Sleep Medicine Reviews, Vol. 6, No. 2, pp 97–111, 2002
doi:10.1053/smrv.2002.0186, available online at http://www.idealibrary.com on IDEAL®

SLEEP MEDICINE reviews

CLINICAL REVIEW

Epidemiology of insomnia: what we know and what we still need to learn

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KEYWORDS
epidemiology, insomnia, DSM-IV, mental disorders

Summary Epidemiologists have published more than 50 studies of insomnia based on data collected in various representative community-dwelling samples or populations. These surveys provide estimates of the prevalence of insomnia according to four definitions: insomnia symptoms, insomnia symptoms with daytime consequences, sleep dissatisfaction and insomnia diagnoses. The first definition, based on insomnia criteria as defined by the DSM-IV, recognizes that about one-third of a general population presents at least one of them. The second definition shows that, when daytime consequences of insomnia are taken into account, the prevalence is between 9% and 15%. The third definition represents 8–18% of the general population. The last definition, more precise and corresponding to a decision-making diagnosis, sets the prevalence at 6% of insomnia diagnoses according to the DSM-IV classification. These four definitions of insomnia have higher prevalence rates in women than in men. The prevalence of insomnia symptoms generally increases with age, while the rates of sleep dissatisfaction and diagnoses have little variation with age. Numerous factors can initiate or maintain insomnia. Mental disorders and organic diseases are the factors that have been the most frequently studied. The association between insomnia and major depressive episodes has been constantly reported: individuals with insomnia are more likely to have a major depressive illness. Longitudinal studies have shown that the persistence of insomnia is associated with the appearance of a new depressive episode. Future epidemiological studies should focus on the natural evolution of insomnia. Epidemiological genetic links of insomnia are yet to be studied. © 2002 Published by Elsevier Science Ltd

INTRODUCTION

Life is filled with events that may cause occasional insomnia in an individual who usually sleeps well. However, for many people, this condition occurs repetitively (nightly, weekly) over a prolonged period that may last from some months to several years. How common is that condition? Who is at greater risk to develop it? The answers to these epidemiological questions are based on the understanding and definitions of insomnia that were promoted when the epidemiological studies were realized. Indeed, over the years, the concept of insomnia has changed to reflect the advancement of our understanding of it. From the concept of "unsatisfactory sleep", promoted by the American Institute of Medicine in 1979 [1], to the definition

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in 1990 by the International Classification of Sleep Disorders of the almost nightly complaint of insufficient sleep or the feeling of being unrested after the habitual sleep period [2], standardized definitions of insomnia have remained infrequently used in epidemiological studies. As we will see, most of the studies focused on three forms of insomnia symptoms: difficulty in initiating sleep, disrupted sleep and early morning awakenings. Non-restorative sleep, an insomnia symptom described in the DSM-IV and the International Classification of Sleep Disorders, was rarely studied. The daytime consequences of these symptoms were also often unexplored.

Epidemiological studies on insomnia have been undertaken in different populations: primary care offices, out-patient clinics, cohorts and general populations. This paper reviews the epidemiological studies of the general population that have been done using non-institutionalized **representative** samples for a country, a city or a delineated geographical area. Excluded were all the studies based on unselected samples such as general practice attenders or cohort studies.

PREVALENCE

The prevalence of insomnia is reviewed according to four main categories:

1. Prevalence of insomnia symptoms will include studies that based the estimation of prevalence only on the report of difficulty initiating or maintaining sleep or non-restorative sleep regardless of the duration or consequences of insomnia.
2. Prevalence of insomnia symptoms accompanied by daytime consequences will be based on studies that additionally assessed daytime consequences of insomnia.
3. Prevalence of dissatisfaction with sleep quality or quantity will be based on studies of subjects who see themselves as poor sleepers, have insomnia problems or are dissatisfied with the quality or quantity of sleep.
4. Prevalence of insomnia diagnoses will include studies having used a classification such as DSM-III-R, DSM-IV or International Classification of Sleep Disorders.

Insomnia symptoms

The following insomnia symptom are included: difficulty in initiating sleep or in maintaining sleep (whether disrupted sleep or early morning awakenings). In addition, some studies also included non-restorative sleep in the list of insomnia symptoms as described in the DSM-III-R [3], the DSM-IV [4] and the International Classification of Sleep Disorders. These symptoms were estimated using different time frames: current symptoms, past month, past year or lifetime.

The epidemiological studies will be reviewed according to how the symptoms were assessed:

(a) based on "yes–no" answers, i.e. **without restrictive criteria**;
(b) based on their **frequency**;
(c) based on their **severity** (e.g. light to extreme).

Without restrictive criteria

In epidemiological studies that assessed the presence of insomnia symptoms without restrictive criteria, the prevalence was about 33% in the general population [5–10]. One of the earliest epidemiological surveys on insomnia symptoms was carried out by Bixler *et al.* [5] in the metropolitan Los Angeles area. This study involved 1006 respondents age 18 years or over. The overall prevalence of insomnia symptoms was 32.2%. Other subsequent studies [6–10] found a similar prevalence in the general population when inquiries were made about the presence of insomnia symptoms (Table 1). In the oldest studies [5–8] the presence of insomnia symptoms was very simply assessed regardless of the frequency or the severity of the symptom. There were two or three questions on whether the subject had trouble falling asleep, woke up during the night or woke up too early in the morning and was unable to fall back to sleep.

