Prevalence and Risk Factors of Subjective Sleepiness in the General Adult Population

Ståle Pallesen, PhD[1,3]; Inger Hilde Nordhus, PhD[2,3]; Siri Omvik, Psy D[2]; Børge Sivertsen, PhD[2]; Grethe S Tell, PhD[4]; Bjørn Bjorvatn, MD, PhD[3,4]

[1]Department of Psychosocial Science, University of Bergen; [2]Department of Clinical Psychology, University of Bergen; [3]Norwegian Competence Center for Sleep Disorders, Haukeland University Hospital; [4]Department of Public Health and Primary Health Care, University of Bergen, Norway

Study Objectives: The aim of this study was to investigate the prevalence and risk factors of self-reported excessive daytime sleepiness (EDS) in Norway.

Design: The Epworth Sleepiness Scale was administered by a telephone interview to a random sample of 2301 adult inhabitants of Norway. Questions of demography, symptoms of sleep disorders, and depression were included.

Setting: Norway

Participants: Two thousand three hundred one subjects, 18 years and older.

Interventions: N/A.

Measurements and Results: The mean score of the Epworth Sleepiness Scale was 6.95 (SD = 3.8), and 17.7% had a score (>10), indicating EDS. Univariate logistic regression analyses showed that being a man; living in southern Norway; working nights; being young; having symptoms of cataplexy, restless legs, or periodic limb movement in sleep; having breathing pauses in sleep; and having symptoms of depression were significantly related to EDS. Of these 9 predictors, only symptoms of restless legs did not maintain the significant relationship with EDS when a multiple logistic regression analysis was performed.

Conclusions: The prevalence of EDS was high in this adult Norwegian population sample. EDS seems to be related to several symptoms of sleep disorders.

Keywords: Epworth Sleepiness Scale, epidemiology, predictors, excessive daytime sleepiness, sleep disorders.

Citation: Pallesen S; Nordhus IH; Omvik S et al. Prevalence and risk factors of subjective sleepiness in the general adult population. *SLEEP* 2007;30(5):619-624

EXCESSIVE DAYTIME SLEEPINESS (EDS) SEEMS TO BE AN INCREASING PROBLEM IN THE GENERAL POPULATION AND MAY HAVE SEVERAL NEGATIVE consequences.[1] Some studies indicate that a large proportion of injuries and accidents can be attributed to sleepiness, fatigue, or both.[2-3] Furthermore, catastrophic industrial and engineering disasters have been related to sleepiness on night shifts.[4] Besides the human sacrifices, sleep-related accidents are also associated with economic losses.[5] Sleepiness is furthermore related to lowered mood[6] and poor scholastic performance.[7]

EDS may be caused by several factors, of which primary sleep disorders, including obstructive sleep apnea, may be the most important contributors. Obesity is a risk factor for developing sleep apnea, a disorder that is more prevalent in elderly than younger subjects.[8] Other primary sleep disorders that may cause EDS are restless legs syndrome, [9] periodic limb movement disorder,[10] insomnia,[11] and narcolepsy.[12] Factors other than primary sleep disorders also induce EDS. One such central factor is night work, which normally causes a reduction in sleep length following the night shift, compared to the length of nocturnal sleep.[13] Sleep difficulties and EDS are therefore common complaints among night workers.[14] In depression, sleep disturbances ranging from insomnia to hypersomnia, including EDS, are commonly seen and might be mediated by malfunction in important brain circuits.[15] An additional factor that also may be related to EDS is season. It has been found that daytime impairment due to poor sleep is more prevalent during winter, compared to summer. This is hypothesized to be related to seasonal differences in natural illumination, possibly mediated by melatonin.[16]

EDS can be characterized in many different ways and a common distinction is drawn between physiologic, manifest, and introspective (subjective) sleepiness.[17] Measures of the latter can be subdivided into state measures, which are sensitive to abrupt changes caused for example by sleep deprivation, and trait measures, which primarily measure the respondents' general tendency to experience sleepiness. The by far most commonly employed subjective trait measure of sleepiness is the Epworth Sleepiness Scale (ESS).[18] It describes 8 situations, and the respondents estimate their likelihood of dozing off in each situation using a 4-point scale. The total score ranges from 0 to 24, in which scores above 10 are regarded as indicative of EDS.[18]

Up until recently, epidemiologic sleep research suffered from the lack of standardized subjective measures of EDS, resulting in a wide range of EDS prevalence estimates.[19] However, in some recent population-based studies using the ESS, the mean score ranged from 5.9[18] to 10.0.[20] The proportion of respondents scoring above 10 seems to vary between 6.4% and 24.5%.[21] Nevertheless, epidemiologic studies employing the ESS in general community samples selected on a nation-wide basis are few in number. In addition, few epidemiologic studies have systematically investigated relevant predictors of sleepiness.

