Chapter 2
Epidemiology of Insomnia

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Abstract Prevalence of insomnia is variable due to inconsistency in defining the syndrome. It can be seen with or without comorbid illnesses and is now recognized as a distinct clinical syndrome even when associated with an underlying medical or psychiatric disorder. It is more common in women and in people who do shift work. Insomnia is present worldwide but appears to be less common in Asians. Individuals who have an anxiety-prone personality and depression are more prone to develop insomnia. It can have a huge economic impact as insomnia sufferers place a significant economic burden on their employers and health care system. Insomnia may be a risk factor for development of depression, hypertension, diabetes, and coronary artery diseases.

Keywords Prevalence of insomnia • Anxiety • Depression • Fatigue • Shift work • Women and sleep • Difficulty sleeping

Sleep accounts for one-third of human life and insomnia is the most common sleep-related complaint and the second most common overall complaint (after pain) reported in primary care settings [1].

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Estimates of the prevalence of insomnia are variable, owing in part to inconsistencies in definitions and diagnostic criteria for insomnia. These issues also make it difficult to define other dimensions of the condition, such as incidence and remission rates, as a uniform characterization of episode lengths is lacking; a positive finding of insomnia at baseline and at 1-year follow-up may reflect unremitting chronic insomnia or two episodes of transient insomnia [2, 3]. Currently, there are three distinct diagnostic nosologic systems for insomnia; the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [4], the International Classification of Sleep Disorders (ICSD-3) [5], and the ICD-10 Classification of Mental and Behavioral Disorders [6]. Several changes have been made to the diagnostic criterion of Insomnia in the DSM-5 and ICSD-3. The ICSD-3 classification of insomnia is notably different in terms of elimination of previous subtypes of insomnia as primary vs. secondary insomnia related to an existing psychiatric, medical, or substance-abuse disorder. There are now three distinct categories of insomnia: chronic insomnia, short-term insomnia disorder, and other insomnia disorder. These diagnoses apply to patients with and without comorbidities. Similarly DSM-5 no longer makes a distinction between primary insomnia and insomnia secondary to a psychiatric, medical, or another sleep disorder. DSM-5 criteria for insomnia includes "any sleep dissatisfaction" or early morning awakening. It should last for at least 3 months and be present for more than three nights per week. Importantly insomnia is now regarded as a disorder and DSM-5 states that it can coexist with "comorbid" vs. "secondary" conditions. These changes were made as it was determined that it was difficult to ascertain which disorder was the cause and which is the consequence and the realization that over time insomnia may remain as a clinically significant condition despite the associated condition being resolved.

Mellinger and colleagues presented data from one of the first attempts to quantify the prevalence of the disorder. Their 1979 USA survey, utilizing a nationally representative sample of 3161 people whose ages ranged from 18 to79, found that insomnia affected 35 % of the general adult population in 1 year [7]. About half of these people experienced the problem as severe [7]; yet only 15 % were treated with hypnotic medications [7]. In 1996, another study by Ohayon et al. in Montreal examined the prevalence of insomnia in a representative sample of the population of 5622 subjects, 15 years of age or more. In their cohort 20.1 % of the participants stated that they were unsatisfied with their sleep or were taking medication for sleeping difficulties [8]. A 2000 study by Leger and colleagues, in France, noted that the prevalence of frequent insomnia was 29 % in a representative sample of the population that included 12,778 individuals [9]. A 2001 study by Sutton et al. reported that 24 % of English-speaking Canadians aged 15 and above reported insomnia [10]. In a representative selection of 1997 German citizens older than 13 years of age, 25 % reported occasional difficulties in falling asleep and/or staying asleep not due to external factors and 7 % reported the same symptoms frequently or all the time [11]. A similar survey in Japan, conducted in a group of 6277 new outpatients from 11 hospitals, revealed a prevalence of 20.3 % with 11.7 % of the people suffering from insomnia for over a month. Only 37 % were treated with hyp-

notics [12]. A second Japanese study, in another representative population sample ($n = 3030$), reported almost identical results [13]. A representative adult sample (18 years and above) of the Norwegian population, comprising 2001 subjects, participated in telephone interviews, focusing on the 1-month point prevalence of insomnia and use of prescribed hypnotics. Employment of DSM-IV inclusion criteria of insomnia yielded a prevalence rate of 11.7 % [14]. A prior Norwegian study had queried 14,667 subjects and reported 41.7 % of the women and 29.9 % of the men complaining of occasional insomnia [15].