Using frequency

Epidemiological studies using frequency quantifiers to determine the prevalence of insomnia symptoms are the most common [12–21]. Two types of quantifiers are used. In one case, the subject has to answer according to a subjective assessment of the frequency of the symptom on a four- or five-point scale [12, 13, 15, 16]: for example, never, sometimes, often or always; often or always being the cut-off point to determine the presence of insomnia. In the other situation, frequency of the symptom is assessed on a weekly basis [14, 17–21]: for example,

Table 1 Prevalence of symptoms, complaints and diagnoses of insomnia in the general population across the world

Authors	Year of publication	Place	*n*	>=Age	Prevalence (%) male/female
Insomnia symptoms					
Without criteria					
Bixler *et al.* [5]	1979	Los Angeles, USA	1006	18	28.9/34.8
Welstein *et al.* [6]	1983	San Francisco, USA	6340	6	31.0
Klink and Quan [7]	1987	Tucson, USA	2187	18	37.8
Quera-Salva *et al.* [8]	1991	France	1003	16	48.0
Klink *et al.* [9]	1992	Tucson, USA	2187	18	34.1
Mallon *et al.* [10]	2000	Sweden	1870	45–65	25.4/36.0
Frequency criteria					
Karacan *et al.* [12]	1976	Alachua County, Florida, USA	1645	18	10.9/15.4
Karacan *et al.* [13]	1983	Houston, USA	2347	18	18.6/28.6
Janson *et al.* [14]	1995	Reykjavik, Iceland, Uppsala and Göteborg, Sweden, Antwerp, Belgium	2202	20–45	DIS: 6–9 EMA: 5–6
Olson [15]	1996	Newcastle, Australia	535	16	17.3/24.9
Ancoli-Israel and Roth [16]	1999	USA	1000	18	9.0
Hoffmann [17]	1999	Belgium	1618	18	22.0
Hetta *et al.* [18]	1999	Sweden	1996	18	22.0
Vela-Bueno *et al.* [19]	1999	Madrid, Spain	1131	18	17.7/27.4
Doi *et al.* [20]	2000	Japan	3030	20	17.3
Léger *et al.* [21]	2000	France	12778	16	25.0/34.0
Severity criteria					
Mellinger *et al.* [22]	1985	USA	3161	18	14.0/20.0
Gislason and Almqvist [23]	1987	Uppsala, Sweden	3201 men	30–69	DIS: 6.9 DMS: 7.5
Liljenberg *et al.* [24]	1988	Gävleborg and Kopparberg counties, Sweden	3557	30–65	DIS: 5.1/7.1 DMS: 7.7/8.9
Weyerer and Dilling [25]	1991	Upper Bavarian area, Germany	1536	15	28.5
Téllez-Lòpez *et al.* [26]	1995	Monterrey, Mexico	1000	18	16.4
Insomnia symptoms + daytime consequences					
Ford and Kamerow [27]	1989	Baltimore, Durham, Los Angeles, USA	7954	18	7.9/12.1
Breslau *et al.* [28]	1996	Southeast Michigan, USA	1007	21–30	21.4/26.7 (lifetime)
Ohayon [29]	1997	France	5622	15	12.7
Ohayon [30]	2001	United Kingdom	4972	15	9.1
Ohayon [30]	2001	Germany	4115	15	8.5
Hoffmann [17]	1999	Belgium	1618	18	11.0
Hetta *et al.* [18]	1999	Sweden	1996	18	13.0
Léger *et al.* [21]	2000	France	12778	16	14.0/23.0
Dissatisfaction with sleep quantity or quality					
Lugaresi *et al.* [31]	1983	San Marino, Italy	5713	3	9.9/16.8
Husby and Lingjaerde [32]	1990	Tromsø, Norway	14667	20–54	29.9/41.7
Ohayon [33]	1996	France	5622	15	15.6/24.4
Yeo *et al.* [34]	1996	Singapore	2418	15–55	12.9/17.5
Kageyama *et al.* [35]	1997	Tokyo, Maebashi, Nagasaki, Naha and Kawasaki, Japan	3600 wom.	20	11.2
Ohayon *et al.* [36]	1997	Montreal, Canada	1722	15	8.7/13.2
Ohayon *et al.* [37]	1997	United Kingdom	4972	15	6.8/10.6
Asplund and Aberg [38]	1998	Jamtland County, Sweden	3669 women	40–64	18.1
Vela-Bueno *et al.* [19]	1999	Madrid, Spain	1131	18	7.8/14.4
Ohayon [30]	2001	Germany	4115	15	5.6/8.2
Ohayon and Smirne [39]	2001	Italy	3970	15	10.1
Insomnia diagnoses (DSM-IV)					
Ohayon *et al.* [36]	1997	Montreal, Canada	1722	15	4.4
Ohayon [29]	1997	France	5622	15	5.6
Ohayon [30]	2001	United Kingdom	4972	15	6.4
Ohayon [30]	2001	Germany	4115	15	6.0
Ohayon and Smirne [39]	2001	Italy	3970	15	6.0

DIS, difficulty initiating sleep; DMS, difficulty maintaining sleep; EMA, early morning awakening.

never, one or two nights, three or four nights, five nights or more per week. In this second case, a frequency of three nights or more per week is used to conclude the presence of insomnia. The prevalence of insomnia symptoms drops to around 16–21% when frequency is used to determine the presence of insomnia and has similar rates among countries (Table 1).

Using severity

Five epidemiological studies using severity quantifiers were found [22–26] (Table 1). These severity quantifiers were as follows: being bothered a lot [22, 26]; having great or very great difficulty initiating sleep (DIS) or difficulty maintaining sleep (DMS) [24]; a major complaint [23]. The prevalence of insomnia symptoms using severity ranges between about 10% and 28% of the general population. However, two of these studies are limited in terms of age and gender of the samples: one is restricted to men between 30 and 69 years old [23] and the other is limited to men and women between 30 and 65 years old [24].

