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Excessive Daytime Sleepiness

Daytime Sleepiness and Sleep Habits of Australian Workers

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Summary: Excessive daytime sleepiness in the general community is a newly recognized problem about which there is little standardized information. Our aim was to measure the levels of daytime sleepiness and the prevalence of excessive daytime sleepiness in a sample of Australian workers and to relate that to their self-reported sleep habits at night and to their age, sex, and obesity. Sixty-five percent of all 507 employees working during the day for a branch of an Australian corporation answered a sleep questionnaire and the Epworth sleepiness scale (ESS) anonymously. Normal sleepers, without any evidence of a sleep disorder, had ESS scores between 0 and 10, with a mean of 4.6 ± 2.8 (standard deviation). They were clearly separated from the "sleepy" patients suffering from narcolepsy or idiopathic hypersomnia whose ESS scores were in the range 12–24, as described previously. ESS scores >10 were taken to represent excessive daytime sleepiness, the prevalence of which was 10.9%. This was not related significantly to age (22–59 years), sex, obesity, or the use of hypnotic drugs but was related significantly but weakly to sleep-disordered breathing (frequency of snoring and apneas), the presence of insomnia, and reduced time spent in bed (insufficient sleep). **Key Words:** Daytime sleepiness—Average sleep propensity—Epworth sleepiness scale—Insomnia.

Sleep disorders are becoming recognized as major public health problems, particularly in relation to excessive daytime sleepiness (1). The term "sleepiness" is used here in the sense of the propensity to doze or fall asleep when intending to remain awake, to be distinguished from subjective feelings of "tiredness" or "fatigue" that are not always related to sleepiness. Epidemiological surveys in several countries have indicated that the prevalence of excessive daytime sleepiness is between 0.3 and 13.3% among adults in the general community (2). However, each of these investigations used different, nonstandardized methods for measuring sleepiness, which makes comparisons difficult. The Epworth sleepiness scale (ESS) is a simple method that has been shown to be reliable and valid, at least for the majority of subjects (3–7). It enables epidemiological data about daytime sleepiness to be collected in a standardized way.

Excessive sleepiness is associated with neuropsychological deficits that increase the likelihood of mistakes or accidents either while driving or at work (8–11). Sixteen to 20% of motor vehicle accidents on highways have been attributed to driver sleepiness (12). Obstructive sleep apnea (OSA) is commonly associated with excessive daytime sleepiness in the community, as shown by a survey in Wisconsin that used polysomnography to quantify sleep apnea (13). However, other sleep disorders, including insomnia with depressive illness, or simply not getting sufficient sleep can also increase daytime sleepiness (9).

The first aim of the present investigation was to assess the average level of daytime sleepiness, measured in a standardized way by ESS scores, of ostensibly healthy men and women who work during the day in Australia. Their responses to a sleep questionnaire also enabled relationships between daytime sleepiness and age, sex, obesity, and their usual sleep habits to be investigated. Then the ESS responses of these workers were compared with those of "sleepy" patients suffering from narcolepsy or idiopathic hypersomnia who had been involved in an earlier investigation (3). We thereby hoped to elucidate what is normal as opposed to excessive daytime sleepiness, as measured by the ESS.

METHODS

The questionnaire asked 32 questions about the respondent's age, sex, height, weight, job category, sleep

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habits, and sleep problems. The sleep habits referred to were mostly those on weekdays, for those on weekends are known to differ (14). Some questions, such as "How long does it usually take you to fall asleep?" were answered in terms of a time estimate (minutes or hours). Others, such as "According to other people how often do you snore when asleep?" were answered by selecting a number from 1 to 5, where 1 = "seldom, if ever" and 5 = "every day". The usual quality of sleep was rated from 1 to 5, where 1 = "very poor sleep" and 5 = "very good sleep". The eight questions of the ESS were incorporated into the questionnaire, with the same explanation as used elsewhere (3). A subject's usual sleepiness in one situation (situational sleep propensity) is not always closely related to that in other situations (7). The ESS involves eight different situations and activities that are often part of daily life. The total ESS score is a measure of the subject's average sleep propensity in those situations. Scores can vary from 0 to 24. The upper limit of normal is thought to be 10, on the basis of an earlier report about adults without sleep disorders (3).

The 27 sleepy patients (13 with narcolepsy and 14 with idiopathic hypersomnia) whose ESS responses were compared with those of the present workers were diagnosed by overnight polysomnography and multiple sleep latency tests, as previously described (3).