In 2001,[16] we published a study on the prevalence of insomnia that incorporated 1 item about daytime impairment. The results showed, among other things, that daytime impairment was more prevalent during winter than in summer. Sleep-onset insomnia

Disclosure Statement

This is not an industry supported study. Dr. Bjorvatn has received research support from H. Lundbeck, A/S and has participated in speaking engagements for H. Lundbeck, A/S, Wyeth, Pfizer, Polarmed, and Boehringer-Ingelheim. Drs. Pallesen, Nordhus, Omvik, Sivertsen, and Tell have indicated no financial conflicts of interest.

Submitted for publication November, 2006
Accepted for publication December, 2006

Address correspondence to: Ståle Pallesen, Department of Psychosocial Science, University of Bergen, Christiesgt. 12, 5015 Bergen Norway; Tel: 47 55 58 88 42; Fax: 47 55 58 98 77; E-mail: staale.pallesen@psysp.uib.no

and total insomnia (all inclusion criteria) were related to an interaction effect between region and season in such a way that it was shown to be more prevalent in summer than winter in northern Norway, but showed the reverse relationship in southern Norway, thus underscoring the importance of including season and region as variables in epidemiologic sleep studies.[16] The design of the present study was similar to the one referred to above, but the focus of the present study was primarily on sleepiness, using the ESS, defining EDS as a score above 10. Predictors included sex, age, socioeconomic status, latitude, season, body mass index (BMI), night work, insomnia, cataplexy, restless legs, periodic limb movements of sleep, snoring, and breathing pauses during sleep, as well as symptoms of depression.

METHODS

Participants

A group of 2301 randomly selected adults, 1259 women and 1042 men, stratified by the number of inhabitants of each county of Norway, participated in the study. Mean unweighted age of the sample was 47.6 years (SD = 15.7; range = 18-90 years). Of the total sample, 8.9% had no education subsequent to mandatory schooling, whereas 29.7% had 1 to 3 years, 31.6% had 4 to 6 years, and 29.8% had more than 6 years of education subsequent to mandatory schooling, respectively. Furthermore, 14.0% of the sample had a family income below 300,000 NOK (7 NOK = $1), 37.1% had a family income between 300,000 and 599,000 NOK, and 29.6% had a family income of 600,000 NOK or more, whereas 19.3% did not report their family income. The mean BMI of the sample was 24.7 (SD = 3.9).

Measurements

In addition to demographic and other background information (age, sex, education, place of residence, family income, height, and weight), the participants were asked to report on sleepiness by completing the ESS. Furthermore, the following questions concerning symptoms of sleep disorders and depression were asked: During the past 4 weeks: (1) How often did you engage in night work, ie, work between 10:00 PM and 7:00 AM? (2) How often did you experience difficulty falling asleep or maintaining sleep? (3) How often did you experience loss of muscle tone (eg, unlocking of the knees) elicited by emotions such as laughter, anger, or surprise? (4) How often did you experience restlessness or "crawling" feelings in your legs at night that were relieved by movement? (5) Do you know (possibly through others) how often you have had repeated rhythmic leg jerks or leg twitches during your sleep? (6) Do you know (possibly through others) how often you have had loud and disturbing snoring? (7) Do you know (possibly through others) how often you have had breathing pauses or stopped breathing in your sleep? (8) How often have you felt depressed most of the day or experienced diminished interest or pleasure in activities you usually enjoy? These 8 questions all had the same response alternatives (never, sometimes, usually, always). Some of these questions were taken from the Global Sleep Assessment Questionnaire.[22]

