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Using difficulty resuming sleep to define nocturnal awakenings

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ABSTRACT

Objective: Nocturnal awakenings are one of the most prevalent sleep disturbances in the general population. Little is known, however, about the frequency of these episodes and how difficulty resuming sleep once awakened affects subjective sleep quality and quantity.
Method: This is a cross-sectional telephone study with a representative sample consisting of 8937 non-institutionalized individuals aged 18 or over living in Texas, New York and California. The interviews included questions on sleeping habits, health, sleep and mental disorders. Nocturnal awakenings were evaluated according to their frequency per week and per night, as well as their duration.
Results: A total of 35.5% of the sample reported awakening at least three nights per week. Of this 35.5%, 43% (15.2% of the total sample) reported difficulty resuming sleep once awakened. More than 80% of subjects with insomnia symptoms (difficulty initiating or maintaining sleep or non-restorative sleep) also had nocturnal awakenings. Difficulty resuming sleep was associated with subjective shorter sleep duration, poorer sleep quality, greater daytime impairment, greater consultations for sleep disturbances and greater likelihood of receiving a sleep medication.
Conclusions: Nocturnal awakenings disrupt the sleep of about one-third of the general population. Using difficulty resuming sleep identifies individuals with significant daytime impairment who are most likely to seek medical help for their sleep disturbances. In the absence of other insomnia symptoms, nocturnal awakenings alone are unlikely to be associated with daytime impairments.

1. Introduction

Insomnia has frequently been studied in the general population across the world. Few of these studies, however, used well-defined criteria to assess insomnia, and proof of its presence has relied mainly on positive answers to general questions about difficulties initiating or maintaining sleep. On occasion, frequency or severity gradations were additionally used to determine the presence of insomnia [1]. Symptoms of insomnia, difficulty initiating sleep, difficulty maintaining sleep, early morning awakening and non-restorative sleep are reported by large percentages of the general population [1–3]. Nevertheless, it is unlikely that all these individuals suffer from diagnosable insomnia. This issue is particularly important when it comes to difficulties maintaining sleep or to the experience of nocturnal awakenings. Recent epidemiological surveys have limited their assessment of nocturnal awakenings to frequency per week (nocturnal awakenings occurring at least three nights per week being considered as enough to conclude the presence of insomnia) [4–6]. According to this definition, as much as one-third of the general population is affected. The problem may seem trivial but current classifications (DSM-IV and ICSD) offer no guidelines to help researchers apply a standard definition that will facilitate comparisons between studies. For example, the four recent epidemiological studies that have assessed nocturnal awakenings have used different definitions. One has used "waking up often during the night" [7]; another has inquired about "problem with nightly awakenings" [8]; another has investigated "sleep fragmentation occurring at least three nights per week" [9] and another has asked about "waking up several times a night at least 3 nights per week" [4]. These different choices of wording and definitions give a prevalence ranging from a low 3.7% to a high 68%. Even when comparing similar age groups and gender, there is still a 20% discrepancy in the lowest and highest prevalence. The problem is that for many individuals, nocturnal awakenings are not sleeping disturbances but mere consequences of organic diseases or of the ageing process. Therefore, a multidimensional approach would be useful in delineating how nocturnal awakenings should be assessed and defined in epidemiology. The use of a common language in establishing when nocturnal awakenings can be consid-

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ered a sleep disturbance would considerably improve the comparability between studies and the identification of individuals in need of treatment.

This study examines how different aspects of nocturnal awakenings modify sleep quantity and quality and the best indicators to identify individuals with daytime impairments.

2. Methods

2.1. Sample

The study was performed between 2003 and 2005. The target population was adults (18 years and older) living in the states of California, New York and Texas (USA). A total of 8937 individuals aged 18 years or older, representative of the general population of these three states (3243 subjects in California, 3445 subjects in New York and 2249 subjects in Texas), were interviewed by telephone. They represented a total of 62.8 million inhabitants. The participation rate was 85.6% in California, 81.3% in New York and 83.2% in Texas.

2.2. Procedures

In the first stage, telephone numbers were randomly selected proportionally to the population size of each county in California, New York and Texas. The selection was done within each state using a computerized residential phone book. In the second stage, during the telephone contact, the Kish method [10] was used to select one respondent per household. This method allowed for the selection of a respondent based on age and gender to maintain a sample representative of these two parameters. If the household member chosen declined to participate, the household was dropped and replaced with another number from the same area, and the process was repeated.

