

Epidemiology of Daytime Sleepiness: Definitions, Symptomatology, and Prevalence

Terry B. Young, Ph.D.

Daytime sleepiness, or difficulty in maintaining a desired level of wakefulness, is frequently viewed by the general population as a common experience and predictable consequence of insufficient sleep. However, daytime sleepiness can have a serious impact on an individual's health, safety, and quality of life. Despite the fact that population-based studies have found that 1 in 5 adults suffers from daytime sleepiness, there is a lack of consistency in how daytime sleepiness is defined, measured, and interpreted, which may affect the medical management of the disorder. For example, many measures of sleepiness based on sleep propensity and falling asleep tend to overlook patients with insomnia and sleepiness. Sleep scales that contain sensitive and specific questions are needed to measure fatigue and perceptions of sleepiness. *(J Clin Psychiatry 2004;65[suppl 16]:12-16)*

An understanding of the epidemiology of daytime sleepiness in the general population is key to appreciating the impact of this condition on health, safety, quality of life, and optimal allocation of health care resources. A population-based, rather than clinic-based, focus is particularly important in describing the occurrence of, risk factors for, and outcomes for sleepiness because most cases, regardless of severity, remain medically unrecognized. As is true for other conditions in which most cases remain occult, a wide variety of referral and other selection biases accounts for some of the characteristics of patient populations, precluding generalization to general populations (Figure 1). Furthermore, with the increasing awareness of sleep disorders over the past few years, factors that influence help seeking and case finding are changing, and it is likely that patient characteristics will change accordingly. For example, with greater recognition of the high prevalence of undiagnosed sleep apnea in adults, primary care providers and patients have become aware of the major symptoms of daytime sleepiness and snoring.¹ This has led to a significant increase in the number of referrals, particularly of patients with mild to moderate sleep apnea severity, to sleep medicine clinics.

Hence, the overall prevalence of sleepiness and insomnia in the general population may be seen as the reservoir of cases that potentially could be diagnosed. The actual proportion of these cases that become diagnosed and treated depends on many factors, such as the availability of new treatment strategies, recognition of adverse health outcomes associated with these conditions, and increased awareness of sleep problems among primary care providers (Figure 1). The importance of these factors varies geographically and is likely to change over time.

DEFINITIONS OF SLEEPINESS

Difficulty in maintaining a desired level of wakefulness is the essence of daytime sleepiness. Defining and quantifying sleepiness, however, are complicated by its wide spectrum of manifestation, the setting in which it occurs, and its consequences including those affecting society as well as the individual. The way in which daytime sleepiness is described or defined has important implications for whether professional help is sought (from the individual's perspective), diagnosis and management (from the clinical perspective), and understanding its public health and safety significance (from a regulatory or policy perspective).

Daytime sleepiness is frequently viewed among individuals in the general population as a common experience, often as the predictable consequence of insufficient sleep time.² Some sleepy persons may suffer considerable impairment and pose a safety risk as a result, but those who view their sleepiness as normal may be unlikely to seek medical help. Little is known about what prompts individuals to define their sleepiness as abnormal.

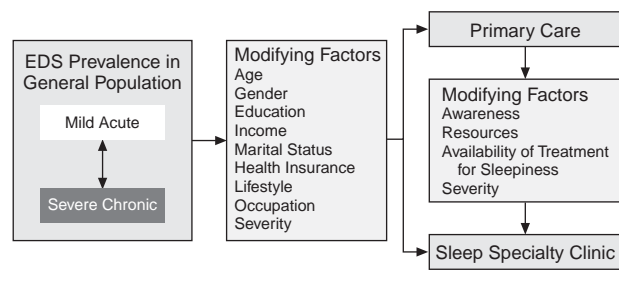
Terms like *sleepiness*, *tiredness*, *fatigue*, *weariness*, and *lack of energy* are thought to be used interchangeably

From the Department of Population Health Sciences, University of Wisconsin Medical School, Madison.

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Corresponding author and reprints: Terry B. Young, Ph.D., Department of Population Health Sciences, University of Wisconsin Medical School, Madison, WI 53705 (email: tbyoung@facstaff.wisc.edu).