Insomnia symptoms with daytime consequences

In the past five years, some studies have explored daytime repercussions of insomnia (daytime sleepiness, irritability, depressive or anxious mood, needing to seek help, etc.) [17, 18, 21, 27–30]. In most of the studies, the prevalence of insomnia symptoms accompanied by daytime consequences was about 10%. One study provided a higher prevalence than the other studies mainly because the rate was based on lifetime estimation [28].

Dissatisfaction with sleep quality or quantity

The study of dissatisfaction with sleep quantity or quality is relatively recent: most of the studies making that distinction have been published in the last four years [19, 30–39].

This category groups heterogeneous definitions. In some cases, it refers directly to dissatisfaction with sleep quality or quantity [30, 33, 36, 37, 39]. Other studies refer to a subjective self-assessment: to consider oneself insomniac [19, 32, 34, 35] or a poor sleeper [31]. This category leads to a comparable prevalence to what is reported in studies assessing insomnia symptoms with daytime consequences. For example, Ohayon [33] obtained a prevalence of 15.6% in men and 24.4% in women in the French population who were dissatisfied with sleep quantity or quality, while Léger *et al.* [21], in the same country, found a prevalence of 14% in men and 23% in women using the presence of insomnia symptoms accompanied by daytime repercussion (Table 1).

Insomnia diagnoses

Epidemiological studies providing data on insomnia diagnoses are scarce. Diagnostic descriptions of insomnia are relatively recent. The Association of Sleep Disorders Centers [1] made the first attempt in 1979. It was only in 1987 that the American Psychiatric Association introduced diagnostic guidelines for sleep disorders in the revision of the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-III-R) [3]. Use of classifications to assess sleep disorders has not yet gained in popularity among sleep epidemiologists. Three main problems have restrained these studies: (1) the duration of interviews limiting the number of participants; (2) the difficulty in making a diagnosis during the interview and, in this case, the need for a specialist or a computer system; (3) the complexity of administration and the costs of these studies.

However, some efforts have been made in the last three years to incorporate elements of diagnostic description of insomnia according to the DSM-IV classification [17, 18, 21, 27, 28, 30, 36, 37]. The studies done by Ohayon *et al.* [29, 30, 36, 39] were the first to provide prevalence of insomnia disorder diagnoses according to the DSM-IV [4]. The diagnoses were given with respect to positive and differential diagnoses provided by the classification. Prevalence of insomnia diagnosis (primary insomnia; insomnia disorder related to another mental disorder; substance-induced sleep disorder, insomnia type; sleep disorder due to a medical condition, insomnia type) varied between 4.4% and 6.4% [29, 30, 36, 39]. Primary insomnia was the most frequent diagnosis, with prevalence ranging between 2% and 4%, followed by insomnia related to another mental disorder, with prevalence ranging between 1% and 3% [29, 30, 36, 39]. Interestingly, about one-third of subjects with insomnia symptoms and dissatisfaction with sleep received a diagnosis of mental disorder,

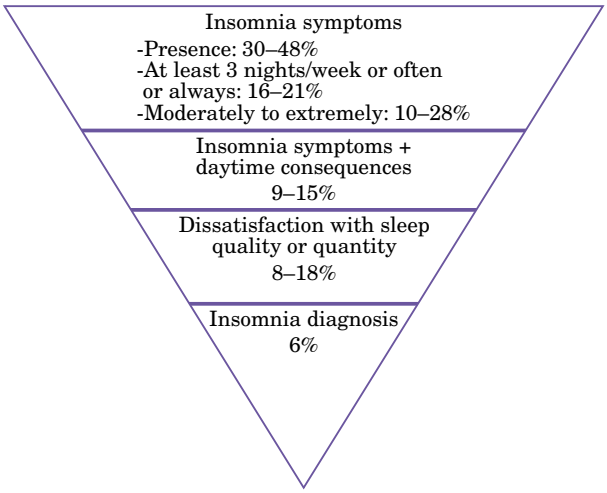

Figure 1 Average prevalence of insomnia symptoms and diagnoses.

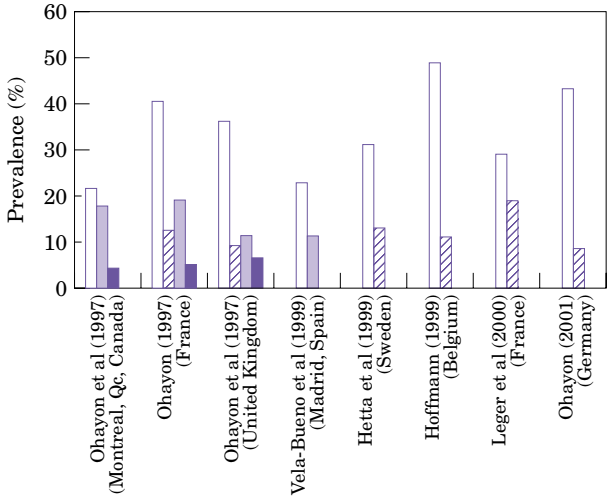

Figure 2 Surveys that provided prevalence for insomnia symptoms, sleep dissatisfaction and diagnoses within a population. The realization years of the studies were as follows 1993 for the French and Canadian studies of Ohayon *et al.*; 1994 for the United Kingdom study by Ohayon *et al.*; 1990 for the Spanish study of Vela-Bueno *et al.* [19]; 1997 and 1998 for the studies of Hetta *et al.* [18] and Hoffman [17]; 1993 for the French study of Léger *et al.* [21]; 1996 for the German study of Ohayon [30] and 1997 for the Italian study of Ohayon and Smirne [39]. Open bars: insomnia symptoms; hatched bars: insomnia symptoms and consequences; shaded bars: sleep dissatisfaction.

which means that the insomnia complaint was not important enough to warrant an insomnia diagnosis.

