

# Epidemiological Overview of Sleep Disorders in the General Population

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There are several hundred of epidemiological studies assessing different sleep complaints and disorders in the general population. This article summarizes the main findings of these studies and underlines some of the aspects that still need to be investigated. Insomnia complaint is one of the most studied sleep disturbances. Nearly one third of the general population complains of insomnia but a diagnosis is warranted in only 6% to 15% of the population. Excessive sleepiness is also another frequent complaint. However, its definition and method of assessment are so diverse that it is difficult to have a clear estimate of its prevalence in the general population: prevalence rates are ranging between 4% and 26%. Narcolepsy is a rare disorder with a prevalence averaging 0.04% in the general population. Obstructive Sleep Apnea Syndrome, often associated with insomnia or excessive sleepiness, is found in approximately 2% to 4% of the general population and has a higher prevalence in men than in women. Restless legs syndrome (RLS), depending on how it was assessed, varies from a low 1% in Asian countries to a high 19% in Northern European countries. RLS is higher in women and increases with age. Unfortunately, despite the high prevalence, sleep disorders remain poorly identified; less than 20% of individuals with insomnia are correctly diagnosed and treated. The figures are even lower for excessive sleepiness and RLS with less than 10% correctly diagnosed and treated.

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**Key Words** Sleepiness, Narcolepsy, Restless legs syndrome, Insomnia, Prevalence.

## INTRODUCTION

Each of us will spend about 27 years of his or her lifetime sleeping. This fact alone explains why neuro-anatomists and neuro-physiologists have been studying sleep for over a century. The epidemiology of sleep, however, is a relatively young field of study, although physicians have always been interested in knowing how widespread abnormal sleep phenomena are in the population. The field of sleep disorders encompasses a broad range of phenomena; such as insomnia, excessive sleepiness, sleep apnea and many other sleep disorders. They are traditionally divided into two broad categories: dyssomnias and parasomnias. The dyssomnias are characterized by abnormalities in the quantity or quality of sleep and its cycles. They are associated with difficulty initiating or maintaining sleep or excessive sleepiness.

This article focuses on sleep disorders most often studied in the general population. It is divided into four main topics: insomnia and its disorders, excessive sleepiness and its disorders, breathing-related sleep disorders and restless legs syndrome (RLS).

## INSOMNIA AND ITS DISORDERS

Over 50 epidemiological studies of insomnia have been conducted worldwide.<sup>1</sup>

To date, there is no consensus on how to define insomnia in the general population. Consequently, the prevalence rates for insomnia in the general population vary greatly depending on the definition used. However, the epidemiological approach to measure insomnia can be summarized into two broad categories 1) dissatisfaction with sleep quantity 2) dissatisfaction with the

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quality of sleep.

Dissatisfaction with sleep quantity can be expressed as a complaint of insufficient sleep. Lack of sleep has a prevalence rate between 20% and 41.7% in the general population.

Dissatisfaction with the quality of sleep is defined in several ways. It can be expressed as a complaint of difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS), nocturnal awakening with difficulty or inability resuming sleep or non-restorative sleep.

The evaluation of DIS or DMS is done using mainly in four strategies: 1) asking participants for the presence of any of these symptoms, 2) what was the frequency of symptoms per week, 3) what was their severity, and 4) what were the consequences on daytime functioning.

Each of these strategies provided different prevalences. Studies limited to the simple evaluation of the presence / absence of DIS or DMS reported high prevalences ranging from 30% to 48%.<sup>1</sup>

Currently, most epidemiological studies have measured the weekly frequency of DIS and DMS. Generally, a frequency of three or more nights per week was used to determine the presence of symptoms. Other studies have used a qualitative assessment of the frequency like “sometimes” “often” or “always”; often or always being the threshold for determining the presence of DIS or DMS. The prevalence of DIS or DMS varies between 16% and 21% when this method is used.<sup>1</sup>

The qualitative assessment of the severity of DIS or DMS (such as being extremely or very annoyed by DIS or DMS) gave a prevalence of DIS/DMS between 10% and 28% of the general population.<sup>1</sup>