Figure 1. Determinants of Help Seeking and Referral for Excessive Daytime Sleepiness (EDS)



by individuals in any context, including casual conversation, unstructured interviews, or expressing complaints.³⁻⁵ Classification of sleepiness based on open-ended or unstructured descriptions may lack sensitivity and specificity. Most inquiries about sleepiness in epidemiologic surveys or clinic screenings are based on operational definitions that capture distinct aspects of sleepiness, notably manifestations of the physiologic drives of sleep and alertness. In addition, modifiers such as frequency and chronicity are important in assessing severity. Structured questions can be used to assess perceptions of feeling sleepy (regardless of whether unwanted sleep occurs), the effects of sleepiness on various aspects of daily living, and sleepy behavior (e.g., likelihood or frequency of falling asleep in various situations).^{4,6}

The subjective measures are indispensable in studies of the epidemiology of sleepiness as well as in patient assessment. However, it is important to understand limitations that diminish the accuracy of these measurements. All self-reported data may be viewed as “true” information filtered by many individual characteristics and environmental or situational characteristics including gender, age, culture, education, experience, mood, perception of stigma, and situation.^{7,8}

Several authors^{4,7-10} have discussed issues in self-reported sleepiness that may contribute to misclassification and ultimately a lack of agreement among the different measures. In the past, sleepiness was often viewed as a sign of laziness and portrayed comically. Dement and colleagues⁵ note that in some cultures “sleepiness” may be seen as a sign of personal weakness, while “tiredness” may be associated with working hard and thus be the less stigmatized and more sensitive term. It is also possible that some people do not recognize even severe sleepiness. Clinic experiences show that patients who have lived with severe sleepiness for many years may underreport their sleepiness due to habituation. Dement et al.⁵ also suggest that there may be variation in sensitivity to the sensations of sleepiness; some individuals fail to attribute the cues indicating a state approaching sleep as “sleepiness.” Clearly, if there are significant interperson differences in

perception of sleepiness cues, education about sleep drive and the sleepiness-alertness continuum should be a priority.⁵

Within a medical framework, with few exceptions (e.g., idiopathic hypersomnia), daytime sleepiness is generally considered to be a major symptom of other sleep disorders, most commonly sleep apnea, or a symptom associated with psychiatric and other medical conditions. For the purpose of differential diagnosis, excessive sleepiness is defined by the American Academy of Sleep Medicine, in the International Classification of Sleep Disorders (ICSD),¹¹ as “a complaint of difficulty in maintaining desired wakefulness or a complaint of excessive amount of sleep.”^{11(p331)} The ICSD further describes excessive sleepiness (also somnolence, hypersomnia) as a subjective report of difficulty maintaining the alert awake state, usually accompanied by a rapid entrance into sleep when the person is sedentary. The severity criteria for sleepiness from the ICSD are based on frequency and degree of associated daytime impairment.

In other classifications, including the ICD-9 and the DSM-III systems, further distinctions in types of sleepiness are based on etiology (intrinsic, extrinsic, or circadian rhythm sleep disorder or associated with mental, neurologic, or other medical disorders).

The manner in which a patient’s complaint of sleepiness is investigated, defined, or classified in clinical settings importantly affects diagnosis. In addition, the availability of effective treatment as well as the degree of daytime impairment are important in treatment decisions.¹² Consequently, definitions that tap appropriate sleepiness constructs (e.g., feelings of sleepiness, drowsy behavior, sleep attacks) as well as modifiers, such as the intensity and duration of problem sleepiness, are critical in discriminating clinically significant sleepiness.^{6,7,9,10}

Confusion of self-reported sleepiness with fatigue has been discussed as an important clinical concern. Pigeon et al.⁴ discuss the need to distinguish between these concepts, both of which have tiredness as a symptom, for proper medical management, as effective interventions may differ. Of particular importance, insomnia is more likely to be associated with chronic tiredness or fatigue and not sleep attacks.