Another study in Austria in a sample of 1000 revealed a prevalence of 26 % with 21 % of them being severe and chronic with duration of 1 year or more [16]. In a representative sample of the South Korean general population composed of 3719 non-institutionalized individuals aged 15 years or older the prevalence of insomnia symptoms occurring at least three nights per week was reported to be 17.0 % [17]. In Mexico the prevalence of insomnia in a group of a 1000 subjects, aged 18–84, was found to be 36 % with 16 % reporting severe insomnia [18]. In Singapore the prevalence of persistent insomnia for over a year was 15.3 % in subjects between the ages of 15 and 55 [19]. In a group of 1099 subjects representative of the Finnish population, Hyyppa and Kronholm reported a male/female prevalence of 9.6/12.8 % of frequent or nightly insomnia and 57.6–62.7 % of occasional insomnia [20]. The prevalence of severe insomnia was 5–14 %, depending on the age group [20].

There are fewer studies in the pediatric population; yet they reveal, in general, similar prevalence rates. In preadolescent children, one of the earliest studies noted that 14 % of an outpatient US pediatric population between the ages of 6 and 12 had insomnia with a mean duration of 5 years [21]. Archbold et al. at Ann Arbor surveyed parents of 1038 unselected children (554 boys) aged 2.0–13.9 years. Forty-one percent of the children had at least one symptom of insomnia and 18 % had two or more symptoms [22]. The prevalence of frequent insomnia in 1413 Swedish schoolchildren aged 6.2–10.9 years was reported to be 13 % [23].

In adolescent groups, the prevalence of insomnia appears to be similar to that of younger children. In a Chinese study, a total of 1365 adolescents between the ages of 12 and 18 years were surveyed and 16.9 % reported insomnia [24]. A multinational study in Europe, in a representative sample of 1125 adolescents aged 15–18 years, from four countries (France, Great Britain, Germany, and Italy) reported insomnia symptoms in approximately 25 % and DSM-IV insomnia disorder in approximately 4 % [25]. Previous studies had reported prevalence rates of 4–5 % for persistent insomnia in a group of 574 (aged 7–17) [26], 10.8–33.2 % for frequent insomnia (at least twice a week) in a group of 40,202 children aged 11–16 [27], 11–12.6 % for frequent insomnia [28–30], 23–38 % for occasional insomnia, and 1–2 % for persistent insomnia [31]. In summary, studies from different countries suggest that insomnia is a universal complaint, and that it is commonly expressed, making it a major health issue.

In a recent review by Ohayon [32] an attempt was made to determine the prevalence of insomnia based on four categories:

Table 2.1 Prevalence of insomnia by country

Country	No. of subjects	Age (years)	Prevalence (%)	Reference
USA	3161	18–79	35	[7]
Canada-French	5622	>15	20.1	[8]
German	1997	>13	25	[11]
Norway	2001	>18	11.7	[14]
South Korea	3719	>15	17	[17]
Mexico	1000	18–84	36	[18]
China	1365	15–18	25	[25]
Europe (France, UK, Germany, Italy)	1125	15–18	25	[25]

1. Insomnia symptoms of difficulty in initiating and maintaining sleep or non-restorative sleep.
2. Insomnia symptoms accompanied by daytime consequences.
3. Dissatisfaction with sleep quality or quantity.
4. Insomnia diagnosis based on definitions established by DSM-IV, or ICSD.

The first category based on insomnia symptoms alone revealed a prevalence of 30–48 %. This dropped to 16–12 % when frequency modifiers were added to symptoms such as presence of symptoms to at least three nights a week or "often" or "always." When severity criteria were added to insomnia symptoms the prevalence of insomnia ranged from 10 to 28 %. The prevalence of insomnia based on insomnia symptoms with daytime consequences (category 2) was around 10 %. The prevalence of insomnia based on dissatisfaction with sleep quality and quantity (category 3) was 8–18 % with a higher prevalence being consistently reported in females. The prevalence of insomnia based on DSM-IV classification varied from 4.4 to 6.4 %. Primary insomnia was the most frequent diagnosis, its prevalence ranging between 2 and 4 % (Table 2.1) [7, 8, 11, 14, 17, 18, 25].

Sociodemographic Determinants

Most epidemiological studies indicate that women, the elderly, and people with coexisting health problems are more likely to suffer from insomnia [33].