Interviewers explained the goals of the study to potential participants. They requested verbal consent before conducting the interview. The participants had the option of calling the principal investigator if they wanted further information. The study was reviewed by the Stanford University Institutional Review Boards (IRB).

Subjects who declined to participate or who gave up before completing half the interview were classified as refusals even though they might have met an exclusion criterion. Excluded from the study were subjects who were not fluent in English, who suffered from a hearing or speech impairment or who had an illness that precluded being interviewed. Phone numbers were dropped and replaced only after a minimum of 10 unsuccessful dial attempts were made at different times and on different days, including weekends. An added-digit technique, i.e., increasing the last digit of a number by one, was employed to control for unlisted telephone numbers. The final sample included 21.4% unlisted telephone numbers. The participation rate was 85.6% in California, 81.3% in New York and 83.2% in Texas.

The interviews lasted on average 74.5 (±37.8) min. An interview could be completed with more than one telephone call when it exceeded 60 min or at the request of the participant. Participants answered an average of 308 questions. The shortest interviews consisted of 110 questions and the longest had 630 questions. The project manager or the team leaders also called nearly all the participants who completed the interview. During this 6–8 min call, they asked a series of random questions related to the interview and also asked the participants how satisfied they were with the interviewer.

It was required that all the interviewers had no specific background in medicine and related sciences or in psychology. The interviewers were college students or had some college education. The training consisted of five 3-h sessions that covered the study objectives, ethics in research, use of the Sleep-EVAL software and role-playing for interview situations. Interviewers were supervised by 2 or 3 team leaders with a ratio of 1 team leader for 6 interviewers.

2.3. Instrument

Interviewers used the Sleep-EVAL knowledge-based expert system [11,12] to conduct the interviews. This computer software is specially designed to administer questionnaires and conduct epidemiological studies in the general population.

The system is composed of a non-monotonic, level-2 inference engine, two neural networks, a mathematical processor, the knowledge base and the base of facts. Simply put, the interview begins with a series of questions asked of all the participants. It includes, in order of appearance: sociodemographic information, sleep/wake schedule, sleeping habits, sleep disturbance symptoms, medical and paramedical consultations and hospitalizations in the last 12-month period, physical diseases, use of prescribed and non-prescribed drugs, a health quality assessment scale, alimentation, fatigue scale, pain questionnaire, height and weight and, for women, questions on menopause. Questions were read out by the interviewer as they appeared on the screen. These questions were either closed-ended (e.g., yes/no, 5-point scale, multiple choice) or open-ended (e.g., duration of symptom, description of illness).

Once this information was collected, the system began the diagnostic exploration of mental disorders. On the basis of responses provided by a subject to this questionnaire, the system formulated an initial diagnostic hypothesis that it attempted to confirm or reject by asking supplemental questions or by deductions. Concurrent diagnoses are allowed in accordance with the Diagnostic and Statistical Manual of Mental Disorders, 4th ed. (DSM-IV) [13] and the International Classification of Sleep Disorders (ICSD) [14]. The system terminated the interview once all diagnostic possibilities were exhausted.

The differential process is based on a series of key rules allowing or prohibiting the co-occurrence of two diagnoses. The questionnaire of the expert system is designed such that the decision about the presence of a symptom is based upon the interviewee's responses rather than on the interviewer's judgment. This approach has proved to yield better agreement between lay interviewers and psychiatrists on the diagnosis of minor psychiatric disorders [15]. The system has been tested in various contexts, in clinical psychiatry and sleep disorders clinics [16,17]. In psychiatry, kappas have ranged from .44 (schizophrenia disorders) to .78 (major depressive disorder). Agreement for insomnia diagnoses was obtained in 96.9% of cases (kappa 0.78) [17].

2.4. Variables

Nocturnal awakenings were assessed for frequency per week and per night, length of the awakening and duration of the symptom and impact on daytime functioning (mood, fatigue, daytime sleepiness, cognitive functioning) and were part of the Nocturnal Awakening Assessment Scale (NAAS) of the Sleep-EVAL system [11].

More specifically, the participants were asked if they have a problem with waking up at night and how often in the week or month it occurred. They were subsequently asked for how long they have this problem and how many times within the same night they woke up and for how long on average. They were also asked if they have difficulty resuming their sleep once they awake. Reasons of nocturnal awakenings were also collected.

Quantity of sleep was noted for the previous week and previous year. Previous-year values were used for this study. More specifically, reported nighttime and daytime sleep durations were collected, as well as amount for extra sleep on weekends and days off.