Some epidemiological studies, in addition to assessing the presence, frequency or severity of insomnia symptoms, also addressed their associations with daytime symptoms such as sleepiness, cognitive impairment, irritability, mood swings, anxiety, or medical consultations. The combined presence of symptoms and their con-

sequences provides significantly lower prevalences ranging from 8.5% and 13.0%.<sup>1</sup>

Several epidemiological studies have assessed the level of sleep satisfaction of participants. The prevalence of individuals dissatisfied with their sleep varies from 8% to 18.5%.<sup>1</sup> Other studies have examined the perception of sleep quality or asked whether participants considered themselves as insomniacs: between 10% and 18.1% of the population reported to be poor sleepers or insomniacs.<sup>1</sup>

The diagnostic evaluation of insomnia in the general population is uncommon. The few studies that evaluated prevalence of insomnia diagnosis reported rates ranging from 4.4% to 11.7%.<sup>1</sup>

Chronicity of insomnia complaint in the general population is poorly documented.<sup>1,2</sup> Yet, studies have shown that insomnia was most chronic and lasted at least one year in 85% of cases.<sup>2</sup>

### Factors Associated with Insomnia

Several other diseases then insomnia disorders can lead to an insomnia complaint. For example, breathing-related sleep disorders such as sleep apnea or sleep hypoventilation account for 5% to 9% of insomnia complaints. Periodic limb movement disorders and / or RLS are found in about 15% of individuals complaining of insomnia. Neurological or medical conditions are observed in 4% to 11% of insomnia complaints. Poor sleep hygiene or environmental factors account for approximately 10% of insomnia complaints. Insomnia associated with the use of a psychoactive substance account for 3% to 7% of insomnia complaints (Fig. 1).

### Mental Disorders

The association between mental disorders and insomnia is well known: Epidemiological studies have shown that between 30 and 60% of people with mental disorders also complain of insomnia. Some studies have shown that up to 80% of individuals with major depressive disorder suffer from insomnia.<sup>3-5</sup> Four longitudinal

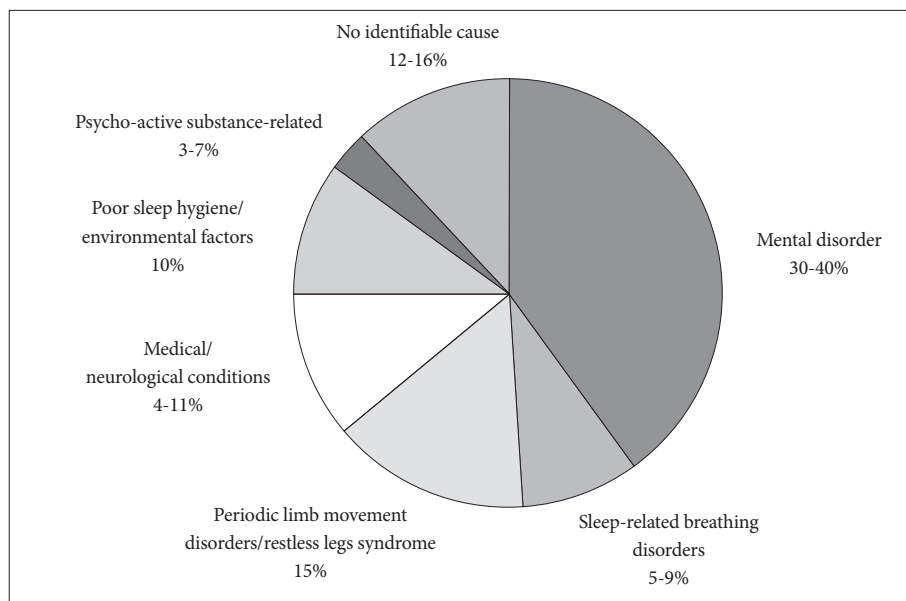


Fig. 1. Diagnostic distribution of insomnia complaints.

studies have examined the relationship between the persistence of insomnia and the onset of mental disorders.<sup>6-11</sup> The persistence of insomnia over time was associated with a likelihood of four to eight times higher of developing a mental disorder.