In summary

Prevalence of insomnia can be viewed in four ways: as insomnia symptoms, as insomnia symptoms accompanied with daytime consequences, as dissatisfaction with sleep quality or quantity and as insomnia diagnoses. Figure 1 presents the average prevalence for each of these concepts. Insomnia symptoms cover a broad range of individuals who may or may not report daytime consequences or dissatisfaction with the quantity and quality of their sleep. Studies that assessed simultaneously these concepts [17–19, 21, 30, 33, 36, 39] showed that at least half of the subjects with insomnia symptoms either had daytime consequences or were dissatisfied with their sleep and, again, half of these subjects had an insomnia disorder diagnosis (Fig. 2).

Semantic as well as definition confusions are present in many epidemiological studies. In this section, epidemiological studies have been grouped by similarity of definition rather than by the terminology used by the authors (e.g. severe insomnia, chronic insomnia).

In addition to inconsistent definitions of insomnia, many studies have used various time frames: currently, past month, past year and lifetime. Therefore, comparisons between most studies should be done with caution.

The distinction between insomnia symptoms alone, insomnia with daytime consequences and dissatisfaction with sleep quality or quantity should routinely be made in epidemiological studies. When this distinction has been made, subjects with insomnia symptoms accompanied by daytime consequences and subjects dissatisfied with sleep quality or quantity appeared to be greater healthcare consumers [27, 30, 33, 36, 37, 40, 41] and more often presented mental disorders [17, 18, 22, 27–29, 30, 36, 37, 42–46] and organic diseases [5, 7, 23, 33, 35, 36, 37, 40, 42–46]. One study showed that non-restorative sleep as an insomnia symptom should be taken with caution when it is the only insomnia symptom, since it can be related to a deliberate self-inflicted sleep deprivation, especially during the work week [36]. Similarly, some subjects complained of insufficient sleep and of being unrested on awakening but failed to report insomnia symptoms. Clearly, a consensus should be obtained for future epidemiological studies on the definition of insomnia and how to categorize it in terms of severity and chronicity.

Practice Point 1

Epidemiological surveys on insomnia provide prevalence for four categories: insomnia symptoms, insomnia symptoms accompanied by daytime consequences, dissatisfaction with sleep quality or quantity and insomnia diagnoses. The main interests in the study of each type of category are:

1. Insomnia symptoms: it offers the opportunity to explore manifestations for which subjects ignore the relationship between their symptomatology and a pathology.
2. Insomnia symptoms with daytime consequences and dissatisfaction with sleep quality or quantity: it gives a figure of the population demand in terms of needs and promotes studies on the answers provided by health care providers and their efficiency.
3. Insomnia diagnoses: it allows the possibility to manager and to treat adequately insomnia pathology.

SOCIODEMOGRAPHIC DETERMINANTS

Insomnia has been constantly reported as being more prevalent in women and in the elderly. However, other sociological and economical factors have been associated with it. This section reviews the most frequently assessed factors in epidemiological studies.

Gender

Women are more likely than men to report insomnia symptoms [12, 13, 15, 19, 21, 22, 36, 37, 47], daytime consequences [17, 18, 21, 27] and dissatisfaction with sleep [21, 33, 34] and to have insomnia diagnoses [30]. Only three studies did not find that difference: one on insomnia symptoms [5], one on dissatisfaction with sleep quality or quantity [37] and one on insomnia symptoms accompanied by daytime consequences [28]. Women/men ratios for insomnia symptoms are about 1.4. The difference between women and men increases with age, the ratio of women/men being about 1.7 after 45 years of age. Women are twice more likely than men to have an insomnia diagnosis. Menopause is often offered as an explanation for the discrepancy between men and women in the prevalence of insomnia in mid-aged subjects. Some studies have found that the prevalence of insomnia increases in menopausal women as compared with their younger counterparts [48, 49]. Another study found that insomnia increased between peri- and post-menopause but not between pre- and peri-menopause [50]. However, underlying chronic physical conditions could better account for the increase in insomnia symptoms than menopause *per se* [51].

Age

Almost all epidemiological studies reported an increased prevalence of insomnia symptoms with age, reaching close to 50% in elderly individuals (65 year old) [5, 7, 8, 16–19, 26, 30, 33, 36, 37]. However, the prevalence of insomnia with daytime consequences and the prevalence of sleep dissatisfaction have mixed results. Some epidemiological studies found that the rate remains quite stable between age groups [34, 36, 37, 40]. Other studies found lower rates in middle-aged individuals [35], while still other studies reported an increasing prevalence with age [18, 19, 21, 27, 33]. The prevalence of insomnia diagnoses is stable between 15 and 44 years; it increases from 45 years of age but the prevalence remains the same in elderly individuals [30].

Insomnia in the elderly

Insomnia in the elderly non-institutionalized population has been the subject of several independent epidemiological studies (Table 2) [42–46, 52–59]. Most of these studies were limited to insomnia symptoms, and only two studies assessed sleep dissatisfaction [46, 58]. The only use of insomnia symptoms without quantifiers gave very high prevalence (up to 65%). In most of these studies, the prevalence of insomnia symptoms and sleep dissatisfaction does not significantly increase with age [42, 45, 46, 54, 58] but is higher in women than in men [42–46, 54, 58]. Studies that assessed the relationship between insomnia symptoms and dissatisfaction with sleep in the elderly found that insomnia symptoms without sleep dissatisfaction have a weak association with physical diseases and mental disorders [46, 58, 60]. Moreover, there is no or only a light increase in the prevalence of insomnia symptoms in healthy elderly (i.e. without