In the societal realm, severity of daytime sleepiness is often described in terms of dangerous behavior (e.g., drowsy behavior while driving) and economic consequences from lost productivity. Interestingly, the term “fatigue” is quite frequently used in the transportation regulatory agencies,⁹ but this term may miss the mark in identifying the important condition of inability to maintain wakefulness.

The lack of consistency in how sleepiness is classified has raised some concerns that significant misclassification results, and that this misclassification is detrimental to medical or societal management. In addition, descriptions

Table 1. Population-Based Studies of Prevalence of Sleepiness According to Definition of Sleepiness

Definition	Sample Size	Age, y	Measure	Prevalence, %
Excessive sleep time ^a				
Michigan Health Maintenance Organization ¹⁶	1007	Range, 21–30	Lifetime prevalence	Women = 17.3, men = 14.7
Alameda County, Calif ¹⁷	2380	≥ 50 (mean = 64.9)	3 y incidence	Women = 8.4, men = 6.3
Sleepy behavior ^b			Past 2 weeks' prevalence	Women = 7, men = 7
Bicester, United Kingdom ²⁶	1084	Range, 35–65	Mean ESS score	Women = 6, men = 6
Sleep Heart Health Study ²²	6440	> 40 (mean = 62.9)	% of sample with ESS score > 10	Women = 13, men = 16
Wisconsin Sleep Cohort Study ²⁰	3328	Range, 30–60	% of sample with ESS score > 10	Women = 21, men = 30
			Mean ESS score	Women = 7.6, men = 8.0
			% of sample with ESS score > 10	Women = 23, men = 24
Warsaw-MONICA ²¹	1186	Range, 38–67	Mean ESS score	Total sample, 8.5
			% of sample with ESS score > 10	Total sample = 26
Australian commercial drivers ²⁷	2342	Range, 16–71	Mean ESS score	Total sample = 7.5
			% of sample with ESS score > 10	Total sample = 24
Perceived feelings of EDS				
Sleep Heart Health Study	6440	> 40 (mean = 62.9)	EDS > 3 days/week	Women = 20.5, men = 13.0
Warsaw-MONICA	1186	Range, 38–67	EDS often, always	Total sample = 26
Finnish Twin Study ³	11,354	Range, 33–60	EDS daily	Women = 11.0, men = 6.7
EDS that interferes with life				
Wisconsin Sleep Cohort Study	3328	Range, 30–60	Daily fatigue associated with at least 1 daytime problem	Women = 52.4, men = 39.7
			Daily EDS/sleep attacks associated with at least 1 daytime problem	Women = 16.4, men = 15.5
Bambui, Brazil ²³	1066	≥ 18 (mean = 39)	EDS associated with problems	Women = 21, men = 10
			≥ 3 days/week for the past year	
Warsaw-MONICA	1186	Range, 38–67	EDS causes problems at work	Total sample = 2.5

^aSleeping too much in a 2-week period daily.

^bAs measured by the ESS.

Abbreviations: EDS = excessive daytime sleepiness, ESS = Epworth Sleepiness Scale.

of the prevalence and other epidemiologic features of sleepiness are highly dependent on the particular measure used. These problems have prompted a call for finding the “best” measure of sleepiness.¹³ However, a key point is that daytime sleepiness is complex, with contributions from distinct drives of sleep and alertness, varying etiologies, state and trait considerations, and a wide spectrum of consequences. This complexity necessitates a variety of definitions in order to address specific public health, clinical, and policy questions.^{7,10}

PREVALENCE AND INCIDENCE OF DAYTIME SLEEPINESS

Sleepiness prevalence in young, middle-aged, and older-aged adults has been estimated from several well-conducted studies over the past 25 years that have used population-based probability sampling strategies and various measures of sleepiness. Partinen and Hublin,¹⁴ in summarizing the prevalence of sleepiness, estimated by 24 studies conducted from 1976 to 1997, found a markedly wide range of 0.3% to 36.0% across studies. However, when the types of definitions used in the studies were taken into account, the concordance of these estimates improved considerably. Questions about “sleeping too much” resulted in the lowest prevalence: 0.3% to 4.0%. The prevalence for “falling asleep in the daytime and frequent sleep attacks” ranged from 5% to 10% in the young

and middle-aged and 20% to 30% in the older-aged. Finally, the prevalence of “perceived sleepiness” ranged from 10% to 15%. Studies conducted more recently are discussed below and summarized in Table 1.