### Physical Illnesses and the Use of Psychoactive Substances

People who complain of insomnia frequently reported being in poor health. Some studies have found that nearly half of those with insomnia symptoms have multiple persistent or chronic health problems. The associations most frequently reported are with upper airway diseases, rheumatic diseases, chronic pain and cardiovascular diseases.<sup>1,12</sup> Several epidemiological studies have observed that the use of tobacco, alcohol and antihypertensive drugs were significantly associated with insomnia symptoms. In these populations, alcohol was used as a means to promote sleep by about 40% of individuals with insomnia.<sup>13</sup>

### Age and Sex

In the general population, the prevalence of DIS and DMS increases linearly with age reaching nearly 50% among individuals older than 65 years.<sup>1</sup> However, this linear increase is not universally found in studies evaluating DIS or DMS accompanied with daytime consequences and in those measuring sleep dissatisfaction. Women are more likely than men to complain of DIS or DMS, daytime consequences, sleep dissatisfaction and to have insomnia diagnoses.<sup>1</sup> Some studies have shown a high prevalence of insomnia in menopausal women compared to those in pre-menopause.<sup>14,15</sup>

### Lifestyle

Several factors related to lifestyle are associated with an increased risk for insomnia in the general population. Such is the case of people who report having a very stressful life,<sup>16,17</sup> unemployed, or shift workers<sup>19</sup> and people sleeping in a bedroom with inadequate temperature.<sup>16</sup>

## EXCESSIVE SLEEPINESS AND ITS DISORDERS

The term excessive sleepiness is often used interchangeably with hypersomnia. This procedure is partially correct; hypersomnia is a disorder including a variety of symptoms such as prolonged nocturnal sleep, naps and inability to stay awake or alert in situations where alertness is required (excessive sleepiness). There is also a growing tendency to label excessive sleepiness as a disease or disorder. To date, there are no data supporting this practice. According to the current classifications, excessive sleepiness is not a disease; it is a symptom of a sleep disorder or another illness. In the International Classification of Sleep Disorders, exces-

sive sleepiness is listed as a main characteristic (i.e., mandatory for diagnosis) for only three sleep disorders: behaviorally induced insufficient sleep syndrome, hypersomnia (idiopathic, chronic or posttraumatic) and Narcolepsy.

In most cases, studies that evaluated excessive sleepiness in the general population can be divided into two categories: those that measure the excessive amount of sleep and those assessing the tendency to fall asleep during wakefulness.<sup>20</sup>

The tendency to fall asleep during waking in situations of diminished attention refers to excessive sleepiness. Its definition and assessment vary almost as much as the number of epidemiological studies having investigated it. Most studies have assessed excessive sleepiness with a single question. Depending on the study, this question received a yes or no, or was answered on a severity or a frequency scale. The duration of excessive sleepiness has rarely been examined.

Many studies only verifying the presence or absence of excessive sleepiness were made with subjects aged 65 and over.<sup>20</sup> In studies based on the entire adult population, the prevalence of excessive sleepiness using yes/no answer usually ranged between 3.9% and 16%. For example, a study in the general population of Mexico reported a prevalence of 21.5% and another study in Japan has achieved a rate of 2.5%.

The frequency of excessive sleepiness was assessed using either a scale ranging from never to very often or always, or using a graduate scale of symptoms frequency during the week.

Prevalence of individuals reporting being often or very often sleepy during the day ranged between 5% and 26% of the population, the highest rates being found in Poland and Japan. Excessive sleepiness occurring at least three days per week was reported with rates varying between 4% and 20.6% in Europe.<sup>20</sup> The great variability of results is largely due to the different formulations of questions to assess excessive sleepiness.

There are few studies in the general population who have compared different types of questions assessing excessive sleepiness. A study<sup>21</sup> showed that three measures of subjective sleepiness had a moderate correlation between them ( $r$  between 0.22 and 0.35). Another study<sup>22</sup> showed that the results obtained in the Epworth Sleepiness Scale corresponded moderately with other measures of subjective excessive sleepiness (feeling sleepy during the day ( $r = 0.36$ ) or feel tired during day ( $r = 0.24$ )).

