/professional, white collar, blue collar, retired/pension and unemployed/student, consistent with previous studies.[12] Participants also reported the language spoken at home which was dichotomised into English or other. Urbanization was assessed by asking participants if they lived in a city, town or rural area. Participant self-reported height and weight were used to determine *Body Mass Index (BMI)*, which was subsequently classified into three categories: normal: <25; overweight: 25 to <30; or obese: ≥30.

The presence of *chronic disease* was assessed by asking participants to indicate which of the following conditions had ever been diagnosed by a doctor: heart disease, high blood pressure, stroke, cancer, depression/anxiety, Type 1 diabetes, Type 2 diabetes, arthritis, chronic back/neck pain, asthma, chronic obstructive pulmonary disease (including airways disease and emphysema) or chronic kidney disease. The total number of chronic diseases was calculated, then classified as: no chronic diseases or ≥ 1 chronic diseases.

Smoking status was assessed by participants indicating if they were currently a smoker or not and subsequently classified into 'Smoker' or 'Non-Smoker'. *Alcohol consumption* was measured using the AUDIT-C instrument and subsequently classified into lower and higher risk alcohol consumption using established scoring protocols.[13] *Fruit and vegetable intake* was assessed the reported number of serves of both fruit and vegetables per day. Responses to both items were summed and then dichotomised as either meeting the Australian recommendations (≥5 serves of vegetables and ≥2 serves of fruit per day) or not meeting recommendations (<5 serves of vegetables and/or <2 serves of fruit per day).[14] *Fast food intake* was assessed using a single item: "In the last week (the last 7 days), how many times did you eat something from a fast-food restaurant like McDonald's, Hungry Jacks, KFC, etc.? This also includes other fast-food and takeaway such as fish and chips, Chinese food and pizza." Responses were collapsed into three categories: never, once per week, twice or more per week.

Physical activity was measured using the Active Australia Questionnaire, which assesses the duration and frequency of engagement in physical activity.[15] Total minutes of physical activity was calculated by adding together the time spent walking (recreation and transport) and doing moderate and vigorous physical activity (excluding gardening) during the last 7 days, with vigorous physical activity weighted by two. This questionnaire has shown acceptable validity and test re-test reliability.[16] Participants were then grouped into four categories: inactive (0-59 min/wk), insufficiently active (60 to 149 min/wk), meeting activity recommendations (150-300 min/wk) and exceeding activity recommendations (>300 min/wk) similar to previous research.[17]

To measure *sitting time*, the two sitting items from the International Physical Activity Questionnaire - Long Form (IPAQ-LF, last 7 days) were used, which shows good validity and test–retest reliability.[18] These items assess sitting time at home, at work, during transport and during leisure time. One item was used for week days and the other was used for weekend days. Total sitting time was calculated as the weighted sum of week day and weekend sitting time [((week day sitting * 5) + (weekend day sitting * 2)) / 7] consistent with the established IPAQ scoring protocols.[19] Sitting time was categorized as sitting ≤8 hours per day or >8 hours per day. This classification was chosen due to evidence showing that sitting for more than 8 hours is associated with significantly higher mortality risk.[20]

The frequency of perceived *sleep insufficiency was* assessed using a single item, "During the past 30 days, for about how many days have you felt you did not get enough rest or sleep?". Responses were divided into two groups: infrequent (0–13 days) or frequent (14–30 days). These classifications were based on those used in previous studies and diagnostic criteria for insomnia which indicate that insomnia symptoms should be present for at least half the nights.[7,21] This item has demonstrated acceptable levels of test–retest reliability (Cronbach $\alpha = 0.84$).[22] Its use in the current study allows comparison with studies that have previously examined correlates of insufficient sleep.[6,21]