Procedure

The study was part of a telephone interview conducted by an opinion-research institute (Opinion), employing the next-birthday technique. In the next-birthday technique, the interviewer asks to speak to the adult member of the household whose birthday comes up next. It is based on the assumption that assignment of birthdates is a random process. Thus, the next-birthday technique constitutes a procedure of randomly selecting individuals within a household, preventing potential selection bias.[23] When no one answered the phone, the number was called up to 6 times. In all, 1301 of the interviews were conducted during winter (1003 during the first 2 weeks of December 2002 and 298 during the first 2 weeks of January 2003), whereas 1000 interviews were conducted during summer (during the first 2 weeks of June 2003). Thus, a total of 2301 respondents participated. This sample was drawn randomly from a survey population, consisting of a telephone-number register that includes approximately 98% of the population. The response rate was 53.2%. In order to investigate whether sleepiness was related to age, the sample was divided into 4 age groups: (1) 18 to 29 years, (2) 30 to 44 years, (3) 45 to 59 years, and (4) 60 years and above. Socioeconomic status was based on length of education and family income. These 2 items were transformed into z-scores and added in order to create a single composite variable. Based upon quartiles, socioeconomic status was divided into 4 groups (low, moderately low, moderately high, and high socioeconomic status). For analyses of regional differences, the 5 most northern counties of Norway were defined as northern (62° - 71° north), whereas the other counties were defined as southern (58° - 62° north).

Statistics

The data analyses were performed with SPSS version 12.0.[24] All prevalence estimates, confidence intervals (CI), and scores of each item of the ESS were calculated by weighting the cases according to the population distribution of sex and age in order to correct for potential divergence between the sample and the distribution of age and sex in the general population of Norway.[25] A weight of 1 would indicate no discrepancy between the sample and the population. The mean discrepancy between the actual weight and 1 was 0.28. Differences in the prevalence of EDS between sex and age groups were explored using the χ^2-statistics. A univariate weighted logistic regression analysis was conducted in order to investigate whether demographic and sleep variables were related to excessive sleepiness (ESS score >10). Sex, region (northern or southern Norway), season (winter or summer), and weight (BMI below or above 30) comprised dichotomous variables, whereas the rest of the predictors (age group, socioeconomic status, night work, symptoms of insomnia, cataplexy, restless legs, periodic limb movements of sleep, snoring, breathing pauses, and depression) all had 4 categories. Except for age group and socioeconomic status, these were "never," "sometimes," "usually," and "always." One interaction term (Region × Season) was also included as a predictor in the logistic regression analysis. The correlation coefficients between the predictor variables were in all cases less than 0.31. Thus, interpretation of the odds ratio for each predictor variable should not be strongly affected by collinearity. The significant predictors from the univariate analysis were subsequently entered into a multivariate analysis in order to identify the independent significant predictors of EDS

(ESS score > 10).

RESULTS

The overall weighted mean ESS score was 6.95 (SD = 3.8, range = 0-22), 7.39 (SD = 3.8) for men and 6.54 (SD = 3.7) for women. In all, 17.7% (95% CI = 16.0 - 19.4) of the respondents had ESS scores above 10 and were accordingly classified with EDS. Table 1 shows the percentages of the respondents classified with EDS in different age and sex groups. Only the sex difference in the oldest age group (60 years and above) was significant ($\chi^2 = 4.11$, df = 1, $P < 0.05$), showing that EDS was more prevalent among older men than women. EDS was more prevalent in the 18- to 29-year group compared with the 45- to 59-year group ($\chi^2 = 6.60$, df = 1, $P < 0.05$) and the 60-years-and-above age group ($\chi^2 = 12.87$, df = 1, $P < 0.01$). Table 2 shows the weighted prevalences of EDS broken down by responses to sleep and further demographic variables. Table 3 shows the results from the univariate regression analyses comprising 15 predictor variables and EDS as the criterion variable. Nine of 15 predictor variables showed a significant relationship with EDS. These were sex, region, age group, night work, cataplexy, restless legs, periodic limb movements of sleep, breathing pauses in sleep, and depression. When these 9 variables were entered into a multivariate analysis, all variables except restless legs syndrome remained significant (see Table 3).