Unlike symptoms of insomnia, excessive sleepiness is not gender-related in several studies. The lack of consistent definition of excessive sleepiness leads to unacceptable variability in prevalence rates. Whether its prevalence increases or decreases with age is not clear, as both trends have been observed.<sup>20</sup> Excessive sleepiness can be caused by various factors such as poor sleep hygiene, work conditions, and psychotropic medication use. It has been found to be associated also with breathing-related sleep disorders, psychiatric disorders, especially depression, and physical illnesses.<sup>20</sup>

## Narcolepsy

There have been some attempts to estimate the prevalence of narcolepsy in different parts of the world.<sup>20,23</sup> Most prevalences are derived from clinical samples or unrepresentative of the general population. Only three studies are based on representative samples of people. According to these studies, the prevalence of narcolepsy ranges from 20 to 67 per 100,000 inhabitants with narcolepsy in Europe and North America. A study in Japan estimated this figure at 590 narcoleptics per 100,000 inhabitants and another Japanese study has established that rate to 160 per 100,000 inhabitants. In Hong Kong, the prevalence was estimated to be between 1 and 40 narcoleptics per 100,000 inhabitants while in Saudi Arabia this rate would amount to 40 per 100,000 inhabitants. Another study with Jewish Israelis, a population known for

its low rate of human leukocyte antigen (HLA-DR2) a marker of narcolepsy, established the prevalence at 0.23 per 100,000 inhabitants.

## BREATHING-RELATED SLEEP DISORDERS

Sleep apnea is characterized by repeated breathing cessations during sleep lasting at least 10 seconds. The number of apnea and hypopnea (respiratory disturbances) events per hour, called the respiratory disturbance index (RDI) or apnea/hypopnea index (AHI), is used to determine whether breathing patterns are abnormal. Usually, an AHI of 5 or more is considered an indicator

**Table 1.** Prevalence of sleep apnea syndrome in community-based studies

Authors, place	n (n recorded)	Age range	Criteria	Prevalence
Lavie, <sup>24</sup> Israel	1502 (78)	32-67 M	AI $\geq$ 10	0.89%
Gislason et al., <sup>24</sup> Uppsala, Sweden	3201 (61)	30-69 M	AHI $\geq$ 30 + excessive sleepiness	1.3%
Cirignotta et al., <sup>26</sup> Bologna, Italy	1170 (40)	30-69 M	AHI $\geq$ 10	2.7%
Martikainen et al., <sup>27</sup> Tempere, Finland	1985: 1190 1990: 626 (22)	36-50	ODI $\geq$ 4% > 5 per hour ODI $\geq$ 4% > 10 per hour	1.8% 1.1%
Ancoli-Israel et al., <sup>28</sup> San Diego, USA	615 (427)	65-95	AI $\geq$ 5 RDI $\geq$ 10	24.0% 62.0%
Stradling & Cosby, <sup>29</sup> Oxford, UK	1001 (893)	35-65 M	ODI $\geq$ 4% > 5 per hour ODI $\geq$ 4% > 10 per hour ODI $\geq$ 3% > 10 per hour + symptoms	5.0% 1.0% 0.8%
Gislason et al., <sup>30</sup> Reykjavik, Iceland	1505 (35)	40-59 W	AHI $\geq$ 30 + excessive sleepiness	2.5%
Young et al., <sup>31</sup> USA	3513 (625)	30-60	AHI $\geq$ 5	4.0% (M) 2.0% (W)
Olson et al., <sup>32</sup> Australia	2202 (441)	35-69	AHI $\geq$ 10	5.7% (M) 1.2% (W)
Bearpark et al., <sup>33</sup> Busselton, Australia	486 (294)	40-65 M	RDI $\geq$ 5 + at least occasional excessive sleepiness RDI $\geq$ 5 + at least often excessive sleepiness	12.2% 3.1%
Bixler et al., <sup>34</sup> Pennsylvania, USA	4364 (741)	20-100 M	AHI $\geq$ 10 + daytime symptoms	3.3%
Bixler et al., <sup>35</sup> Pennsylvania, USA	12,219 (1,000)	20-100 W	AHI $\geq$ 10 + daytime symptoms	1.2%
Duran et al., <sup>36</sup> Vitoria-Gasteiz, Spain	2148 (555)	30-70	AHI $\geq$ 10	19.0% (M) 14.9% (W)
Ip et al., <sup>37</sup> Hong Kong	1532 (106)	30-60 W	AHI $\geq$ 5 AHI $\geq$ 5 + excessive sleepiness	3.7% 2.1%
Udwadia et al., <sup>38</sup> Bombay, India	658 (250)	35-65 M	AHI $\geq$ 5 AHI $\geq$ 5 + excessive sleepiness	19.5% 7.5%
Sharma et al., <sup>39</sup> Semi-urban community of Delhi, India	2,150 (150)	30-60	AHI $\geq$ 5 AHI $\geq$ 5 + excessive sleepiness	13.7% 3.57%
Reddy et al., <sup>40</sup> South Delhi, India	2,505 (360)	30-65	AHI $\geq$ 5 AHI $\geq$ 5 + excessive sleepiness	9.3% 2.8%

M: men, W: women, AI: apnea index, AHI: apnea/hypopnea index, ODI: oxygen desaturation index, RDI: respiratory disturbance index.