Statistical analysis

Chi-square testing was used to compare socio-demographic, health and lifestyle characteristics between the 2015 and 2016 surveys. Binary logistic regression was used to examine the association between socio-demographic, health, lifestyle characteristics and frequent perceived insufficient sleep, and also between participants included and excluded from the current study due to missing data. The following variables were included in the analysis; gender, age, education, occupational level, language spoken at home, urbanization, BMI, chronic disease presence, smoking, alcohol, fruit and vegetable intake, fast food intake, physical activity, and sitting time. All variables were entered into the model using the classification detailed in the methods. A variable indicating the year of the survey was also included in the logistic regression model. Only participants with complete data for all variables were included in the analysis ($n = 2211$) and statistical significance was set at 0.05. All analyses were conducted in June 2017 using Stata version 14.

Results

The response rates for the 2015 and 2016 NSS's were 33% and 26% respectively, and are comparable to other telephone surveys.[23] A total of 1217 and 1318 participants provided data in the 2015 and 2016 NSS respectively and a total of 2211 participants (2015: n = 1041; 2016: n = 1170) provided complete data for the current study. Participants who were excluded (n = 324) due to missing data were more likely to be female, aged 65 years old, be overweight, report frequent insufficient sleep, and be a lower risk drinker. Missing data on BMI (n = 166), occupational category (n = 39), and age (n = 22) were the largest contributors to missing data. Table 1 shows the proportion of participants across the socio-demographic and behavioral variables. Compared with 2015, the 2016 survey had a higher proportion of females ($P = .028$), English speaking participants ($P = .019$), participants consuming 2 fruits and 2 vegetables per day ($P = .002$) and high-risk drinkers ($P = .028$).

Approximately half of the participants were male (49%) and were aged 51 years and older (56%). The majority of the population had a University education (45%), were employed in a managerial or professional position (43%), spoke English at home (85%) and lived in a city (51%). Overall, 41% of the sample had a BMI <25 and a similar proportion (41%) engaged in >300 minutes of physical activity. A large majority of the participants reported sitting for ≤8 h/d (85%), not smoking (86%) and not consuming 2 servings of fruit and 5 servings of vegetables per day (87%). Approximately 50% of participants reported never consuming fast food and 35% reporting consuming fast food once per week. Approximately half of the participants reported having <1 chronic disease (45%) and were classified as a lower risk drinker (50%).

Table 2 shows that compared to males, females were more likely to report frequent perceived insufficient sleep (OR = 1.48, 95% CI 1.19–1.83, $P < .001$). In comparison to adults aged 18–34 years, adults aged 51–64 years (OR = 0.69, 95% CI 0.49–0.96, $P = .026$) and 65 years and older were less likely to report frequent insufficient sleep (OR = 0.46, 95% CI 0.30–0.72, $P = .001$). Participants reporting engaging in 150–300 min/wk (OR = 0.70, 95% CI 0.51–0.95, $P = .024$) or >300 min/wk (OR = 0.72, 95% CI 0.54–0.94, $P = .007$) were significantly less likely to report insufficient sleep compared to those reporting 0–59 minutes/wk of physical activity. Frequent insufficient sleep was significantly more likely to be reported by participants sitting >8 h/d (OR = 1.46, 95% CI 1.33–2.08, $P = <0.001$), with a BMI ≥30 (OR = 1 .43, 95% CI 1.10–1.86, $P = .008$), who had ≥1 chronic disease (OR = 1.66, 95% CI 1.33–2.08, $P < .001$), who smoked (OR = 1.61, 95% CI 1.22–2.13, $P = .001$) or consumed fast food 2 or more times per week (OR = 1.41, 95% CI 1.05–1.89, $P = .022$) relative to their respective comparison groups. There were no statistically significant associations between frequent perceived insufficient sleep and education, employment, language spoken at home, urbanization, fruit and vegetable consumption and alcohol intake.

