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Original Article

Comparative levels of excessive daytime sleepiness in common medical disorders

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ABSTRACT

Introduction: Sleep restriction and sleep disorders are common causes of excessive daytime sleepiness (EDS). Medical disorders (MD) can also cause EDS, but previous studies have used non-standardized measures, selected samples, or have examined EDS in singular disorders. This study describes the relative degree of EDS associated with medical disorders to provide comparative data across a range of common medical conditions in a large unselected community-based sample.
Methods: Responses of 2612 individuals (aged 18–65) were assessed after excluding those with suspected sleep disordered breathing, narcolepsy, and shift workers. Participants across a range of medical disorders were evaluated using the Epworth Sleepiness Scale (ESS) and patient reports of nocturnal sleep.
Results: Sixty-seven percent of the sample reported a MD. The prevalence of EDS (ESS $\geqslant$ 10) was 31.4% in individuals with MD and increased as a function of a number of MD (0 MD = 29.4%, 1 MD = 28.4%, 2 MD = 31.0%, 3 MD = 35.3%, 4 MD = 38.4%). Disorders which were independent predictors of EDS were ulcers OR = 2.21 (95% CI = 1.35–3.61), migraines OR = 1.36 (95% CI = 1.08–1.72), and depression OR = 1.46 (95% CI = 1.16–1.83) after controlling for other conditions, age, gender, time in bed, caffeine, smoking and alcohol use. Participants with ulcers had the highest prevalence of sleepiness, 50.0%, as well as the highest level of problems falling asleep (40.8%) and awakenings during the night (62.5%).
Conclusions: Individuals with ulcers, migraines, and depression have independent and clinically significant levels of EDS relative to other common MD.

1. Introduction

Excessive daytime sleepiness (EDS) is defined by the inability to stay awake and alert during the major waking episodes of the day [1]. The prevalence of EDS in the general population is between 11% and 25% [2–5]. Excessive daytime sleepiness is an important clinical and public health concern and can lead to significant decreases in quality of life [6], an increased risk of occupational and vehicular accidents [6,7], as well as interference with tasks of daily living [8]. Profound impairment of cognitive and psychomotor performance and mood disturbance is also associated with the presence of EDS, further emphasizing its clinical significance [9]. Insufficient sleep due to poor sleep hygiene, sleep fragmentation, and circadian rhythm disturbance are common causes of excessive sleepiness. Although a variety of sleep disorders are well known causes of EDS, there is evidence that specific medical disorders (MD) play an important role as well [10].

The Epworth Sleepiness Scale (ESS) is a validated clinical tool for the evaluation of EDS [11]. Several studies in selected populations have used the ESS to characterize EDS in separate disorders, such as neurological diseases [12,13], headache [14], depression [15], and [16] Parkinson's disease (PD). PD patients had a statistically higher ESS mean compared to controls, and there was positive correlation between ESS and disease severity [16]. In epilepsy patients, ESS was not significantly different compared with controls [17]. In patients with migraines, EDS was found at a prevalence of 37% (ESS $\geqslant$ 10), with a mean ESS of 8.4, in a study of 200 consecutive patients [14]. In a cross-sectional study, 57.2% from a sample of 70 patients with depression had an ESS $\geqslant$ 10 [14,18]. In a study of sleep disorder patients, mean ESS was similar in those with or without mental disorders (12.8 vs. 12.2, $p = 0.48$). But comorbidities associated with EDS were not controlled for, and ESS is known to be higher in clinic-based samples [15]. Despite separate studies of ESS measured sleepiness in specific conditions, there are limited data available comparing the relative degree of EDS across multiple medical conditions in a large community-based sample.

Several studies have investigated the relationship between EDS and general MD using a non-standardized sleepiness assessment

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(i.e., one question). Foley et al. used the 2003 National Foundation's annual *Sleep in America* survey to look at the association between common sleep disturbances, including daytime sleepiness, and 10 chronic MD (obesity, pain, arthritis, osteoporosis, depression, memory problems, heart disease, stroke, diabetes, and lung disease) [8]. Daytime sleepiness was associated with stroke OR = 2.20 (95% CI, 1.16–4.34), depression OR = 2.19 (95% CI, 1.36–3.55) diabetes OR = 1.98 (95% CI, 1.24–3.14), lung disease OR = 1.81 (95% CI, 1.10–2.99), and body pain 1.73 (95% CI, 1.13–2.66). However, the study had a low response rate of only 23% and used an unvalidated yes–no item for the assessment of sleepiness in a limited sample of older individuals. Furthermore, the risk associated with MD was not adjusted for confounding variables and each disorder was examined separately, preventing conclusions regarding the independent contribution of specific disorders.