Table 2 Prevalence of insomnia in the elderly

Authors	Year of publication	Place	*n*	Age	Criteria used	Prevalence (%) male/female
Brabbins *et al.* [52]	1993	Liverpool, UK	1070	65	DIS, DMS or EMA, 1 month prevalence	35.0
Henderson *et al.* [42]	1995	Canberra and Queanbeyan, Australia	874	70	DIS, EMA, nearly every night in the past 2 weeks	12.6/18.0
Foley *et al.* [43]	1995	E. Boston, New Haven, Iowa, Washington counties, USA	9282	65	DIS or EMA, most of the time	19.5–29.4/25.4–36.4
Blazer *et al.* [53]	1995	North Carolina, USA	3976	65	DIS, DMS or EMA, most of the time	DIS: 14.8 DMS: 26.6 EMA: 14.3
Ganguli *et al.* [54]	1996	Mid-Monon-gahela Valley, Pennsylvania, USA	1050	66–97	DIS sometimes or usually	26.7/44.1
					DS sometimes or usually	19.2/35.8
					EMA sometimes or usually	8.7/23.3
Newman *et al.* [44]	1997	Forsyth (NC), Sacramento (CA), Washington counties, Maryland and Pittsburg, USA	5201	65	Presence of DIS, DS, EMA	DIS: 14/30 DS: 65/65 EMA: 17/15
Mallon and Hetta [55]	1997	Sweden	876	65–79	Moderate or major complaints of DIS, DS, EMA	DIS: 14/30 DS: 31.4 EMA: 33.4
Maggi *et al.* [45]	1998	Veneto region, Italy	2398	65	Often or always having DIS or EMA	35.6/54.0
Chiu *et al.* [46]	1999	Hong Kong, China	1034	70	Consider themselves as having insomnia	8.6/17.5
Yamaguchi *et al.* [56]	1999	Kanazawa, Japan	236	>60	Insomnia 3 nights/week	14.0/19.7
Baber *et al.* [57]	2000	Hawaii, USA	3845 males	71–93	DIS, DS, DMA	32.6
Ohayon *et al.* [58]	2000	Paris, France	1026	60	Dissatisfied with sleep quality or quantity	11.5/16.0
Ohayon *et al.* [59]	2001	UK, Germany, Italy	2429	65	DIS, DS, EMA, NRS	DIS: 16.0 DS: 33.0 EMA: 16.0 NRS: 11.0

DIS, difficulty initiating sleep; DS, disrupted sleep; EMA, early morning awakening; NRS, non-restorative sleep.

disease and medication) [28, 34, 36, 37, 40, 46, 58, 59]. Healthy elderly sleep as well as younger subjects.

Marital status

Epidemiological studies that examined the association between marital status and insomnia mostly reported a higher prevalence of insomnia symptomatology in individuals who were separated or divorced or who were widowers [21, 33, 36, 37, 40], but the association is more likely to be found in women [36, 37].

Income and education

When the association between income and education levels is explored, prevalence of insomnia is higher in individuals with lower incomes [5, 36, 44] and in those with lower education [5, 16, 61]. However, this association may be fictitious. Indeed, studies that additionally used multivariate analyses failed to identify lower income and education levels as independent risk factors for insomnia symptomatology [36, 37], and several studies failed to report such associations with incomes [16] or education [28, 42]. This suggests that other factors such as age better explain the association. The use of an index that takes into account age, education, household income and size of the household would give a better indication about the importance of poverty in insomnia.

Occupational status

Individuals who do not work are usually more likely than workers to report insomnia symptomatology [17, 19, 36, 37, 40]. However, this relationship cannot be generalized to all classes of non-workers. Studies that distinguished between the different classes of non-workers showed the highest risk of insomnia symptomatology was in retirees, followed by homemakers [37]. Students were not at risk. Therefore, the relationship could be only an effect of age and gender. This is why, to have some validity, the examination of occupational status should make these distinctions and take care to differentiate daytime and shift workers [37].

Practice Point 2

Gender and marital status appeared to be constantly associated with a higher prevalence of insomnia. Age had mixed results in relationship to insomnia symptomatology, sleep dissatisfaction and insomnia diagnoses. Education, incomes and occupational status need to be examined by controlling for possible confounding effects of age and gender in order to provide more definite conclusions.

ASSOCIATED FACTORS

Numerous factors can initiate or maintain insomnia symptoms. A summary of the most common factors is provided in Figure 3. With the exception of mental disorders and some organic diseases, these factors have received little attention in epidemiological studies performed in the general population.

Medical condition

According to Bixler *et al.* [5], half of subjects with insomnia symptoms have recurrent, persistent or multiple health problems. A similar finding was reported by Mellinger *et al.* [22], who observed that insomnia symptoms affected more than half the participants with two or more health problems. Klink and Quan [7] noted that insomnia symptoms were related to obstructive airway diseases, especially concurrent asthma and chronic bronchitis. Gislason and Almqvist [23] reported a higher occurrence of obstructive pulmonary disease in individuals who had difficulty in maintaining sleep and a higher occurrence of rheumatic disease and non-treated hypertension in individuals who had difficulty in initiating and maintaining sleep. Ohayon *et al.* [33, 36, 37] found in their surveys that insomnia complainers were more likely to have a physical illness, especially arthritis, heart diseases or a painful physical affliction (e.g. back pain). A Swedish study assessing the impact of chronic pain in 1806 subjects of the general population reported also that insomnia was one of the consequences of chronic pain [62]. An epidemiological longitudinal study with 6800 elderly subjects done in 1982 and in 1985 [63] showed that the incidence of insomnia was higher in subjects with heart disease, stroke, incident hip fracture and respiratory symptoms. Furthermore, the persistence of insomnia over the three-year period was associated with heart disease, incident diabetes, baseline respiratory symptoms and stroke. Some studies, mostly with elderly people, have assessed the self-perceived health. All these studies found that individuals with insomnia symptoms are more likely to report a poor self-rated health [42–46, 61]. Insomnia subjects have been constantly reported to make greater use of healthcare services [25, 27, 33, 36, 37, 40]. A recent review of epidemiological studies that examined the association between heart disease and insomnia reported 10 studies that had an explicit measure of association between coronary heart disease and insomnia [64]. According to their conclusions, the