Difficulty initiating sleep (DIS) was considered present when the subject reported having difficulty falling asleep at least three evenings per week for at least one month.

Early morning awakenings (EMA) were considered present when the subject reported waking up too early in the morning (termination of sleep at least 2 h before the desired time) at least three mornings per week for at least one month.

Non-restorative sleep (NRS) was considered present when the subject reported that the sleep was not refreshing even if the duration was normal at least three mornings per week for at least one month.

Sleep disorder diagnoses were assessed according to DSM-IV and ICSD classifications respecting positive and differential diagnosis processes. International Classification of Diseases-10 (ICD-10) was used for the classification of organic diseases.

2.5. Analyses

A weighting procedure was applied to correct for disparities in the geographical, age and gender distribution between the sample and the populations of California, New York and Texas. Results were based on weighted *n* values and percentages. ANOVA with post hoc comparisons were used to analyze sleep duration. Logistic regression was used to compute the odds ratios (OR) associated with insomnia symptoms. Logistic regressions were performed using the SUDAAN software, which allows an appropriate estimate of the standard errors from complex samples by means of a Taylor series linearization method. Reported differences were significant at the .05 level or less.

3. Results

3.1. Demographic characteristics

The total sample was composed of 52% women. The average age of the whole sample was 45.9 (±17.8) years old; California subjects were significantly younger than subjects living in New York or Texas ($p < .0001$). Half of the sample (51.4%) was married (or living with a domestic partner); the proportion of widowers was lower in California (6.3%) than in New York (8.7%) or Texas (9.9%; $p < .0001$). More than half (56.5%) of the sample had a high school degree.

3.2. Prevalence of nocturnal awakenings

A total of 35.5% of the sample reported awakening at least three nights per week. Awakenings occurring 3–6 nights per week were unrelated to age; 23.0% of the sample reported a nightly occurrence of nocturnal awakenings. The prevalence of nightly awakenings significantly increased with age, reaching 34.6% in subjects aged 65 years or older.

Women reported awakening every night more frequently than men (26.6% vs. 18.8%; OR: 1.6 [1.4–1.7]; $p < .0001$). There was no gender difference in individuals reporting nocturnal awakenings 3–6 nights per week.

A total of 43% of subjects with nocturnal awakenings reported having difficulty resuming sleep after such an event. The average duration of their nocturnal awakenings was 107.4 min (SD 78.8) with a minimum of 15 min and a maximum of 390 min.

The number of awakenings within the same night was comparable between age groups: 40.9% of subjects reported only one awakening; 30.2% reported two awakenings; 16.1% reported three awakenings; and 12.8% reported four awakenings or more in the same night.

3.3. Association with insomnia symptoms

The Venn's diagram presented in Fig. 1 depicts the association between reported nocturnal awakening events and reported insomnia symptoms. As seen, DIS occurring at least three evenings per week for at least one month was reported by 11.3% of the sample. DIS occurred alone in only 16.8% of the cases and 66.4% of DIS subjects reported having nocturnal awakenings as well. NRS occurring at least three mornings per week for at least one month was reported by 17.2% of the sample. Of these subjects, 27.3% (4.7% of the sample) reported only NRS and 59.3% also reported nocturnal awakenings. EMA at least three mornings per week for at least a month was reported by 10.3% of the sample. EMA occurred alone for only 1.6% of the sample.

Fig. 2 shows how the frequency of nocturnal awakenings per night and difficulty resuming sleep once awakened affect the association between insomnia symptoms and daytime impairment. As seen, individuals who have difficulty resuming sleep once awakened were more likely to report DIS, NRS and EMA compared to individuals who reported no difficulty resuming sleep. Individuals with difficulty resuming sleep were also more likely to report daytime impairment than the other participants with nocturnal awakenings: 77.5% reported daytime impairment. Also, in the absence of other insomnia symptoms, individuals who woke up at night without difficulty resuming sleep were unlikely to report daytime impairment. Only 6.7% of the subjects woke up at night without difficulty resuming sleep and without any other insomnia symptoms or reported daytime impairment.

3.4. Nighttime sleep duration

Table 1 (online supplementary material) shows how nocturnal awakenings examined as a function of weekly or nightly frequency affect reported sleep duration. Nighttime sleep duration was about 20 min shorter among individuals waking up at least five nights per week compared to those who awakened fewer than three nights per week. Reported sleep duration also consistently and significantly decreased with an increase in number of awakenings within the same night. But difficulty resuming sleep once awakened was the strongest factor in the reduction of sleep duration.