Excessive Sleep Time

Few studies in which sleepiness is defined by “sleeping too much” have been published since the often-cited Ford and Kamerow¹⁵ analysis of data from the National Institutes of Health Epidemiologic Catchment Area study from 1981 to 1985 in which a 6-month prevalence of 3.5% in women and 2.8% in men was reported. The construct of hypersomnia is most closely aligned with that of the DSM-III, where there is a focus on sleepiness in psychiatric disorders, rather than the experience of fighting off frequent sleep attacks. Ford and Kamerow¹⁵ surprisingly found that the prevalence of sleepiness decreased with age; this age trend has been consistently reported ever since.

Two studies using sleepiness classifications similar to those of the DSM-III have been reported more recently (Table 1). In 1996, Breslau et al.¹⁶ interviewed a sample of Michigan Health Maintenance Organization enrollees aged 21 to 30 years about sleep problems; sleepiness was defined as “a period of at least 2 weeks of sleeping too much, nearly every day.” Lifetime prevalence of sleepiness was 16.3% (17.3% in women and 14.7% in men); the incidence of sleepiness during the 3-year follow-up was 8.4% for women and 6.3% for men.

A similar prevalence was found for men and women aged 50 years and older in a survey of participants in the Alameda County study.¹⁷ In both 1994 and 1995, the prevalence of "sleeping too much every day in the last 2 weeks" was about 7% for both men and women. However, only 2% to 3% of the sample reported sleepiness at both time points, and the prevalence did not increase with age. Because chronic medical conditions would be expected to be higher in older adults, it is surprising that the sleepiness prevalence in this study was not markedly higher in the group aged 65 years and older.

It is possible that the prevalence of "sleeping too much" may indicate the occurrence of severe sleepiness in comorbid conditions or primary disorders of sleepiness that are not predominantly those of older age. However, perhaps caution in using this construct for other types of sleepiness is needed. The construct of sleeping too much can reflect a single but long sleep period, e.g., sleeping for 14 hours as part of the major sleep period, but may not be sensitive to dangerous or disabling and repeated sleep attacks while attempting to remain awake and function. Furthermore, this construct does not capture sleepiness in people who are sleep deprived or have insomnia (and feel they sleep too little, rather than too much).

Sleepy Behavior

Most measures of sleepy behavior are based on self-reported episodes of falling asleep. Objective measures of sleep propensity, such as the Multiple Sleep Latency Test (MSLT) are rarely used in population studies or primary care settings. Subjective measures of sleepy behavior are more common, including single item questions and scales consisting of multiple items. Examples of the latter are a subscale of the Sleep-Wake Activity Inventory (SWAI)¹⁸ and the Epworth Sleepiness Scale (ESS),¹⁹ both based on questions about falling asleep in situations that range from highly soporific (watching television, lying down to rest) to highly alerting (e.g., talking with others). The frequency of sleep onset attacks is clearly an important measure in assessing severity, impairment, and danger associated with sleepiness. However, it is possible that there is a dilution effect in scales where items that may reflect lifestyle rather than excessive sleepiness are given the same weight as items that reflect situations where sleep attacks would never be welcome. For example, napping in the afternoon, one of the items in the ESS, is a common and encouraged practice in some cultures, and it is likely that there is a significant proportion of people who have the habit of watching television in bed at night with no intention of staying awake.

In spite of the possibility that the ESS may lack sensitivity and specificity due to a mix of different aspects of sleepiness (e.g., wanted and unwanted), it has been used in a number of studies of middle-aged to older adults. The metric of the ESS ranges from 0 to 24; a score of over 10 is

considered clinically significant.¹⁹ As shown in Table 1, the average scores in various population studies range from 6 to 8.5. Using the cutoff score of > 10 to indicate sleepiness, prevalence ranges from 13% to 30%.