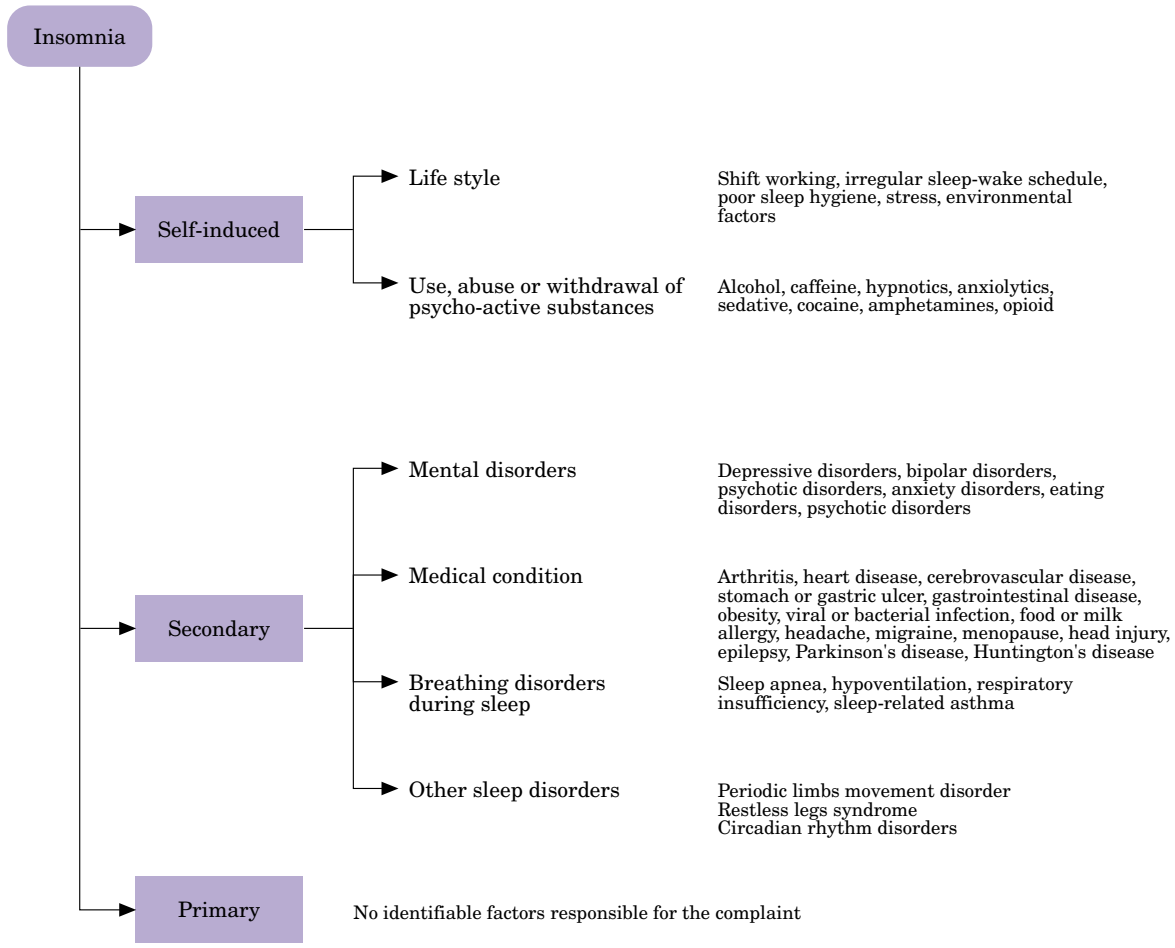

Figure 3 Factors associated with insomnia.

risk ratios between trouble falling asleep and coronary events were between 1.5 and 3.9.

Drugs and medications disrupting sleep

Smoking was found to be positively related to difficulties in initiating sleep and estimated sleep latency in an epidemiological study of 2202 European subjects aged 20–45 years [14]. Assessing the sleep and health of 869 individuals aged 14–84 years, Philips and Danner [65] found that cigarette smokers were significantly more likely than non-smokers to report problems falling sleep, problems staying asleep, daytime sleepiness, minor accidents, depression and high daily caffeine intake. Similarly, Wetter and Young [66] found in a sample of 3516 adults that smoking was associated with difficulty initiating sleep and difficulty waking up. Excessive daytime sleepiness was related to smoking only for females, while nightmares and disturbing dreams were related to smoking only among males. Another study reported that smokers were more likely to sleep for less than 6 h per night than non-smokers [67].

Although often reported in clinical studies, the association between the use of antihypertensive drugs and insomnia was seldom reported in epidemiological studies. In an epidemiological study of 8000 Swedish subjects, Bardage and Isacson [68] reported that nearly 20% of the users of antihypertensive drugs reported side-effects, insomnia being one of those that had the strongest negative impact on health utility. Another epidemiological study with 3201 Swedish men reported different results. Men with hypertension had more frequently a complaint of insomnia, but those treated with β-blockers had lower rates of insomnia [23].