Gender

All of the available epidemiological studies that compare the prevalence of insomnia between the genders report a higher prevalence in women [8]. The female-to-male ratio is roughly 1.5/1 [33]. This is especially true when comparing peri- or

Table 2.2 Prevalence of insomnia by gender

Country	Age (years)	Insomnia % female/male	Reference
USA	11–14	30.4/16.8	[36]
Germany	>18	5/3 (severe insomnia)	[39]
Hong Kong	18–65	14/9.3	[38]
South Korea	>15	19.1/14/8	[17]
Singapore	15–55	17.5/12.9	[19]
France	18–65+	12/6.3	[9]

post-menopausal women to age-matched men. One of the most common perimenopausal symptoms in women ranging in age from 35 to 55 is insomnia [34, 35].

There are, however, other studies that report an increased prevalence of insomnia in younger women, and even in adolescent girls, when compared to age-matched male counterparts. When studying a group of children and adolescents between ages of 3 and 14 ($n=452$), Camhi et al. found that the complaints of insomnia were much higher in adolescent girls (ages 11–14) than in the rest of the group (30.4–16.8 %) [36]. This suggests that insomnia, or the processes that produce it, are operant in women as early as adolescence. The increased prevalence of insomnia in adult women of all ages when compared to men seems to be a universal phenomenon. Studies from Hong Kong [37, 38], Germany [39], Canada [8, 13], the USA [2, 40], Norway [15], Scotland [41], and other countries [42, 43] have all reported increased prevalence in adult women when compared to age-matched male counterparts (Table 2.2) [9, 17, 19, 36, 38, 39].

Age

Advancing age is thought to be a risk factor for developing insomnia. The odds ratio was noted to be 1.3 in one study [33]. Despite other reports of increased prevalence of insomnia with aging [13, 14], a few studies that involve elderly populations exclusively have failed to demonstrate this effect [42, 44, 45]. In 2001, Ohayon et al. surveyed 13,057 subjects, whose ages were above 15 years, from three different countries (UK, Germany, and Italy). Insomnia symptoms were reported by more than one-third of the population aged 65 and older. Multivariate models showed that age was not a predictive factor for insomnia symptoms when controlling for activity status and social life satisfaction. The authors concluded that the aging process per se is not responsible for the increase of insomnia often reported in older people. Instead, inactivity, dissatisfaction with social life, and the presence of organic diseases and mental disorders were the best predictors of insomnia, with the contribution of age being insignificant. In this study, the prevalence of insomnia symptoms in healthy seniors was similar to that observed in younger individuals [46].

Ethnocultural Factors

The few studies that have looked at the impact of ethnocultural variables on insomnia have shown that, among the elderly, European-Americans more frequently complained of insomnia than African-Americans [47, 48] and had a greater reliance on sleep medications [48]. In a nationwide sleep survey [49] in the USA of 1007 individuals (aged 25–60) to characterize sleep habits in different ethnic groups, insomnia in adults was diagnosed in 20 % Whites, 18 % Blacks, 14 % Hispanics, and 9 % Asians. Overall, Asians were most likely to report getting a good night sleep [49]. It is possible that people of different ethnicities and cultures experience and perceive their sleep problems differently due to sociocultural influences and what may be experienced as abnormal in one group may be considered as normal in another.

Shift Work

Several studies have demonstrated that rotating daytime shift workers report sleep-onset insomnia more frequently than the fixed daytime-schedule workers (20.1 % vs. 12.0 %) [50], with the complaints of insomnia increasing in proportion to the number of shifts worked. Insomnia and other sleep complaints are significantly more common in three-shift workers than in two-shift workers. By the same token two-shift workers complain more of insomnia than straight-day shift workers [51]. Working the night or third shift may not only acutely cause insomnia but may have persistent deleterious effects on sleep quality, when adhered to for prolonged periods of time, even after reversion to day or evening shifts [52].