The subjects of the present investigation were all 507 employees (418 men and 89 women) of a major Australian corporation working in various locations in southwest Victoria, Australia, in May 1994. The questionnaire, a postcard, and a letter outlining the study were sent to each person. The questionnaire was answered and returned anonymously. The postcard, which was returned separately, had on it the respondent's name and organizational unit. This was used to assess the representativeness of respondents on the basis of age, sex, and type of work.

The type and hours of work differed among organizational units and between the sexes. Some jobs were mainly outside and physically active; others were inside and mainly sedentary. The former involved a standard working day of 6:30 a.m. to 1:48 p.m., the latter of 7:00 a.m. to 2:18 p.m. Many of the women worked more flexible hours (see below). Their work day of 6 hours 45 minutes could begin at a variety of times staggered between 7:00 a.m. and 4:22 p.m. None worked overnight. The body mass index (BMI) of each subject was calculated from the reported body weight (kilograms) divided by the height (meters) squared. This survey and its methods were approved by the relevant health and safety committees of the corporation.

Statistical analysis was by nonparametric methods (chi-square, Fisher's exact test, Mann-Whitney *U* test, Spearman's rho test). Significance was accepted at $p < 0.05$ in two-tailed tests. Confidence intervals (CI; 95%) were calculated for many of the means.

RESULTS

Respondents

There were 331 respondents, 267 male and 64 female, aged between 22 and 59 years. The overall response rate was 65% (64% for men and 72% for women). Respondents did not differ significantly from nonrespondents in terms of their age, sex, or type of work. The mean age of the men [40.8 ± 8.1 (standard deviation, or SD) years] was similar to that of the women [39.7 ± 10.0 (SD) years]. The majority (262 men and 35 women) worked standard hours; the others (two men and 29 women) worked at more flexible times, as described above. The data about working hours were missing for three men. A higher proportion of men (46.5%) than women (31.1%) were overweight, with a BMI >25. There were few other missing data (e.g. two item scores in all ESS responses), which were replaced by the mean of that variable for all subjects.

Sleep patterns

The usual timing and duration of the respondents' sleep period at night did not differ with the type of work but did differ with the times of work. However, when working at the same time of the day, men (n = 262) and women (n = 35) did not differ in this respect. Overall, the mean sleep period was 7 hours 20 minutes ± 55 minutes (SD). This often included time awake during the night and was not synonymous with the total duration of sleep. There were 7.6% of men and 9.7% of women whose usual sleep period was <6 hours. The total time spent in bed on a weeknight varied from 6 hours to 12 hours 30 minutes, with a mean of 8 hours 15 minutes ± 55 minutes (SD). Purposely having a nap during the day or evening on weekdays, at least fairly often, was reported by 10.5% of men and 3.2% of women, a difference that was not statistically significant. The subjects' overall ratings of their usual quality of sleep did not differ significantly with age, sex, type of work, or the times of work. There were 12.4% of men and 18.8% of women who rated the quality of their usual sleep as "very poor" or "poor". Several more specific sleep problems were commonly reported (Table 1).

Insomnia involves some or all of the following problems: often having difficulty falling asleep and taking more than 30 minutes to do so, waking often during the night, having difficulty going back to sleep, and waking up feeling tired or sleepy. Taking the com-

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TABLE 1. *Percentage of men and women reporting various sleep problems, with the statistical significance of differences between the sexes*

	Men (%)	Women (%)	Fisher's exact test
Very poor or poor quality sleep	12.4	18.8	0.3
Takes >30 minutes to fall asleep	10.6	17.7	0.2
Difficulty falling asleep at least fairly often	10.2	25.0	0.005
Wakes up three or more times per night	18.1	31.3	0.04
At least moderate difficulty going back to sleep	19.5	28.1	0.2
Consulted doctor about sleep	4.5	9.4	0.2
Takes sleep medication at least fairly often	1.1	3.2	0.5
Snores at least fairly often	39.5	18.8	0.002
Stops breathing or makes choking noises at night	30.4	14.1	0.01

bination of poor or very poor quality sleep with one or more of the above symptoms, an estimate can be made that clinically significant insomnia was present in 11.3% of men (CI 7.5–15.1) and 18.8% of women (CI 9.2–28.4). Neither men nor women used medications very often to help them sleep, and few had consulted a doctor about their sleep in the previous year. Women reported more frequently waking at night than men but did not report more difficulty in returning to sleep. The causes for awakenings were not always specified but included extraneous influences such as the need to attend to children during the night.