**Table 2.** Prevalence of Restless Legs Syndrome in community-based studies

Authors, Place	n	Age range	Prevalence
Restless Legs Syndrome assessed with 1 or 2 questions			
Lavigne & Montplaisir, <sup>41</sup> Canada	2,019	≥ 18	10% to 15%
Phillips et al., <sup>42</sup> Kentucky, USA	1,803	≥ 18	9.4%
Kageyama et al., <sup>43</sup> 5 cities, Japan	4,612	≥ 20	3-7% W 4-10% M
Rijsman et al., <sup>44</sup> Krimpen, Netherlands	1,437	50-109	7.1%
Kim et al., <sup>45</sup> South Korea	9,939	40-69	12.1%
Elwood et al., <sup>46</sup> Caerphilly, South Wales, UK	1,986 M	55-69	23.0%
Phillips et al., <sup>47</sup> USA	1,506	≥ 18	9.7%
Yokoyama et al., <sup>48</sup> Japan	1,769	≥ 70	11.4%
Juuti et al., <sup>49</sup> Oulu, Finland	995	57	18.0%
1995 International Restless Legs Syndrome Study Group criteria			
Rothdach et al., <sup>50</sup> Augsburg, Germany	369	65-83	9.8%
Ulfberg et al., <sup>51</sup> Dalarna County, Sweden	2,608 M	18-64	5.8%
Ulfberg et al., <sup>52</sup> Dalarna County, Sweden	140 W	18-64	11.4%
Sevim et al., <sup>53</sup> Mersin, Turkey	3,234	≥ 18	3.2%
Berger et al., <sup>54</sup> Pomerania, Germany	4,310	20-79	10.6%
Högl et al., <sup>55</sup> Bruneck, Italy	701	50-89	10.6%
Mizuno et al., <sup>56</sup> Izumo city, Japan	3,287	≥ 65	1.06%
Tison et al., <sup>57</sup> France	10,263	≥ 18	8.5%
Gao et al., <sup>58</sup> 14 states in USA	65,554 W 23,119 M	W: 38-55 M: >56	≥ 5t/mth (≥ 15t/mth): W: 6.4% (2.7%) M: 4.1% (1.7%)
Tsuboi et al., <sup>59</sup> Ajimu, Japan	1,251	≥ 65	0.96%
2003 International Restless Legs Syndrome Study Group criteria			
Allen et al., <sup>60</sup> USA + 5 European countries	15,391	≥ 18	7.2% 2.7% (≥ 2t/wk + moderate/ severe distress)
Bjorvatn et al., <sup>61</sup> Denmark & Norway	2,005	≥ 18	8.8% Denmark 14.3% Norway
Castillo et al., <sup>62</sup> Guayaquil and Quito cities, Ecuador	500	25-85	3.2% Quito 0.8% Guayaquil
Lee et al., <sup>63</sup> Baltimore, USA	1,028	58 (±12)	4.2%
Vogl et al., <sup>64</sup> South Tyrol	530	≥ 18	8.9%
Hadjigeorgiou et al., <sup>65</sup> Larissa, Greece	3,033	≥ 20	3.9%
Rangarajan et al., <sup>66</sup> Bangalore, India	1,266	18-90	2.1%
Ulfberg et al., <sup>67</sup> Sweden	1,000	18-90	5.0%
Broman et al., <sup>68</sup> Uppsala, Sweden	1,335	20-59	18.8% 5.8% (≥ 2t/wk)
Cho et al., <sup>69</sup> 5 regions, South Korea	5,000	20-69	7.5%
Froese et al., <sup>70</sup> British Columbia, Canada	430	≥ 18	17.7%
Happe et al., <sup>71</sup> Dortmund, Germany	1,312	25-75	8.8%
Nomura et al., <sup>72</sup> Daisen, Japan	2,812	≥ 20	1.8%
Wesström et al., <sup>73</sup> Dalarna county, Sweden	3,516 W	18-64	15.7%
Winkelman et al., <sup>74</sup> USA	3,254	44-98	5.2%