Alcohol is a central nervous system depressant known for its important effects on sleep and wakefulness. On sleep patterns, alcohol at bedtime ac-

celerates the sleep onset, increases the amount of slow-wave sleep, decreases the amount of rapid eye movement sleep and causes sleep disruption in the second half of the sleep period [69]. However, prolonged use of alcohol at bedtime loses its effects on sleep onset but sleep disruption remains. Still, alcohol is often used as a sleeping aid in the general population [16, 70]. An epidemiological study reported that about four out of 10 insomnia subjects medicated themselves with over-the-counter medications or alcohol [16]. Other medications, such as serotonergic re-uptake inhibitors, some neuroleptics, some antiparkinsonians and amphetamines, may all provoke insomnia among patients using these kinds of medications. Hypnotics and anxiolytics may cause insomnia in several situations: a tolerance can be developed over time, causing the resurgence of insomnia; a rebound of insomnia on discontinuation of the treatment and on abrupt withdrawal. Tolerance to hypnotics and anxiolytics has often been studied in the general population. The results are the same: chronic users of hypnotics and anxiolytics show little or no difference when compared with non-treated insomnia subjects [71–73].

Mental disorders

The association between insomnia and mental disorders has been investigated in different ways in the general population. In individuals with a current major depressive episode, the presence of insomnia symptoms was found in nearly 80% of the subjects [74, 75]. The rate was nearly 90% when an anxiety disorder was present concomitantly [74]. In 10 studies that used depression or anxiety scales to this end, participants with insomnia symptoms scored higher on these measures than did those without [17, 18, 22, 40, 42–47]. Three epidemiological studies have used longitudinal study design to assess this relationship [27, 28, 76].

Ford and Kamerow [27] carried out the first comprehensive study assessing the relationship between mental disorders and insomnia in the general population. They found a high co-occurrence of insomnia complaints and mental disorders (40%). Insomnia complaints were associated with a higher risk (odds ratio of 39.8) for developing a new major depressive illness if they persisted over two interviews within a 12 month interval but were not a significant factor if they ceased by the second interview. This design was reproduced later in a young adult population of 1007 individuals between 21 and 30 years of age [28]. Individuals with a history of insomnia were four times more likely to develop a new major depressive disorder in the 3.5 years following the initial interview. Another survey followed up 2164 individuals age 50 years and over in Alameda County (California) during a one-year period [76]. This study found that the presence of major depression at the last assessment was eight times more likely to occur in individuals with insomnia complaints on both assessments and 10 times more likely to occur in those who reported insomnia complaints only on the last assessment. However, insomnia is a less important predictor of future depression than other depressive symptoms (anhedonia, feelings of worthlessness, psychomotor agitation/retardation, mood disturbance, thoughts of death) [76].

These studies, however, do not take into account the predominance or not of the insomnia complaint: they are based only on the co-occurrence of insomnia symptoms and mental disorder. Should the insomnia warrant a specific diagnosis? Should the insomnia be considered as part of the mental disorder manifestation? The answer requires the use of a classification; not only the symptomatic description of a diagnosis but also the elements of the differential diagnosis. However, few epidemiological studies on insomnia used this approach [29, 30, 36, 37, 77]. The first epidemiological study using a classification to categorize insomnia subjects was published in 1997 [29]. The differential diagnosis of insomnia was based on the DSM-IV classification. The study involved 5622 subjects 15 years of age and over from the general population of France. Insomnia was present when (1) the subjects reported at least one insomnia symptom (difficulty initiating sleep, disrupted sleep, early morning awakenings or non-restorative sleep) and (2) when in addition the subjects claimed to be dissatisfied with their sleep quantity or quality or needed medication to increase the quality of sleep. Overall, 19.1% of the sample met these two conditions.

To be eligible for a DSM-IV insomnia diagnosis, two other features needed to be present: (1) the insomnia must have persisted for at least one month; (2) the sleep disturbance or daytime fatigue must have caused clinically significant distress or impairment in social, occupational or other important areas of functioning. This description was found in 12.7% of the sample. The DSM-IV decision-making

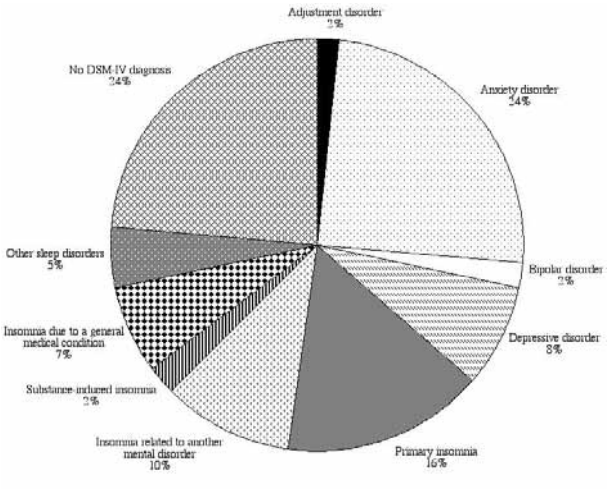

Figure 4 DSM-IV diagnostic distribution of subjects with insomnia.

process was then applied to these subjects. Accordingly, when insomnia was accompanied by a general medical condition or substance use responsible for the insomnia symptoms, respondents received a diagnosis of "sleep disorder due to a general medical condition, insomnia type" or of "substance-induced sleep disorder, insomnia type". When a mental disorder was present, additional questions were asked to determine whether the insomnia complaint constituted the predominant characteristic of the symptomatology or was simply associated with it. If the former proved true, respondents received a diagnosis of "insomnia related to another mental disorder"; if the latter was true, insomnia disorder was ruled out and a mental disorder diagnosis was formulated instead. When the insomnia complaints were not accompanied by a mental or a general medical condition or by substance use, a "primary insomnia" diagnosis was made. Respondents with characteristics of several forms of insomnia were classified in the "dyssomnia not otherwise specified" category. Overall, 5.6% of the sample had one of the DSM-IV insomnia diagnoses. "Insomnia related to another mental disorder" and "primary insomnia" were the most frequent diagnoses.