Snoring was reported more frequently by men than women (p = 0.001) and increased with age in men (p = 0.03) but not in women. Overall, 75.5% of men and 46.9% of women snored at least occasionally. Snoring every night or almost every night (habitual snoring) was reported by 21.8% of men and 11.0% of women. Stopping breathing or making choking noises when asleep (i.e. possible apneas) occurred at least occasionally in 30.4% of men (CI 24.8–36.0) and 14.1% of women (CI 5.6–22.6). The difference between the sexes was statistically significant (p = 0.01); the effect of age was not.

Daytime sleepiness

The mean of ESS scores for all 331 subjects was 5.8 ± 4.0 (SD). That for men was 5.8 ± 4.0 and for women 5.7 ± 3.0, virtually the same. The range of ESS scores was 0–22 (Fig. 1). Daytime sleepiness, as measured by ESS scores for all 331 subjects, was related significantly to their frequency of reported apneas (rated 1 = none to 3 = frequent; rho = 0.18, p = 0.001), the frequency of snoring (1 = none to 5 = every night; rho = 0.13, p = 0.02), the quality of sleep (1 = very poor to 5 = very good; rho = −0.15, p = 0.008), the presence or absence of insomnia (0 = no, 1 = yes; Mann-Whitney U, p = 0.02), the length of the sleep period in hours (rho = −0.13, p = 0.02),

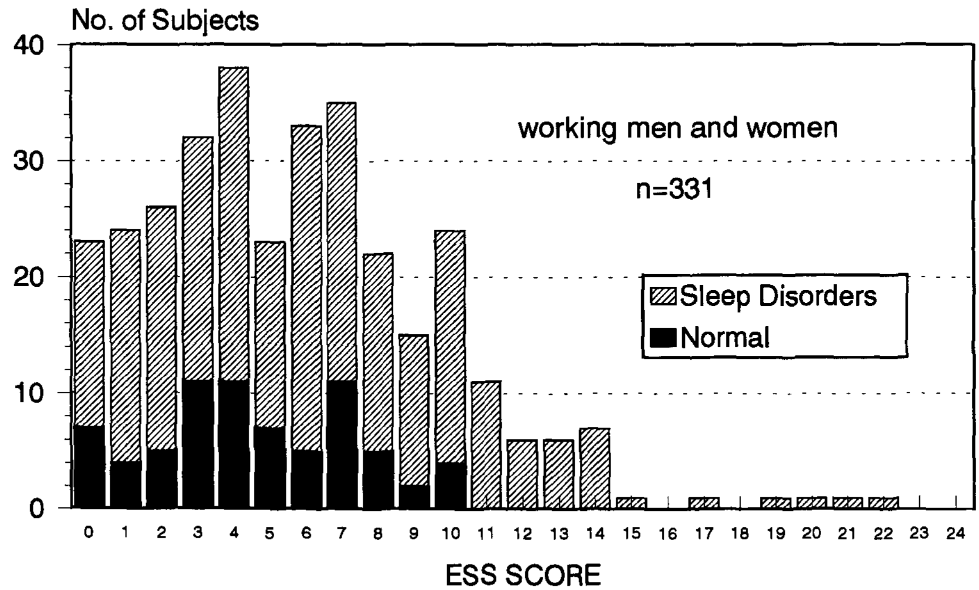

FIG. 1. The frequency distribution of Epworth sleepiness scale scores for the 72 men and women who were normal sleepers and for the 259 other subjects. The majority of the latter subjects with sleep problems had normal daytime sleepiness nevertheless.

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and the time of going to bed at night (rho = 0.12, p = 0.02). It was not related significantly to age, sex, BMI, the time of finally waking, or the use of hypnotic drugs.

Subjects without a sleep disorder

There were 72 subjects (57 men and 15 women) who, by their reports, had no evidence of a sleep disorder and who were taken to represent normal sleepers. Their usual quality of sleep was "very good" or "good"; they did not snore or snored only occasionally; they were not heard to stop breathing or make choking noises during sleep; they seldom had difficulty in falling asleep initially and usually took less than 30 minutes to do so; they did not usually wake more than twice per night, if at all, and they did not have difficulty going back to sleep. These normal sleepers did not differ significantly from other subjects in terms of their age (40.0 ± 8.7 SD years), sex, BMI (25.5 ± 3.5 SD), or hours or type of work. The mean sleep period for the normal sleepers was 7 hours 37 minutes ± 54 minutes (SD), with a range from 5 hours 25 minutes to 11 hours 30 minutes.