Table 1—The Prevalence of Excessive Daytime Sleepiness in Different Age and Sex Groups

Age group, y	Men	Women
18-29[a]	25.3 (19.3-31.3)	20.8 (15.1-26.5)
30-44	20.1 (15.5-24.7)	16.1 (11.7-20.5)
45-59	19.1 (14.1-24.0)	13.8 (9.4-18.2)
60+	17.5 (12.0-23.0)[b]	10.8 (7.0-14.7)

Data are presented as percentages (95% confidence intervals). Excessive daytime sleepiness is defined as an Epworth Sleepiness Scale Score > 10.
[a]Excessive daytime sleepiness was significantly more prevalent in this age group compared to the 45-59 and the 60 years and above age groups.
[b]Excessive daytime sleepiness was significantly more prevalent in men compared to women in this age group.

DISCUSSION

The overall mean ESS score in the present study was 6.95, similar to that obtained in other studies of general adult population samples.[26-27] A total of 17.7% had ESS scores above 10, meeting the criterion for having EDS. Also, this figure is similar to that of a study with a comparable sample.[27] Still, the prevalence of EDS should be considered high since about 1 in 6 respondents reported subjective sleepiness in the pathologic range.

Overall, sex was a significant predictor of EDS showing that men reported a higher prevalence than women. In a recent study in which items from several sleep questionnaires were examined by factor analysis, it was found that women scored higher than men on items reflecting general perceived sleepiness. However, on items reflecting sleep propensity in both active and passive situations, such as reflected by the ESS, men scored higher than women.[28] This finding is thus confirmed in the present as well as in several other studies.[27,29-30] Such findings have further been corroborated by measures of objective daytime sleepiness.[31] Based upon the fact that sleep quality in general deteriorates with age, a positive relationship between age and EDS, as reported in a similar study,[27] was expected. It was therefore somewhat surpris-

Table 2—The Weighted Prevalence (Given in Percentage) and 95% Confidence Intervals of ESS Scores Above 10 In The Different Response Categories To The Questions About Sleep, Depression, Region, Season, Socioeconomic Status, and Body Mass Index

	Night work	Insomnia	Cataplexy	Restless legs	Limb movements	Loud snoring	Breathing pauses	Depression
Never	16.7 (14.9-18.6)	18.3 (15.7-21.0)	16.1 (14.4-17.9)	16.4 (14.4-18.4)	16.0 (14.0-17.9)	16.1 (13.7-18.6)	17.1 (15.1-19.0)	15.6 (13.6-17.5)
Sometimes	23.8 (18.6-29.1)	17.3 (14.6-20.0)	30.6 (23.6-37.1)	21.3 (17.4-25.2)	21.7 (16.6-26.9)	20.0 (16.5-23.4)	30.0 (20.4-39.6)	23.4 (19.7-27.0)
Usually	9.9 (1.4-18.4)	17.9 (12.6-23.1)	47.3 (26.3-68.4)	21.2 (12.5-29.9)	46.3 (31.3-61.3)	21.4 (15.7-27.0)	10.8 (- 3.8-25.3)	16.8 (7.9-25.8)
Always	30.2 (11.3-49.2)	16.9 (9.7-24.1)	N/A	22.0 (8.5-35.6)	32.0 (4.2-59.7)	18.9 (11.6-26.3)	32.4 (3.0-61.7)	18.2 (-12.0-48.4)

N/A refers to not available due to few respondents (< 10).

Region		Season		Socioeconomic status		Body mass index (BMI)	
North	12.6 (9.2-16.1)	Winter	17.9 (15.5-20.4)	Highest quartile	18.3 (14.8-21.9)	Underweight < 18.5	19.5 (8.1-30.9)
South	18.9 (17.0-20.9)	Summer	17.5 (15.1-20.0)	Third quartile	16.6 (13.2-19.9)	Normal weight ≥ 18.5 and < 25	17.8 (15.5-20.1)
				Second quartile	19.5 (15.9-23.1)	Overweight ≥ 25 and < 30	18.9 (15.8-22.0)
				Lowest quartile	16.6 (13.4-19.9)	Obese ≥ 30	16.6 (10.2-23.0)

Table 3—Weighted Logistic Regression Analysis Comprising 15 Predictor Variables and Excessive Daytime Sleepiness as the Criterion Variable