Perceived Feelings of Excessive Daytime Sleepiness

The prevalence of sleepiness based on the ESS gives a sense of the rather high underlying sleep drive during the main wake period in the general population, but frequent attacks of sleepiness without actual sleep onset also negatively affect functioning. Simple clinical questions that directly address feelings of sleepiness without actual sleep onset are probably most common in clinic settings but have been used in a few population studies.

Nearly identical questions about the frequency of experiencing excessive daytime sleepiness (EDS) were used in 4 large, population-based, epidemiology studies in the United States, Poland, and Finland. The prevalence of daily EDS in the Finnish study was 11.0% in women and 6.7% in men, but a slight decrease in prevalence with age was noted in this study.³ The prevalence of EDS "often or always" (2 highest categories) was 26% in the Warsaw-MONICA study²¹ and in the Sleep Heart Health Study (SHHS),²² was 20.5% for women and 13.0% for men. In further analysis of the SHHS, Baldwin et al.²² found an important difference in prevalence of sleepiness between men and women depending on what construct was used, with men having a higher prevalence for "falling asleep" (using the ESS) and a lower prevalence for "feelings of sleepiness" (EDS), compared with women (Table 1).

Perceived Sleepiness With Daytime Impairment

Few studies have estimated the prevalence of severe EDS that meets the ICSD definition of daily frequency of sleepiness that has a significant impact on daily activities. In a recent study²³ of 1066 residents of a Brazilian community aged 18 years and older, EDS that causes impairment at least 3 times per week over various time intervals was assessed. The prevalence for having this condition for at least 1 year was 10% in men and 21% in women (Table 1). In addition to the higher rates in women, prevalence was higher in unemployed and low-income groups but did not increase with age.

Two questions plus a list of daily activities were used to discriminate fatigue and sleepiness with functional impact in the Wisconsin Sleep Cohort Study. As shown in Table 1, the prevalence of fatigue with impact on daily living was about twice as high as the prevalence of sleepiness with impact on daily living. Prevalences were higher for women compared with men for fatigue but not for sleepiness. In the Warsaw-MONICA survey,²¹ 2.5% of the sample of men and women reported that excessive daytime sleepiness caused problems with work.

Daytime Sleepiness With Nighttime Wakefulness

Insomniacs, in spite of their sleep deprivation, are often found to have a low propensity for falling asleep in the daytime^{4,10} yet report daytime impairment. Given the high prevalence of insomnia in the general population, understanding its daytime consequences is imperative. Indeed, as discussed above, many measures of sleepiness based on sleep propensity or falling asleep would miss insomniacs with sleepiness. As reported by Pigeon and coworkers,⁴ insomniacs may fail to report "sleepiness" but rather see their daytime impairment in terms of fatigue. Perlis et al.²⁴ suggest that daytime sleepiness be considered as a part of the medical management of insomnia.

Ohayon,²⁵ in an extensive review of the epidemiology of insomnia, cites 45 studies estimating prevalence in adults. As with daytime sleepiness, variation in definitions and modifiers accounts for major differences in estimates, from about 30% of adults reporting some insomnia symptoms to about 5% of adults who were diagnosed or would meet clinical criteria for diagnosis.²⁵ The prevalence of insomnia in conjunction with daytime impairment, including depression, was found to range from 9% to 15%,²⁵ but there is a paucity of studies with the primary aim of understanding daytime sleepiness in insomnia.

CONCLUSION

In summary, population-based studies have consistently shown that sleepiness is a strong correlate of morbidity across the adult age range and that about 1 in 5 adults has intrusion of sleep during wake time. Contrary to widespread belief, perceptions of sleeping too much, sleep attacks, and feelings of excessive sleepiness do not increase with age in adults. About 16% of adults experience sleepiness that impairs their daily functioning. A particularly important finding is that women and men may express sleepiness differently, with men reporting sleepy behavior and women reporting feelings of excessive sleepiness. A special problem is the need for sensitive and specific questions to recognize fatigue and sleepy feelings in those who do not have sleep attacks, such as insomniacs.

Disclosure of off-label usage: The author has determined that, to the best of her knowledge, no investigational information about pharmaceutical agents has been presented in this article that is outside U.S. Food and Drug Administration–approved labeling.

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