Other Factors

Occupation, socioeconomic status, marital status, and mental and physical health also impact the prevalence of insomnia. A few studies have reported a direct relationship between being unemployed [8, 13, 38, 53], lower socioeconomic status [33, 38], lower educational level [38], and increased prevalence of insomnia. Higher prevalence of insomnia complaints has also been reported among single, widowed, or divorced adults as compared to ones who were married or partnered [8, 12, 53]. Noisy environments are associated with increased reports of poor sleep particularly in women [38, 54]. Psychosocial stressors and [24] poor physical health are also associated with higher prevalence of insomnia [12, 24, 33, 37, 43–45] as is poor mental health [12, 42, 44, 45]. Medical problems associated with insomnia include depressive disorders [44, 55], anxiety disorders [55, 56], substance abuse [56], schizophrenia [55], congestive heart failure, sleep-disordered breathing [57], back and hip problems, and prostate problems [58]. In the 2015 Sleep in America poll,

Table 2.3 Factors impacting prevalence of insomnia

Low unemployment	[8, 13, 38, 53]
Lower socioeconomic status	[33, 38]
Lower educational level	[38]
Single/divorced/widowed status	[8, 12, 53]
Noisy environment	[38, 54]
Increased psychosocial stressors	[24]
Mental health disorders; schizophrenia, depression, anxiety	[44, 55, 56]
Medical problems; CHF, COPD, sleep apnea, chronic pain, enlarged prostate	[12, 24, 33, 37, 43–45, 57, 58]
Substance abuse	[56]

1044 individuals (age range from 18 to 91 years) were surveyed [59]. Those with severe or very severe stress were twice as likely to report poor sleep quality compared with those with mild or no stress (83 % vs. 35 %). Pain was also associated with poor sleep quality. 65 % of those with no pain reported good sleep quality compared to 45 % with acute pain and 35 % with chronic pain.

Seasonal differences have been reported in patients suffering from chronic insomnia. In Norway a survey of a representative sample of 14,667 adults living in the municipality of Tromso, north of the Arctic Circle, revealed increased incidence of complaints of insomnia during the dark period of the year than during any other time [15] (Table 2.3) [8, 12, 13, 24, 33, 37, 38, 43–45, 53–58].

Psychiatric Disorders

In 1989 Ford and Kamerow surveyed 7954 subjects with standardized questionnaires and then repeated the survey a year later. Of this community 10.2 % had insomnia at baseline. The risk of developing new major depression over the course of 1 year was much higher in those who had insomnia at baseline (odds ratio, 39.8; 95 % confidence interval, 19.8–80.0). The risk was less (odds ratio, 1.6; 95 % confidence interval, 0.5–5.3) in those whose insomnia had resolved by the time of the second visit [60].

In 1997 Chang et al. published a landmark paper on the subject of insomnia and its relation to the development of depression. A total of 1053 men provided information on sleep habits during medical school at The Johns Hopkins University (classes of 1948–1964) and were followed for several years after graduation. During a median follow-up period of 34 years (range 1–45), 101 men developed clinical depression (12.2 %) and 13 committed suicide. A Cox proportional hazard analysis adjusted for age at graduation, class year, parental history of clinical depression, coffee drinking, and measures of temperament revealed that the relative risk of subsequent clinical depression was greater in those who reported insomnia in medical school [61]. In the same year Weissman et al. published a study that reported data

from a survey of over 10,000 adults living in three US communities. Psychiatric disorders were assessed utilizing a structured diagnostic interview. The prevalence of insomnia (not due to medical conditions, medication, and drug or alcohol abuse), during the subsequent 1 year of follow-up, was also assessed. The results revealed that 8 % of subjects who had primary insomnia had sought psychiatric help at the end of that year for different psychiatric problems vs. 2.5 % of the normal controls. Uncomplicated or primary insomnia was also associated with an increase in risk for first onset of major depression, panic disorder, and alcohol abuse over the following year [55]. These, and similar studies, have suggested that insomnia is a risk factor for the development of major depression and other psychiatric disorders [62].

It also appears that individuals who have an anxiety-prone personality and who have a lower ability to manage day-to-day stresses are more prone to insomnia. Le Blanc et al. evaluated 464 good sleepers over 1 year to assess the incidence of developing insomnia and potential risk factors. Five variables were associated with a new onset of insomnia syndrome: (1) previous episode of insomnia, (2) positive family history of insomnia, (3) higher arousability predisposition, (4) poorer self-rated general health, and (5) higher bodily pain. Individuals who developed insomnia also appeared to have a premorbid psychological vulnerability to poor sleep, characterized by higher depressive and anxiety symptoms, lower extraversion, and poorer self-rated mental health at baseline [63]. Individuals with lower extraversion tend to be less outgoing, and are more reserved and less talkative. The activation of the hypothalamic pituitary adrenal axis leads to hyperarousal and sleeplessness in patients with insomnia. Vgontzas showed that plasma ACTH and 24-h serum cortisol in insomniacs were higher compared to controls and the greatest elevation occurred in the evening and the first half of the night [64]. In an excellent review Reimann explores the concept that primary insomnia can be conceptualized as a final common pathway resulting from the interplay between a genetic vulnerability and an imbalance between arousing and sleep-inducing brain activity, psychosocial and medical stresses, and perpetuating mechanisms like dysfunctional sleep-related behavior, learned sleep-preventing associations, and tendency to ruminate [65].