Table 1
Sociodemographic, health and lifestyle characteristics of participants (n = 2211)

	Overall		2015		2016		p-value
Variable	n	%	n	%	n	%	p
Gender							
Male	1088	49.21	538	51.68	550	47.21	0.028
Female	1123	50.79	503	48.32	620	52.99	
Age							
18–34	423	19.13	201	19.31	222	18.97	0.745
35–50	532	24.06	253	24.30	279	23.85	
51–64	636	28.77	288	27.67	348	29.74	
65+	620	28.04	299	28.72	321	27.44	
Education							
Primary/Secondary School	702	31.75	318	30.55	384	32.82	0.504
TAFE/Technical	511	23.11	247	23.73	264	22.56	
University	998	45.14	476	45.73	522	44.62	
Employment							
Manager/Professional	967	43.74	462	44.38	505	43.16	0.240
White collar	210	9.50	96	9.22	114	9.74	
Blue collar	164	7.42	82	7.88	82	7.01	
Retired/Pension	655	29.62	315	30.26	340	29.06	
Unemployed/Student	215	9.72	86	8.26	129	11.03	
Language spoken at home							
English	1883	85.17	867	83.29	1016	86.84	0.019
Other	328	14.83	174	16.71	154	13.16	
Urbanization							
City	1138	51.47	557	53.51	581	49.66	0.089
Town	506	22.89	218	20.94	288	24.62	
Rural	567	25.64	266	25.55	301	25.73	
BMI							
<25	913	41.29	445	42.75	468	40.00	0.270
25–29.9	774	35.01	347	33.33	427	36.50	
≥30	524	23.70	249	23.92	275	23.50	
Physical activity classification							
0–59 mins	464	20.99	213	20.46	251	21.45	0.481
60–149 mins	381	17.23	173	16.62	208	17.78	
150–300 mins	444	20.08	223	21.42	221	18.89	
>300 mins	922	41.70	432	41.50	490	41.88	
Sitting time							
≤8 h/d	1894	85.66	892	85.69	1002	85.64	0.976
>8 h/d	317	14.34	149	14.31	168	14.36	
Chronic disease							
0 chronic diseases	1004	45.41	486	46.69	518	44.27	0.255
≥1 chronic disease	1207	54.59	555	53.31	652	55.73	
Smoking							
Non-smoker	1908	86.30	901	86.55	1007	86.07	0.742
Smoker	303	13.70	140	13.45	163	13.93	
Fruit and vegetable consumption							
≥2 fruit and ≥5 veg	238	10.76	89	8.55	149	12.74	0.002
<2 fruit and/or <5 veg	1973	89.24	952	91.45	1021	87.26	
Fast food							
Never	1097	49.62	512	49.18	585	50.00	0.144
Once per week	754	34.10	343	32.95	411	35.13	
≥2 times per week	360	16.28	186	17.87	174	14.87	
Alcohol							
Lower risk drinker	1124	50.84	555	53.31	569	48.63	0.028
Higher risk drinker	1087	49.16	486	46.69	601	51.37	
Insufficient sleep							
0–13 d	1669	75.49	783	75.22	886	75.73	0.781
14–30 d	542	24.51	258	24.78	284	24.27	

Discussion

This study identified a range of sociodemographic and behavioral characteristics of Australian adults that are associated with frequent perceived insufficient sleep. Specifically, frequent perceived insufficient sleep was more likely to be reported by females, adults reporting sitting for >8 h/d, having a BMI greater than or equal to 30, having 1 or more chronic diseases, being a smoker and eating fast food 2 or more times per week. Participants less likely to report perceived frequent insufficient sleep were those engaging in 150–300 min/wk and> 300 min/wk and those aged 51 years and older.