The mean ESS score for these normal sleepers was 4.6 ± 2.8 (SD) (CI 3.9–5.3), with a range from 0 to 10 (Fig. 1). This indicates that the normal range of ESS scores should be 0–10, which would coincide with the mean ± 2 SD and with the 5th and 95th percentiles.

Subjects with ESS scores greater than 10

There were 36 subjects (29 men and 7 women) who had ESS scores >10, in the range 11–22. Their prevalence was 10.9%, which was the same for men (CI 7.2–14.6) and women (CI 4.5–21.3). They could be considered to be relatively "sleepy" subjects in comparison with the 72 normal subjects. These sleepy subjects did not differ significantly from the others in terms of their age (mean = 41.0 years), BMI (25.1), type of work, or hours of work. All had evidence of a sleep disorder, even though an accurate diagnosis could not be made by this questionnaire. Fifteen of the 36 (41.7%) snored at least fairly often, 9 (25%) had apneas at least occasionally, and 17 (47.2%) had some form of insomnia. Thus, 25% had some evidence of sleep-disordered breathing, but there were more without than with evidence of sleep-disordered breathing. Insomnia was frequently associated with excessive daytime sleepiness, whether or not the subject also snored and had apneas. The sleep period was less than 7 hours for 17 of the 36 sleepy subjects and less than 6 hours for 7. It appears likely, therefore, that some of these subjects were excessively sleepy simply because they did not have enough sleep to meet their needs, especially since some reported the quality of their sleep as "good" or "very good". Considering all 259 subjects (331 minus 72 normal subjects) who had evidence of a sleep disorder, only 36 (14%) had ESS scores >10. The majority of workers with a sleep disorder, albeit simple snoring, had ESS scores within the normal range, 0–10 (Fig. 1).

Comparisons with "sleepy" patients

Patients with narcolepsy or idiopathic hypersomnia invariably suffer from excessive daytime sleepiness (15). Whatever their level of daytime sleepiness, it can be taken to be abnormal. Their ESS scores reflect that, with a mean of 17.6 ± 3.5 (SD) for the 27 patients here, 20.1 ± 2.7 for 188 narcoleptics in the U.K. (15), and 16.6 ± 4.3 for 12 narcoleptics in Florida (6). By contrast, the ESS scores of patients with obstructive sleep apnea are often, but not always, >10 (5). The ESS scores of the 27 sleepy patients here ranged from 12 to 24, clearly separating them from normal. Neither the multiple sleep latency test (MSLT) nor any other comparable test of daytime sleepiness has been shown to achieve this separation between normal and abnormal results. For example, 80–90% of narcoleptics have a mean sleep onset latency in the MSLT of ≤5 minutes, but so do 25% of normal subjects (16).

The relative soporific nature of the eight situations in the ESS has been described previously for patients in the Epworth Sleep Centre (7). The situations in items 5, 2, and 1 were the most soporific, items 4, 3, and 7 were intermediate, and items 6 and 8 were the least soporific for three separate groups of patients. Those rankings were the same here for the group of 331 subjects, as well as for the subgroups of normal and sleepy workers and for the 27 sleepy patients.

Normal and abnormal daytime sleepiness measured by the ESS

What it means to have normal or abnormal ESS scores can be illustrated by comparing the item scores of three of these groups of subjects: the 72 normal subjects, 36 sleepy workers, and 27 sleepy patients. Table 2 shows the percentage of subjects in each group who reported their chances of dozing in each of the eight situations. As a matter of clinical experience, normal subjects do not often doze when intending to stay awake during the day. However, the results in Table 2 show that many normal subjects have a slight or moderate chance of dozing in relatively soporific situations such as lying down to rest in the afternoon

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TABLE 2. *Percentage of subjects in each of three groups reporting their usual chances of dozing in the eight situations of the Epworth sleepiness scale*

Item no.	Situation	Group[a]	% of subjects for whom chance of dozing was: None	Slight	Moderate	High
1	Sitting and reading	a	44	44	8	3
		b	6	16	39	39
		c	0	7	19	74
2	Watching television	a	28	46	21	5
		b	0	16	42	42
		c	0	18	4	78
3	Sitting, inactive in a public place	a	71	25	4	0
		b	8	47	19	25
		c	0	15	48	37
4	As a passenger in a car for an hour without a break	a	61	19	17	3
		b	3	33	25	39
		c	4	19	22	56
5	Lying down to rest in the afternoon when circumstances permit	a	24	33	27	17
		b	0	6	11	83
		c	0	0	4	96
6	Sitting and talking to someone	a	93	7	0	0
		b	58	36	3	3
		c	19	48	26	7
7	Sitting quietly after a lunch without alcohol	a	63	33	4	0
		b	6	42	28	25
		c	0	30	22	48
8	In a car, while stopped for a few minutes in traffic	a	93	7	0	0
		b	64	28	8	0
		c	18	41	19	22