**Table 2.** Continued

Authors, Place	n	Age range	Prevalence
Cho et al., <sup>75</sup> South Korea	6,509	18-64	0.9%
Erer et al., <sup>76</sup> Orhangazi, Bursa, Turkey	1,124	40-95	9.7%
Benediktsdottir et al., <sup>77</sup> Reykjavik, Iceland Uppsala, Sweden	769 601	≥ 40	18.3% Iceland 11.5% Sweden
Celle et al., <sup>78</sup> St-Etienne, France	667	68.6 (±0.8)	26.0%
Chen et al., <sup>79</sup> Taiwan	4,011	15-70	1.57%
Kim et al., <sup>80</sup> South Korea	714	≥ 65	8.4%
Park et al., <sup>81</sup> South Korea	1,000 W	40-69	6.5%
Tasdemir et al., <sup>82</sup> Kandira, Turkey	2,111	≥18	3.4%
Winkler et al., <sup>83</sup> Northern Tanzania	7,654	14-110	0.013%
Yilmaz et al., <sup>84</sup> Gaziantep, Turkey	3,304	15-18	3.6%
Other criteria			
Ohayon and Roth, <sup>85</sup> 5 European countries	18,980	15-100	ICSD: 5.5%
Picchietti et al., <sup>86</sup> UK and USA	10,523	8-17	Pediatric NIH criteria 1.9% 8-11 y.o. 2.0% 12-17 y.o.
Ram et al., <sup>87</sup> USA	6,139	≥16	Physician-diagnosed: 0.4%

ICSD: International Classification of Sleep Disorders, RLS: restless legs syndrome.

of an inordinate number of sleep respiratory disturbances. Few studies have estimated the prevalence of sleep apnea or obstructive sleep apnea syndrome from representative samples of the general community (Table 1). The target population, methods, and criteria vary considerably between studies. In all cases, the prevalence rates are estimates because it is nearly impossible to perform polysomnographic recordings for all participants. Screening questionnaires were first used to identify participants most likely to have sleep apnea or Obstructive Sleep Apnea Syndrome and then polysomnographic recordings were conducted to confirm the diagnosis. Obstructive sleep apnea syndrome, often associated with insomnia or excessive sleepiness, is found in 2% to 4% of the general population (Table 1) while sleep apnea (i.e., presence of sleep respiratory disturbances with or without associated symptoms) is far more frequent ranging between 9% and 24%. The prevalence of Obstructive sleep apnea syndrome is about twice higher in men than in women.<sup>31,34,35,39,40</sup>

## RESTLESS LEGS SYNDROME

RLS has been more extensively studied in the general population in the last decade. RLS studies are reported in Table 2. Nine studies<sup>41-49</sup> assessed RLS using a limited set of questions (one or two questions). In these cases prevalence rates ranged from 7% to 23% with an average around 10% when studies included all the adult population (≥ 18 y.o.).<sup>41,42,47</sup> The higher prevalences were observed in older samples (≥ 55 y.o.).<sup>46,48,49</sup>

Another 10 studies<sup>50-59</sup> used the 1995 RLS criteria proposed by

the International RLS Study Group (Table 2). Five of them targeted a broad age range of the general population.<sup>51-54,57</sup> In these studies, the prevalence was around 8%. Three studies reported very low RLS prevalence: two of them were done in Japan<sup>56,59</sup> with people aged at least 65 years (prevalence around 1%) and one was done in Turkey (prevalence at 3.2%).<sup>53</sup>

A total of 26 studies<sup>60-84</sup> used the 2003 revised RLS criteria of the International RLS Study Group (Table 2). Sixteen of them had samples targeting most of the adult general population.<sup>60-62,64-67,69,70-73,75,79,82,83</sup> Prevalence greatly varied according to the geographic location with prevalence rates highest in Northern European countries (Norway, Sweden, Iceland) with prevalences between 14% and 19% and lowest in Asian countries with prevalence between 1% and 2% (Table 2). There are several methodological issues to consider however. For example, the participation rate greatly varied between the studies ranging from 35% to 95%. Furthermore, although studies were based on the same diagnostic criteria, the methodology to assess these criteria was different between the studies: some studies requested only the presence of the 4 criteria while other studies had the participants interviewed by a sleep specialist or a neurologist to eliminate disorders that mimics RLS which led to lower prevalences.