Predictor	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Sex		
Women (n = 1259)	1.00	1.00
Men (n = 1042)	1.44 (1.14-1.83)	1.54 (1.15-2.07)
Region		
Northern Norway (n = 432)	1.00	1.00
Southern Norway (n = 1869)	1.62 (1.16-2.25)	1.63 (1.09-2.42)
Season		
Summer (n = 1000)	1.00	
Winter (n = 1301)	1.03 (0.81-1.30)	
Region × Season	1.12 (0.88-1.42)	
Body mass index		
< 30 (n = 2065)	1.00	
≥ 30 (n = 171)	0.89 (0.55-1.43)	
Age group, y		
18-29 (n = 281)	1.89 (1.32-2.71)	1.76 (1.12-2.77)
30-44 (n = 256)	1.40 (0.99-1.98)	1.36 (0.89-2.10)
45-59 (n = 750)	1.24 (0.87-1.78)	1.10 (0.70-1.74)
60+ (n = 514)	1.00	1.00
Socioeconomic status		
Lower quartile (n = 606)	0.89 (0.64-1.24)	
Second quartile (n = 555)	1.08 (0.78-1.50)	
Third quartile (n = 579)	0.88 (0.63-1.24)	
Upper quartile (n = 561)	1.00	
Night work		
Never (n = 1902)	1.00	1.00
Sometimes (n = 292)	1.56 (1.13-2.13)	1.75 (1.21-2.55)
Usually (n = 57)	0.55 (0.22-1.38)	0.44 (0.15-1.32)
Always (n = 30)	2.16 (0.92-5.03)	2.28 (0.74-7.02)
Insomnia		
Never (n = 999)	1.00	
Sometimes (n = 884)	0.93 (0.72-1.21)	
Usually (n = 266)	0.97 (0.65-1.44)	
Always (n = 146)	0.91 (0.53-1.55)	
Cataplexy		
Never (n = 1998)	1.00	1.00
Sometimes (n = 218)	2.27 (1.61-3.19)	1.83 (1.17-2.85)
Usually (n = 33)	4.67 (2.11-10.36)	5.51 (2.02-15.05)
Always (n = 12)	N/A	N/A
Restless legs		
Never (n = 1599)	1.00	1.00
Sometimes (n = 506)	1.38 (1.05-1.81)	1.19 (0.84-1.69)
Usually (n = 115)	1.37 (0.80-2.33)	1.66 (0.84-3.27)
Always (n = 51)	1.44 (0.67-3.10)	0.85 (0.28-2.55)
Periodic limb movements in sleep		
Never (n = 1603)	1.00	1.00
Sometimes (n = 298)	1.46 (1.05-2.04)	1.17 (0.80-1.73)
Usually (n = 54)	4.53 (2.49-8.25)	2.78 (1.23-6.29)
Always (n = 16)	2.47 (0.80-7.62)	2.99 (0.57-15.72)
Snoring		
Never (n = 1013)	1.00	
Sometimes (n = 618)	1.30 (0.98-1.72)	
Usually (n = 261)	1.41 (0.97-2.06)	
Always (n = 150)	1.21 (0.72-2.01)	
Breathing pauses in sleep		
Never (n = 1731)	1.00	1.00
Sometimes (n = 109)	2.08 (1.30-3.32)	1.90 (1.10-3.26)
Usually (n = 25)	0.58 (0.14-2.36)	N/A
Always(n = 16)	2.32 (0.72-7.74)	2.63 (0.64-10.89)
Depression		
Never (n = 1568)	1.00	1.00
Sometimes (n = 608)	1.65 (1.28-2.13)	1.69 (1.24-2.31)
Usually (n = 96)	1.10 (0.58-2.09)	0.74 (0.29-1.93)
Always (n = 13)	1.21 (0.23-6.13)	0.83 (0.13-5.48)

Note: For some questions, the number of respondents does not add up to 2301 due to nonresponders. CI refers to confidence interval; N/A, not available due to few respondents.

ing that the relationship between EDS and age was reversed in the present study, but also such findings have been reported elsewhere[32] and may reflect a greater sleep debt in younger compared with older subjects.[16] Besides age and sex, region was a significant predictor of EDS in the univariate as well as in the multivariate analyses, showing a higher prevalence of sleepiness in the southern compared to the northern regions of Norway.