Females are consistently reported to have shorter sleep duration, as well as poor sleep quality and more frequent insufficient sleep than males,[10,24,25] which is consistent with the current study showing that females were more likely to report perceived frequent insufficient sleep (OR = 1.48, 95% CI 1.19–1.83, $P < .001$). Interestingly, adults aged 51 years and over in the current study were less likely

Table 2
Adjusted odds ratios of insufficient sleep according to sociodemographic characteristics and lifestyle behaviors in Australian adults (n = 2211)[1]

Characteristic	OR	95% CI	p
Survey year			
2015	1.00		
2016	0.93	0.76–1.15	0.513
Gender			
Male	1.00		
Female	1.48	1.19–1.83	<0.001
Age			
18–34	1.00		
35–50	1.22	0.90–1.67	0.200
51–64	0.69	0.49–0.96	0.026
65+	0.46	0.30–0.72	0.001
Education			
Primary/Secondary School	1.00		
TAFE/ Technical	0.96	0.73–1.26	0.754
University	0.85	0.65–1.10	0.218
Employment			
Manager/Professional	1.00		
White collar	1.08	0.75–1.55	0.672
Blue collar	1.05	0.70–1.58	0.816
Retired/Pension	1.07	0.76–1.49	0.708
Unemployed/Student	1.20	0.85–1.69	0.296
Language spoken at home			
English	1.00		
Other	1.02	0.75–1.37	0.913
Urbanization			
City	1.00		
Town	1.04	0.80–1.34	0.788
Rural	1.23	0.96–1.58	0.104
BMI			
<25	1.00		
25–29.9	1.01	0.79–1.29	0.949
≥30	1.43	1.10–1.86	0.008
Physical activity classification			
0–59 mins	1.00		
60–149 mins	0.95	0.69–1.30	0.737
150–300 mins	0.70	0.51–0.95	0.024
>300 mins	0.72	0.54–0.94	0.018
Sitting time			
≤8 h/d	1.00		
>8 h/d	1.46	1.11–1.92	0.007
Chronic disease			
0 chronic diseases	1.00		
≥1 chronic diseases	1.66	1.33–2.08	<0.001
Smoking			
Non-smoker	1.00		
Smoker	1.61	1.22–2.13	0.001
Fruit and Vegetable Consumption			
2 fruit and 5 veg	1.00		
<2 fruit and/or< 5 veg	0.80	0.58–1.11	0.181
Fast food			
Never	1.00		
Once per week	0.92	0.72–1.16	0.466
≥2 times per week	1.41	1.05–1.89	0.022
Alcohol			
Lower risk drinker	1.00		
Higher risk drinker	0.85	0.69–1.04	0.120

Note. 1. Odds ratios (OR) are adjusted for all other variables in the table.

to report frequent insufficient sleep. This inverse relationship with age is consistent with research that has used a similar measure of frequent sleep insufficiency[6,26] but it is in contrast to studies that assessed sleep duration[10] or quality.[27] These contrasting findings may be in part due to different components of sleep being assessed between these studies (e.g. duration, quality, sufficiency). Alternatively, older adults may have adapted perceptions of what is "acceptable" in terms of sleep duration or quality[27] or older adults with frequent insufficient sleep may have died earlier, leading to lower estimates of frequent insufficient sleep.[6] Consistent with the current study, several studies have reported associations between chronic disease and insufficient sleep,[7] as well as short and long sleep.[28] Further studies that utilize prospective study designs and assessing sleep health and sleep disorders are necessary to better understand these observations. The shape of the relationship between sleep duration and BMI is inconsistent[24] and studies have shown short sleep duration to be associated with obesity[29] and its development.[30] The current study reported that obesity determined by self-reported BMI is positively associated with frequent insufficient sleep. Due to the cross-sectional nature of the study, causation could not be established and it may be that underlying issues such as sleep apnea, which were not captured in the current study, may have influenced this relationship.