3.5. Correlates of insomnia

Logistic regressions were used to calculate adjusted odds ratios for the association between insomnia symptoms and nocturnal awakening events using backward stepwise procedures (Table 2; online supplementary material). Variables tested in the four models were: age, gender, nocturnal awakenings (with or without difficulty resuming sleep), nighttime sleep duration and sleep quality. Only individuals reporting nocturnal awakenings with difficulty resuming sleep or nocturnal awakenings occurring at least three times in the same night were more likely to report all three insomnia symptoms—difficulty initiating sleep, non-restorative sleep, and early morning awakenings—as well as global sleep dissatisfaction.

3.6. Consultation for sleep disturbances and treatment

As seen in Fig. 3, the proportion of insomnia individuals who consulted specifically about their sleep disturbances varied between 5.6% and 16%. The higher percentage of individuals seeking medical help for their sleep disturbances were found among individuals who had difficulty resuming sleep and those who

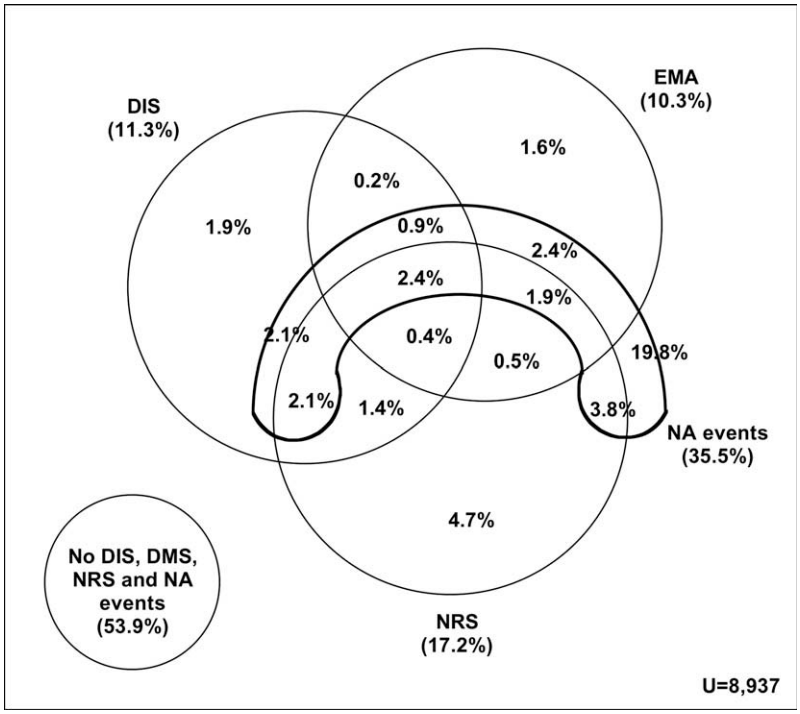

Fig. 1. Association between nocturnal awakening events and insomnia symptoms. Dis, difficulty initiating sleep; NRS, non-restorative sleep; EMA, early morning awakenings; NA, nocturnal awakenings.