Clearly, EDS has been found to be prevalent in MD. In the majority of studies, however, data were gathered from samples of convenience, some with small numbers of patients, in the absence of control groups, using a non-standardized measure of EDS and in some cases without controlling for potential confounding variables. The few epidemiological studies on sleepiness and MD targeted elderly populations [8,19,20]. To date, there are no epidemiological studies that evaluated and compared EDS across specific conditions in the adult population (18–65 years old). The objective of our study was to characterize EDS associated with MD in a large randomly drawn adult population-based sample (18–65 years old), using the ESS as a standardized measure of EDS. Another goal was to provide information regarding the presence of sleep disturbances and their association with clinically significant EDS in a number of common MD encountered in the general population.

2. Methods

The subjects for this study were a subset (see below) of those who participated in a larger epidemiologic study assessing the relationship between daytime sleepiness and automotive accidents. The subjects were drawn from the general population of the tri-county Detroit area. The institutional review board approved all procedures, and informed consent was obtained verbally from all participants before commencing with the phone survey. Individuals were paid $25 for study participation.

3. Data collection

Random digital dialing techniques were used to identify potential subjects. The calling address had to be a residence and the respondent an adult aged 18–65. A random probability selection procedure was used to determine the sex of the target adult. If two or three adults within the target sex were present in a household, a random probability selection procedure (oldest/s, oldest/youngest) was used to determine the target respondent. If four or more adults with the target sex were present in the household, the last birthday method was used to determine the target respondent. Participants completed a 20-min telephone interview which included questions related to sleep habits, excessive sleepiness, medical and psychiatric history and disability. Individuals who could not answer the questionnaire due to sensory or mental impairment were excluded from the sample.

Out of a total 4682 participants, 3283 individuals were interviewed. The response rate, calculated by the number of interviews conducted relative to the number of eligible participants, was 70.1%. After exclusion (see below), 2612 individuals were included in the study. One individual was excluded because he was outside of the age range criteria. Individuals with suspected sleep disordered breathing ($n = 218$), narcolepsy ($n = 3$), and night and rotating shift workers ($n = 536$) were excluded. The total excluded was 670 subjects, who could be in more than one of these categories. Individuals with suspected sleep disordered breathing were defined by the presence of self-reported "loud" snoring and a BMI $\geqslant 34$. Narcolepsy was self-reported as diagnosed by a physician. Night and rotating shift workers were determined based on self-reported current work schedules (previous 2 weeks).

4. Medical disorders assessment

Participants were asked about specific and current MD which were diagnosed by their doctor. The list of MD included cardiac disease, hypertension, diabetes, chronic bronchitis or emphysema, asthma, thyroid disease, cancer, gastro-duodenal ulcers, colitis, arthritis, migraine, stroke, epilepsy or seizures, other neurological diseases, menstrual and gynecological disorders, other disorders (e.g., acid reflux, psoriasis, kidney stones, etc.), and major depression. As many patients with depression are often undiagnosed, depression was assessed using the Diagnostic Interview Schedule [21]. We further divided our sample into subjects who do not have the disorder and those who do not currently have the respective disorder.

5. Sleep habits assessment

Participants reported their habitual weekday and weekend total sleep time (TST) and time in bed (TIB) per 24 h in the last 2 weeks prior to the study. TST was determined with two questions about how long they slept on weekdays and on weekends, TIB by asking individuals their bedtime and wake time for both weekdays and weekends. The TST was calculated as a weighted average of weekdays and weekends ([week-day TST $\times$ 5 + week-end TST $\times$ 2]/7), and TIB was calculated in a similar manner. Sleep efficiency was calculated by the formula TST/TIB $\times$ 100. Sleep efficiency (SE) was considered 100% if calculated SE% was >100%. This occurred as the result of the overestimation of TST or underestimation of the TIB of some participants. Problems with falling asleep and frequent awakenings were determined by responses to the following questions regarding the past 2 weeks: "Did you have difficulty falling asleep?" and "Did you wake up more than three times during the night?" Participants responded with "often," "sometimes," "rarely" or "never." Problems falling asleep or frequent awakenings were operationalized as individuals who reported "often" to the respective question. Alcohol intake was reported as number of drinks per week, as calculated by multiplication of the number of drinks per occasion and number of days used per week in the past 12 months. Caffeine intake per day was calculated as the addition of the average number of cups of coffee and other caffeinated beverages per day in the past 2 weeks. Smoking was assessed as the reported number of cigarettes smoked per day.

5.1. Excessive daytime sleepiness (EDS) assessment

Excessive daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS) [22]. The ESS is a well validated tool [22,23] used for quantification of sleepiness [11,22]. Unlike other scales, which measure sleepiness at a single point in time, the ESS is designed to evaluate the general level of sleepiness. The ESS is an eight-item, self-administered questionnaire that is designed to provide a measure of subject's propensity to fall asleep in a variety of situations. Similar to previous studies [5], we used a score of 10 or greater on the ESS to measure excessive sleepiness.