It is not clear why the results turned out this way. Studies have shown that ethnic differences in sleepiness may exist.[27] The indigenous people of Scandinavia, the Sami people, primarily live in the northern part of Norway, and, in one study, subjects from the Sami people were shown to be more resistant to mood changes due to season than were other Scandinavians.[33] Another possible explanation for the regional differences in EDS is related to natural illumination, which varies more with seasons in northern than in southern Norway. It seems unlikely, however, that seasonal fluctuations in illumination could be directly related to subjective sleepiness given that the Season × Region interaction turned out to be nonsignificant. In our study published in 2001,[16] we found that, although the general level of sleep problems was similar in northern and southern Norway, the level of hypnotic use was significantly higher in the latter. This underscores the existence of cultural and regional differences regarding experiencing, reporting, and responding to sleep-related phenomena. Moreover, in a study using the ESS in 10 countries, there were large national differences in the level of EDS. However, because nonprobability samples were employed, firm conclusions about geographic and ethnic differences cannot be drawn on the basis of that study.[21] EDS was not associated with subjective reports of insomnia in the present study. This may be related to the fact that one subgroup of insomniacs seems to be characterized by hyperarousal, assumed to counteract sleepiness.[34] Snoring is a symptom of sleep-related breathing disorders and would therefore be expected to be associated with EDS, as has been reported by others.[29] However, this turned out not to be the case in the present study. A possible explanation for this might be that snoring is also fairly common in healthy individuals.[35] Because obesity has been linked to sleepiness even in studies controlling for sleep-disordered breathing,[36] the finding from this study revealing no association between BMI and subjective sleepiness was also unexpected. Night work has consistently been related to sleepiness,[14] a finding confirmed in the present study. Contrary to another study,[26] socioeconomic status was not related to sleepiness. We have previously reported that the risk of reporting daytime impairment was greater during

winter than in summer.[16] The results from the present study do not however suggest a relationship between sleepiness and season. The apparent discrepancy between these findings seems to be related to the difference between perceived general sleepiness and subjective sleep propensity in active and passive situations.[28] So far, the data indicate that perceived general sleepiness is influenced by season, whereas this does not seem to be the case for subjective sleep propensity. However, this interpretation should be corroborated by further studies.

Overall, our results do show that predictors considered as relatively unambiguous symptoms of sleep disorders, such as cataplexy, restless legs, periodic limb movements of sleep, and breathing pauses,[37] all were significantly related to EDS in the univariate analyses. In the multivariate analysis, only restless legs did not maintain the significant relationship with EDS. Depression was significantly related to EDS in both the univariate and multivariate analyses. This finding is in line with the fact that sleepiness is related to lowered mood[6] and the presumption that depression is related to disturbances in pathways involved in the regulation of sleep and wakefulness.[15]

Limitations of the Present Study

The response rate of 53.2 % was relatively low, hence the estimated prevalence of sleepiness may be uncertain. The participation rate is however comparable to that of other sleep-related epidemiologic studies.[16, 38] It could be argued that people with sleep problems may have been more willing to participate than were people without such problems. However, the questions in the present study were asked as a part of an omnibus that also included questions about other topics, reducing the probability of self-selection of subjects with sleep problems. Compared to our 2001 study,[16] the mean age and level of education of the participants were somewhat higher in the present study. The cases were weighted in order to adjust for sex and age discrepancies between the sample and the population.[25] The level of adjustment in the present study was identical to the adjustment in the 2001 study.[16] When analyzing the prevalence of EDS in some subgroups, the CI became very wide due to the low number of respondents. It should also be noted that the instrument employed for measuring sleepiness in the present study, the ESS, has been the object of some criticism because the scores often diverge from scores of objective measures of sleepiness.[39] Thus, subjective sleepiness does not necessarily represent the same construct as objective sleepiness. The lack of data on sleep duration in the present study is of concern, especially because sleep duration has been found to be related to sleepiness,[40] as well as to sex[41] and possibly to region.[42] Thus, the unexpected sex and regional differences noted could reflect variability in sleep duration. It should also be noted that the lack of association between snoring and EDS in the present study could reflect random misclassification of variables because such misclassification normally weakens the degree of any association.