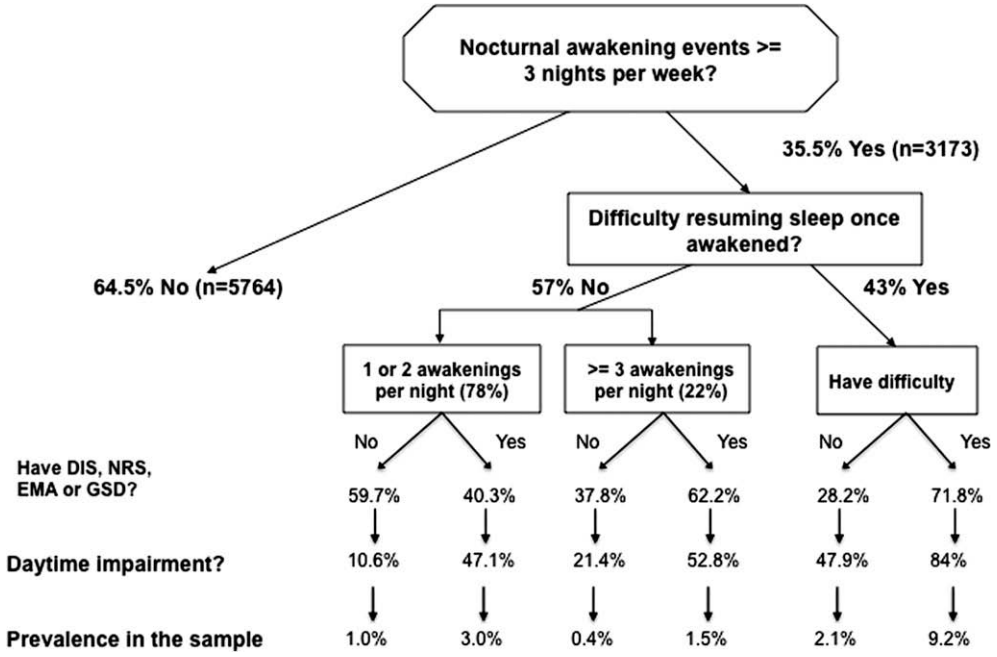

Fig. 2. Association between frequency of nocturnal awakenings per night, difficulty resuming sleep and sleep quality. Dis, difficulty initiating sleep; NRS, non-restorative sleep; EMA, early morning awakenings; GSD, global sleep dissatisfaction.

awakened at least three nights per week or on at least three occasions within the same night but without difficulty resuming their sleep. Individuals with difficulty resuming sleep were also more likely to get a medication for their sleep following the consultation.

The determinants for sleep consultations among subjects having insomnia symptoms were examined using a logistic regression. The presence of a major depressive disorder (OR: 2.5 [1.9–3.4]); bipolar disorder (OR: 1.9 [1.1–3.3]); anxiety disorder (OR: 1.71 [1.4–2.2]); dissatisfaction with sleep quantity (1.4 [1.1–1.8]); Global Sleep Dissatisfaction (OR: 2.1 [1.6–2.7]); nocturnal awakenings with difficulty resuming sleep (OR: 1.5 [1.2–1.9]); presence of at least moderate daytime consequences of sleep disturbances (OR: 2.7 [2.1–3.5]); gastro-oesophageal reflux disease (OR: 1.9 [1.3–2.3]) and chronic pain (OR: 2.3 [1.9–2.9]) were significant determinants for consultations for sleep disturbances.

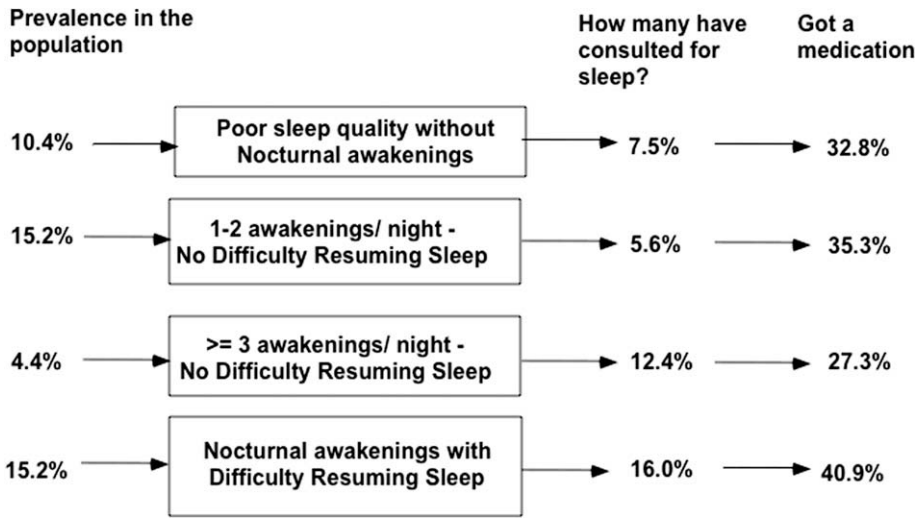

Fig. 3. Consultations and treatment for sleep disturbances.

4. Discussion

Reports of nocturnal awakenings are frequent in the general population: more than one-third of the subjects reported awakening at night at least three nights per week. Defining nocturnal awakenings only with a frequency per week, however, appeared insufficient to identify individuals with significant insomnia symptoms and who will benefit from a treatment. As our results show, individuals with nocturnal awakenings without difficulty resuming sleep and without any other insomnia symptoms rarely reported daytime impairment. On the other hand, difficulty resuming sleep once awakened was accompanied with daytime repercussions in 77% of the cases. Those results clearly indicate that the definition of nocturnal awakenings in classifications should be tightened to avoid inflation of insomnia prevalence.