Morbidity and Mortality

A number of studies have demonstrated a decreased quality of life as a direct consequence of the insomnia. Chevalier and colleagues, using the SF-36, demonstrated that the degree of impairment in quality of life was directly proportional to the severity of insomnia. They also demonstrated that individuals with severe insomnia showed a higher level of healthcare utilization [42]. Hajak and the SINE group (Study of Insomnia in Europe) in Germany and Leger and colleagues in France reported very similar results regarding quality of life and health care utilization [39, 66]. Zammit et al. and Hatoum et al., independently, reported similar results in the USA [67, 68]. In a qualitative study individuals with insomnia described feeling

isolated and daily difficulties with cognitive emotional and physical functioning and had the cumulative effect of reducing work performance and social participation [69]. Cognitive deficits identified on objective testing have been associated with chronic, persistent, insomnia as well [70, 71]. In a recent study by Fortier-Brochu, individuals with insomnia showed clinically significant alterations in attention and episodic memory. Objective deficits on neuropsychological variables were also more pronounced and appeared to be associated with sleep continuity [72].

In a meta-analysis which summarized the findings of 21 studies, patient with insomnia had a twofold increased risk of developing depression [73].

The limited numbers of studies that have examined the association between insomnia, its treatment, and mortality have been inconsistent. Kripke et al. followed 1.1 million subjects for 6 years and reported that insomnia alone was not associated with increased mortality [74]. However, another study showed that mortality risk over a 6-year follow-up period was significantly elevated in older adults who used medications other than traditional hypnotics for improving sleep [75]. There is an association between difficulties falling asleep and mortality due to coronary artery disease in men [76]. In a study published by Suka M et al. on Japanese middle-aged male workers and after adjusting for all confounders (age, BMI, smoking, alcohol, and job stress), persistent complaints of difficulty initiating and maintaining sleep were associated with an increased risk of hypertension [77]. In another study by Vgontzas et al. chronic insomnia with short sleep duration was associated with increased risk of developing diabetes after adjusting for age, race, sex, BMI, smoking, alcohol use, depression, sleep-disordered breathing, and periodic limb movements [78].

Epidemiology of Hypnotic Use

The use of hypnotics increases with age, particularly among middle-aged and elderly women [79, 80]. Sleeping pill use varies with occupation. According to one study, the rate of frequent or habitual hypnotic use among male gardeners, female social office workers, and male construction workers was higher than the rate in other surveyed occupations [81]. Alcohol is the most commonly used hypnotic among insomniacs (roughly 15 % have reported using alcohol for insomnia) [56, 82]. Between 1987 and 1996 there was a dramatic shift, in the USA, towards the use of antidepressants instead of hypnotics for the symptomatic treatment of insomnia, despite a paucity of data regarding their efficacy, and despite the potential for serious side effects [83]. Antidepressants and over-the-counter sleep aids remain the most commonly recommended and prescribed treatments for insomnia complaints [83]. Despite the favorable safety profile of benzodiazepine receptor agonists they remain less utilized in the USA, possibly owing to concerns regarding their potential for dependence and abuse and their DEA status as “scheduled” agents and, until recently, their cost [84].

Economic Impact of Insomnia

Insomnia costs the American public $92.5 to $107.5 billion annually, in both direct and indirect expenses, due to medical procedures and medications, accidents, and reduced productivity associated with absenteeism and decreased work efficiency [85]. Insomnia sufferers place a significant burden on both the health care system and their employers [86]. Weissman et al. noted that insomnia sufferers were more prone to access medical and psychiatric care providers during a 1-year follow-up period [55]. In 1995 Walsh and Engelhardt reported a total direct cost of $13.9 billion in the USA [87].

Conclusion

Insomnia is a prevalent complaint and often encountered by health care practitioners. It is costly and can cause significant morbidity if not addressed appropriately. Women and the elderly tend to suffer from insomnia more than other groups of the population. Other risk factors include psychosocial stressors, psychiatric and medical problems, low income, unemployment, excessive environmental noise, not having a life partner, and job-related stressors among others.

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