CONCLUSIONS

The overall prevalence of subjective EDS was high, 17.7%. Subjective EDS was related to male sex and being a young adult. EDS does not seem to be strongly related to some symptoms of sleep disorders, such as being overweight and snoring, whereas other symptoms of sleep disorders such as breathing pauses, cataplexy, and periodic limb movements in sleep were consistent predictors of EDS.

ACKNOWLEDGMENTS

This study was supported by a grant from the Research Council of Norway.

REFERENCES

1. Ferrara M, DeGennaro L. How much sleep do we need? Sleep Med Rev 2001;5:155-79.
2. Melamed S, Oksenberg A. Excessive daytime sleepiness and risk of occupational injuries in non-shift daytime workers. Sleep 2002;25:315-22.
3. Powell NB, Schechtman KB, Riley RW, Li K, Guilleminault C. Sleepy driving: Accidents and injury. Otolaryngol Head Neck Surg 2002;126:217-27.
4. Mitler MM, Carskadon MA, Czeisler CA, Dement WC, Dinges DF, Graeber, RC. Catastrophes, sleep, and public policy: Consensus report. Sleep 1998;11:100-9.
5. Dinges DF. An overview of sleepiness and accidents. J Sleep Res 1995;4:4-14.
6. Jean-Louis G, von Gizycki H, Zizi F, Nunes J. Mood states and sleepiness in college students: influence of age, sex, habitual sleep and substance use. Percept Mot Skills 1998;87:507-12.
7. Tagaya H, Uchiyama M, Ohida T, et al. Sleep habits and factors associated with short sleep duration among Japanese high-school students: A community study. Sleep Biol Rhythms 2004;2:57-64.
8. Bassiri AG, Guilleminault C. Clinical features and evaluation of obstructive sleep apnea-hypopnea syndrome. In: Kryger MH, Roth T, Dement WC, eds. Principles and practice of sleep medicine, 3rd ed. Philadelphia: WB Saunders; 2000:869-78.
9. Allen RP, Picchietti D, Hening WA, Trenkwalder C, Walters AS, Montplaisir J, the participants in the Restless Legs Syndrome Diagnosis and Epidemiology workshop at the National Institutes of Health in collaboration with members of the International Restless Legs Syndrome Study Group. Restless legs syndrome: diagnostic criteria, special considerations, and epidemiology. A report from the restless legs syndrome diagnosis and epidemiology workshop at the National Institute of Health. Sleep Med 2003;4:101-19.
10. Montplaisir J, Nicolas A, Godbout R, Walters A. Restless legs syndrome and periodic limb movement disorders. In: Kryger MH, Roth T, Dement WC, eds. Principles and practice of sleep medicine, 3rd ed. Philadelphia: WB Saunders; 2000:742-52.
11. Hauri PJ. Insomnia. Clin Chest Med 1998;19:157-68.
12. Zeman A, Britton T, Douglas N, et al. Narcolepsy and excessive daytime sleepiness. BMJ 2004;329:724-8.
13. Pilcher JJ, Lambert BJ, Huffcutt AI. Differential effects of permanent and rotating shifts on self-report sleep length: a meta-analytic review. Sleep 2000;23:155-63.
14. Åkerstedt T. Work hours, sleepiness and the underlying mechanisms. J Sleep Res 1995;4:15-22.
15. Stahl SM, Zhang L, Damatarca C, Grady M. Brain circuits determine destiny in depression: A novel approach to the psychopharmacology of wakefulness, fatigue, and executive dysfunction in major depressive disorder. J Clin Psychiatry 2003;64:6-17.
16. Pallesen S, Nordhus IH, Nielsen GH, et al. Prevalence of insomnia in the adult Norwegian population. Sleep 2001;24:771-9.
17. Mysliwiec V, Henderson JH, Strollo PJ. Epidemiology, consequences, and evaluation of excessive daytime sleepiness. In: Lee-Chiong TL, Sateia MJ, Carskadon MA, eds. Sleep Medicine. Philadelphia: Hanley Belfus; 2002:187-92.
18. Johns MW. A new method for measuring daytime sleepiness: the