Similar studies were conducted in the United Kingdom, Germany, Canada, Italy and Portugal [29, 30, 36, 37, 77]. The European studies included 20 536 subjects age 15 years and over. The overall prevalence of insomnia symptoms accompanied by sleep dissatisfaction was 12.4%. Figure 4 shows how these subjects were distributed according to the DSM-IV classification. Insomnia diagnoses were observed in 35% of the subjects with insomnia; non-insomnia sleep disorders accounted for an additional 5%. The final diagnosis resulted in a mental disorder diagnosis in 36% of the insomnia symptoms accompanied by sleep dissatisfaction. No diagnosis was given for 24% of insomnia symptoms accompanied by sleep dissatisfaction.

Practice Point 3

1. Insomnia symptoms are present in the majority (over 80%) of subjects with a major depressive illness.
2. Persistent insomnia symptoms increase the likelihood of developing a major depressive illness within a one-year period with a risk factor of at least 4.
3. Insomnia symptoms are associated with a mental disorder in more than one-third of cases.

WHAT WE STILL HAVE TO LEARN

Definition and evaluation of insomnia

Insomnia is still evaluated in an idiosyncratic way in epidemiological studies. As a result it is almost impossible to compare studies between each other and to summarize them in a meaningful way. This situation is due to the fact that no clear definition exists of insomnia and how to assess it. For example, the DSM-IV gives as the first criterion for insomnia "the predominant complaint is difficulty initiating or maintaining sleep, or non-restorative sleep, for at least one month". This criterion is pretty large and difficult to apply in epidemiological study: what is a predominant complaint? How frequently should the insomnia symptom occur? On what facts should we rely to conclude the presence of an insomnia symptom? The general strategy adopted by most epidemiologists is to ask a single question for each symptom and to determine its presence on the basis mainly of its frequency, typically at least three times per week, or, less frequently, its severity, for example, being bothered by the symptom. Furthermore, the diagnoses of insomnia proposed by the DSM-IV and ICSD classifications still lack of validity as demonstrated by the difficulties in achieving good inter-rater agreements [78].

Natural evolution of insomnia

The epidemiology of insomnia is still in its infancy. Our knowledge is still limited with regard to the natural evolution of insomnia in the general population. Almost all epidemiological studies have a cross-sectional design. Therefore, they represent a photograph of a given population at a given time. What occurred before the photograph was taken and what will happen to people when this photograph fades away are virtually unknown.

From longitudinal epidemiological studies presented earlier, we know that persistence of insomnia over time is associated with a higher incidence of depressive disorders [27, 28, 76]. Another study with the elderly population has explored the evolution of insomnia over time in association with several physical health problems and depressive mood [63]. It was found that nearly half of subjects with insomnia at the first assessment no longer reported these symptoms three years later. These subjects were more likely to have an improvement in self-perceived health than the elderly individuals who still displayed insomnia symptoms. On the other hand, incidence and maintenance of insomnia symptoms were associated with perceived poor health, depressed mood, presence of a chronic disease, physical disability and widowhood. They concluded that the incidence of insomnia is not related to the aging process *per se* but to the other risk factors associated with insomnia. This fact fits with other studies that observed that insomnia accompanied by dissatisfaction with sleep quality or quantity is not related to age *per se* [28, 34, 36, 37, 40, 46, 58, 59]. Therefore, the increased prevalence of insomnia symptoms with age could be due to the definitions used and how insomnia is assessed.

Longitudinal studies will allow us to estimate the prevalence of transient and seasonal patterns of insomnia complaints, the factors associated with its remission and those that contribute to the maintenance of the problem.

Insomnia and genetic link

Genetic factors involved in insomnia are not well known. With the exception of fatal familial insomnia, the existence of possible genetic links in insomnia complaints was rarely studied. Two studies done with twins [79, 80] showed a genetic contribution in insomnia complaint. In one study, the heritability was higher in monozygotic than in dizygotic twins [79]. A recent clinical study [81] reported a higher probability to have a familial history of insomnia, but non-significant, in patients diagnosed with psychophysiological, idiopathic, psychiatric or drug/alcohol-related insomnia. These results suggest the existence of a familial vulnerability to insomnia; however, further studies are needed to determine the genetic contribution to insomnia.

CONCLUSIONS

The epidemiological surveys described in this paper clearly show that dissatisfaction with sleep with quantity or quality, insomnia symptoms and diagnoses are very common in the general population. For a sizeable portion of the population, insomnia represents serious sleep and/or mental disorders that require medical attention. Unfortunately, healthcare providers seldom detect sleep disorders, even if patients report some of the serious repercussions that these can entail. In childhood, sleep disorders can cause learning disabilities, whereas, in adulthood, they can interfere with almost every important area of functioning, including work, family and social life. About one out of five people perceives his or her insomnia symptoms as a sleep problem. Although most of these will consult a healthcare professional several times over the course of a year, the majority will choose not to discuss sleep disturbances with their physicians: epidemiological studies that investigate this aspect reported that between 27% and 45% of insomnia complainers will discuss their sleep problems [16–18, 29, 34, 35, 37]. To remedy this situation, physicians must acquire a better understanding of sleep disorders and must be aware that patients do not always describe symptoms specifically related to sleep problems.

Research Agenda

In the coming years, epidemiological research efforts should focus on the following:

1. Greater emphasis should be placed on distinguishing between the various subtypes of insomnia.
2. Seasonal or transient patterns of insomnia need to be examined.
3. Longitudinal epidemiological data on the evolution and consequences of insomnia need to be gathered.

4. Epidemiological genetic links need to be studied. It is obvious that cultural and genetic specificities contribute to some sleep particularities.

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