Indeed, the results of this study demonstrate that not all self-reported nocturnal awakenings are equal in terms of their impact on subjective sleep quantity and quality. In epidemiological studies, it is commonly accepted that the presence of nocturnal awakenings occurring at least three nights per week is sufficient to indicate an insomnia symptom (1, 4–6, 9,10). This appears to be at least partially correct. We have demonstrated that individuals who had difficulty resuming sleep once awakened reported the shortest sleep duration. They were also more likely to have poorer overall subjective sleep quality as illustrated by the high proportion who had other insomnia symptoms, felt unrested upon awakening and were dissatisfied with their sleep. They were also more likely to seek medical help for their sleep disturbances. In the absence of difficulty resuming sleep, the number of nocturnal awakenings during the same night and the presence of other insomnia symptoms had a significant effect on sleep quality, especially when subjects reported at least three awakenings per night (at least three nights per week). In contrast, subjects who awakened only one or two times within the same night (at least three nights per week) were nearly indistinguishable from the rest of the sample, who did not report nocturnal awakenings at least 3 nights per week in terms of sleep quality and quantity. These relationships indicate the importance of future epidemiological studies, taking into account difficulty resuming sleep, in addition to the standard examination of the number of nights per week when a nocturnal awakening might occur.

Interestingly, the majority of subjects reporting other insomnia symptoms such as difficulty initiating sleep or non-restorative sleep also reported nocturnal awakenings. One way to conceptualize this is to say that what may be most important in assessing subjective sleep quality and duration may be awakenings and associated difficulty falling back to sleep. Effectively the only difference between DIS and DMS (particularly when the apparent importance of the inability to resume sleep as demonstrated in this study is considered) is the inability to initiate (or resume) sleep, whether before sleep has begun, during sleep or if sleep ends "early." The demonstrated importance of subjective inability to resume sleep in predicting poor sleep quality and shorter sleep duration suggests not only that an important parameter of subjective sleep quality has not previously been measured, but also that it may be a more crucial measure of sleep quality than the exact timing (before, during, after) of wakefulness per se.

There is a need for a better definition of insomnia symptoms in epidemiological studies. Classifications have offered some guidelines but many imprecisions need to be clarified for a greater uniformity in the assessment of insomnia symptoms. For example, the DSM-IV defines insomnia symptoms as difficulty initiating or maintaining sleep or non-restorative sleep for at least one month. The frequency of the symptom is not specified and the description of the symptoms is barely existent. The newest International Classification of Sleep Disorders [18] made a notable effort to increase the precision of insomnia definition. In this classification insomnia symptoms are defined as "a complaint of difficulty initiating sleep, difficulty maintaining sleep or waking up too early or sleep that is chronically non-restorative or poor in quality" [14]. Also in this classification, the frequency of symptoms per week is omitted. Nevertheless, daytime impairment is essential to conclude the presence of insomnia. It should be noted that difficulty maintaining sleep and early morning awakenings are listed as separated symptoms. As in the DSM-IV, the ICSD-II assumes that insomnia symptoms are self-explanatory and that no definition is needed. But in epidemiological studies we cannot ask participants if they have difficulty maintaining their sleep because it will have different meanings from one individual to another. For some individuals it will mean nocturnal awakenings, while for others it could mean having the feeling that sleep is light.

This study has some limitations. First, symptoms were evaluated on the basis of self-reports; no objective measures such as polysomnographic recordings were collected. While such measures are desirable, to date they have not been regularly incorporated into community-based epidemiological studies. Thus, while such data would be useful to have, self-reports and interview-based measures remain the most widely used standards in community surveys. Also, since the data are based on the recollection of the subjects, the number of nocturnal awakenings during a given

night is only an approximation. Subjects are unaware of micro-arousals or complete arousals that last only seconds. Therefore, reported awakenings are most likely related to episodes where the subject is fully awake at least for more than a few seconds.

Nevertheless, a diagnosis of insomnia is made based solely on patient self-report, effectively casting doubt on the insomnia symptoms examined here. The findings of the current study demonstrate the importance of assessing nighttime wakefulness in greater detail than its frequency of occurrence across a week or month. They clearly indicate that nighttime awakenings should be assessed both in terms of their frequency within a given night as well as the difficulty an individual may have in returning to sleep after such awakenings occur.

5. Conflict of interest

The authors report no conflicts of interest.

Acknowledgments

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.sleep.2009.11.004.

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