Numbers are rounded to nearest integer.
[a] Group a = 72 normal subjects, group b = 36 "sleepy" workers, and group c = 27 "sleepy" patients with narcolepsy or idiopathic hypersomnia.

when circumstances permit (item 5), when watching television (item 2), or when sitting and reading (item 1). Few have a high chance of dozing in those situations. By contrast, patients with narcolepsy or idiopathic hypersomnia have a high chance of dozing in those situations. They also have a moderate or high chance of dozing in much less soporific situations, such as sitting and talking to someone (item 6) or in a car while stopped for a few minutes in traffic (item 8). The higher the total ESS score, the more likely that person is to doze in nonsoporific situations. The 36 sleepy workers here had a mean ESS score of 13.4 ± 2.9 (SD). Their chances of dozing in each situation were intermediate between those of the normal subjects and the sleepy patients (Table 2). Thus, ESS scores and the average sleep propensity that they represent are a continuum from low-normal to very high (0–24).

DISCUSSION

The results provide information about normal and abnormal daytime sleepiness; data were collected in a standardized way from Australian workers for the first time. The 72 normal sleepers had ESS scores that ranged from 0 to 10, with a mean of 4.6 ± 2.8 (SD). This is similar to that reported for 188 normal subjects in the U.K. [4.5 ± 2.2 (SD)] (15). Both figures are slightly lower than that for normal subjects reported previously [5.9 ± 2.2 (SD)] (3). The lower limit of normal scores was reported previously as 2, but with the present results, that should now be extended to 0. ESS scores and the average sleep propensity in daily life that they reflect are continuous variables, but scores >10 can be said to represent excessive daytime sleepiness, i.e. the tendency to doze in situations that seldom facilitate dozing in normal subjects.

The sleep habits reported by these Australian workers are consistent with those reported previously (14). These subjects are probably typical of a large section of the Australian community that works during the day. However, other occupational groups, such as night-shift workers, would differ. The prevalence of excessive daytime sleepiness, defined here as an ESS score >10, was 10.9%. It was the same for men and women, although there were far fewer women than men in the group, and small differences between the sexes may not have been detected. In a large, randomized sample of adults from general practices in the U.K., 18.3% of men and 16.2% of women had ESS scores >10 (17). In another large survey in the U.K., 12.0% of male car drivers and 8.5% of truck drivers had ESS scores >10, a prevalence similar to that reported here (18). Their ESS scores were related significantly to their frequency of road accidents and to the tendency to doze at the wheel without having an

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accident. The ESS scores in the present survey did not vary significantly with age within the range 22–59 years. However, subjects older than 60 or younger than 22 years may be different (4). Daytime sleepiness was not related significantly to obesity, confirming the findings of Schmidt-Nowara et al. (19).

Subjective reports of sleep habits cannot provide accurate diagnoses to explain excessive daytime sleepiness in terms of sleep disorders. Nevertheless, analysis of the relationships between ESS scores and the reported characteristics of sleep at night for the whole group of 331 subjects, and for the subgroup of sleepy workers with ESS scores >10, suggests that sleep-disordered breathing, insomnia, and insufficient sleep may all have contributed to their daytime sleepiness. Similar conclusions have been reported from a large survey using a different questionnaire in Finland (20). However, none of the relationships between sleep habits and daytime sleepiness was very close (rho approximately 0.15). This is not simply because of inaccuracies with subjective reports. Objective measurements of sleep by overnight polysomnography are not closely related to daytime sleepiness measured by the MSLT either (21). Part of the difference in daytime sleepiness among subjects may not be due to sleep disorders, at least as we currently assess them, but to other factors that may be psychophysiological, perhaps partly inherited and partly learned. This requires further investigation. The daytime sleepiness that is measured by the ESS is an average over a period of days or longer. Sleepiness can be further increased in the short term, for example, after a night without sleep, after taking a sedative drug, or after heavy consumption of alcohol at night that temporarily makes any sleep apnea worse. Alcohol consumption was not assessed in this investigation, which is a limitation.

Excessive daytime sleepiness, measured by a standardized method in a sample of Australian workers, has a relatively high prevalence (10.9%). This adds weight to the contention of others that, because of its consequences, it represents a major public health problem (1).

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