There is evidence of a bidirectional relationship between physical activity and sleep[31] and meta-analytic evidence that physical activity can improve sleep quality and efficiency.[32] Regular physical activity is also a key component of sleep hygiene recommendations and results of the current study, which showed that higher levels of physical activity were associated with a reduced likelihood to report frequent insufficient sleep, supports the role of using physical activity as a strategy to improve sleep quality.[33] Relative to physical activity there is limited information examining the relationship between sleep and sedentary behaviour or sitting time. A meta-analysis found that higher sedentary behaviour was associated with insomnia risk and sleep disturbance, but not daytime sleepiness or sleep quality. The meta-analysis also reported that higher total sitting time was associated with sleep disturbances.[34] The current study, which demonstrated that higher sitting time is associated with frequent insufficient sleep, extends knowledge regarding the relationship between sitting time and sleep by examining an indicator of sleep health that the meta-analysis was unable to examine due to limited study availability.

The relationship between alcohol and the components of sleep health is not ubiquitous amongst studies, including the current study, observing no relationship between alcohol intake and sleep,[5] whilst other studies observe that alcohol disrupts sleep and reduces sleep efficiency.[25,26] The current study could not assess the timing or volume of alcohol intake, which is important in understanding the relationship between alcohol and sleep.[25] However, as alcohol can shorten the time of sleep onset, participants may perceive this fast transition into sleep as an indication that they have good sleep although they may have a poorer sleep quality overall, with subsequent sleep becoming lighter with more arousals.[25] As noted by others,[25] the association between alcohol and sleep requires further work in relation to the impact timing and volume have on sleep, as well as the presence of alcohol-dependency. With its stimulant effects, nicotine may cause arousal and a delay in sleep onset, as well as early morning awakenings as a consequence of withdrawal.[25] Our finding that smoking is strongly associated with frequent insufficient sleep is consistent with this literature.[6,25,26]

Poor sleep quality and sleep restriction are associated with an increased frequency of snacking, consumption of energy-rich foods and higher energy intake,[35,36] however the influence of diet on sleep is less clear.[35] Fruit and vegetable consumption was not associated with sleep in the current study, this is in contrast to observations that a lower frequency of fruit and vegetable intake was associated with more frequent insufficient sleep, although this relationship was of a trivial magnitude.[4] Further research is necessary to understand the relationship between diet and sleep and the current study

makes a contribution to this by demonstrating that frequent fast food consumption was associated with frequent insufficient sleep. This association is interesting given that fast food consumption is associated with obesity, poor dietary quality and higher energy intake.[37,38] Further research is necessary to better understand that relationship between sleep and diet including the timing of food intake and assessing dietary intake in a more comprehensive manner. As observed in the current study, several lifestyle behaviors are associated with perceived frequent insufficient sleep, this is consistent with evidence that sleep behaviors co-occurs with other lifestyle behaviors such as physical activity, dietary and sedentary behaviour.[17,39] Better understanding of how lifestyle behaviors co-occur and vary by sociodemographic characteristics of the population can assist in identifying population groups at greater risk of poor health.

Limitations

A cross-sectional, self-report telephone survey was used to collect data, which has inherent limitations due to self-report bias and the inability to determine casual relationships. Data from multiple surveys were pooled for analysis and it is possible that the same individual may have participated in more than one survey, however given the sampling methods used this is unlikely. Participants spanned the age ranges although there was a lower proportion of younger adults, which should be addressed in future research given the life changes that occur during young adulthood (eg, study, family, occupation).[40] The presence of sleep disorders was not assessed and may also be a source of potential confounding. Sleep health has multiple components and the current study only assessed a single component, perceived frequency of insufficient sleep, future studies may wish to examine if the identified determinants are consistently associated with the individual components of sleep health.[4]

Conclusion

The current study examined a broad range of potential correlates of frequent perceived insufficient sleep and identified that a number of sociodemographic and behavioral factors were associated with frequent insufficient sleep in Australian adults. Several observations were not consistent with existing research; therefore, further research is necessary to confirm these associations. The use of study designs that can be used to establish causality between these potential determinants and sleep health are warranted and could provide evidence for recommendations to be made to current sleep hygiene practices.

Conflict of interest

None of the authors declare any conflicts of interest.

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Appendix A. Supplementary data

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