Epworth Sleepiness Scale. Sleep 1991;14:540-5.
19. D'Alessandro R, Rinaldi R, Cristina E, Gamberin, G, Lugaresi E. Prevalence of excessive daytime sleepiness. An open epidemiological problem. Sleep 1995;18:389-91.
20. Aloe F, Pedroso, A, Tavares SM. Epworth sleepiness scale outcome in 616 Brazilian medical students. Arq Neuropsiquiatr 1997;55:220-6.
21. Soldatos CR, Allaert FA, Ohta T, Diekos DG. How do individuals sleep around the world? Results from a single-day survey in ten countries. Sleep Med 2005;6:5-13.
22. Roth T, Zammit G, Kushida C, et al. A new questionnaire to detect sleep disorders. Sleep Med 2002;3:99-108.
23. Salmon CT, Nichols JS. The next-birthday method of respondent selection. Public Opin Q 1993;47:270-6.
24. SPSS for Windows [computer program]. Version 12.0. Chicago: SPSS Inc.; 2003.
25. Rea LM, Parker RA. Designing and conducting survey research. A comprehensive Guide, 3rd ed. San Francisco: Jossey-Bass; 2005.
26. Izquierdo-Vacario Y, Ramos-Platon MJ, Conessa-Peraleja D, Lozano-Parra AB. Epworth Sleepiness Scale in a sample of the Spanish population. Sleep 1997;20:676-7.
27. Gander PH, Marshall NS, Harris R, Reid P. The Epworth Sleepiness Scale: influence of age, ethnicity, and socioeconomic deprivation. Epworth Sleepiness scores of adults in New Zealand. Sleep 2005;28:249-53.
28. Kim H, Young T. Subjective daytime sleepiness: dimensions and correlates in the general population. Sleep 2005;28:625-34.
29. Gottlieb DJ, Whitney CW, Bonekat WH, et al. Relation of sleepiness to respiratory disturbance Index. Am J Respir Crit Care Med 1999;159:502-7.
30. Whitney CW, Enright PL, Newman AB, Bonekat W, Foley D, Quan SF. Correlates of daytime sleepiness in 4578 elderly persons: The Cardiovascular Health Study. Sleep 1998;21:27-36.
31. Punjabi NM, Young T. Prevalence of objective daytime sleepiness in the general population. Sleep 2003;26:A189-90.
32. Liu X, Uchiyama M, Kim K, et al. Sleep loss and daytime sleepiness in the general adult population of Japan. Psychiatry Res 2000;92:1-11.
33. Saanjarvi S, Lauerma H, Helenius S, Saanletho S. Seasonal affective disorder is common in Finland. Biol Psychiatry 1997;42:255S.
34. Bonnet MH, Arand DL. 24-hour metabolic-rate in insomniacs and matched normal sleepers. Sleep 1995;18:581-8.
35. Counter P, Wilson J. The management of simple snoring. Sleep Med Rev 2004;8:433-41.
36. Vgontzas AN, Bixler EO, Tan TL, Kantner D Martin LF. Obesity without sleep apnea is associated with daytime sleepiness. Arch Intern Med 1998;158:1333-7.
37. The International Classification of Sleep Disorders. Diagnostic and Coding Manual. Rochester, MN: American Sleep Disorders Association; 1990.
38. Ancoli-Israel S, Roth T. Characteristics of insomnia in the United States: results of the 1991 National Sleep Foundation Survey. I. Sleep 1999;22:347-53.
39. Miletin MS, Hanly PJ. Measurement properties of the Epworth Sleepiness Scale. Sleep Med 2003;4:195-9.
40. Bixler EO, Vgontaz AN, Lin HM, Calhoun SL, Vela-Bueno AV, Kales A. Excessive daytime sleepiness in a general population sample: The role of sleep apnea, age, obesity, diabetes and depression. J Clin Endocrinol Metab 2005;90:4510-5.
41. Ursin R, Bjorvatn B, Holsten F. Sleep duration, subjective sleep needs, and sleep habits of 40- to 45-years olds in the Hordaland Health Study. Sleep 2005;28:1260-9.
42. Rosen LN, Rosenthal NE. Seasonal-variations in mood and behavior in the general-population – a factor-analytic approach. Psychiatry Res 1991;38:271-83.