In nearly all the studies, RLS prevalence was higher in women than in men. It also increased steadily with age until 65 years in European and North American countries but not in Asian countries. In European and North American men, RLS prevalence is approximately 2% among the 20-25 years old and reaches about 6% among men aged 65 years or older. In European and North American women, RLS prevalence is around 4.5% among the 20-

25 years old and reaches about 11% among those aged 65 years or older. In Asian countries, RLS prevalence is approximately 1.8% in men and 3% in women.

## CONCLUSIONS

Sleep disorders are very common in the general population but they are poorly identified: less than 20% of individuals with insomnia are correctly diagnosed and treated, despite the fact that a considerable proportion of the population is suffering from serious sleep disorders and requires medical attention. For excessive sleepiness and RLS, the figures are even worse with less than 10% correctly diagnosed and treated.

Insomnia and excessive sleepiness affect many spheres of functioning: professional, social or family life, and cause concentration and memory problems. In addition, a sleepy individual increases his risk of road, occupational or domestic accidents. The high prevalence rates of insomnia and excessive sleepiness clearly indicate that this is a major public health problem requiring education and prevention initiatives and justifying greater attention from health authorities.

In the coming years, epidemiological research efforts should focus on: 1) distinction between the various subtypes of insomnia and a better operationalization of insomnia definition, 2) for excessive sleepiness: better definition of the concept and how to measure it in the general population. To date, comparisons between studies are virtually impossible since no study evaluate excessive sleepiness in the same way. 3) Seasonal or transitional forms of insomnia and excessive sleepiness need to be examined and 4) longitudinal epidemiological studies on the evolution and consequences of insomnia and excessive sleepiness need to be conducted.

### Conflicts of Interest

The author has no financial conflicts of interest.

### REFERENCES

- Ohayon MM. Epidemiology of insomnia: what we know and what we still need to learn. *Sleep Med Rev* 2002;6:97-111.
- Ohayon MM, Roth T. Place of chronic insomnia in the course of depressive and anxiety disorders. *J Psychiatr Res* 2003;37:9-15.
- Mellinger GD, Balter MB, Uhlenhuth EH. Insomnia and its treatment. Prevalence and correlates. *Arch Gen Psychiatry* 1985;42:225-32.
- Ohayon MM, Roth T. Place of chronic insomnia in the course of depressive and anxiety disorders. *J Psychiatr Res* 2003;37:9-15.
- Ohayon MM. Prevalence of DSM-IV diagnostic criteria of insomnia: distinguishing insomnia related to mental disorders from sleep disorders. *J Psychiatr Res* 1997;31:333-46.
- Weissman MM, Bland RC, Canino GJ, Faravelli C, Greenwald S, Hwu HG, et al. Cross-national epidemiology of major depression and bipolar disorder. *JAMA* 1996;276:293-9.
- Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders. An opportunity for prevention? *JAMA* 1989;262:1479-84.
- Breslau N, Roth T, Rosenthal L, Andreski P. Sleep disturbance and psychiatric disorders: a longitudinal epidemiological study of young adults. *Biol Psychiatry* 1996;39:411-8.
- Roberts RE, Roberts CR, Chen IG. Impact of insomnia on future functioning of adolescents. *J Psychosom Res* 2002;53:561-9.
- Roberts RE, Shema SJ, Kaplan GA, Strawbridge WJ. Sleep complaints and depression in an aging cohort: a prospective perspective. *Am J Psychiatry* 2000;157:81-8.
- Ohayon MM. Observation of the natural evolution of insomnia in the American general population cohort. *Sleep Med Clin* 2009;4:87-92.
- Mallon L, Broman JE, Hetta J. Sleep complaints predict coronary artery disease mortality in males: a 12-year follow-up study of a middle-aged Swedish population. *J Intern Med* 2002;251:207-16.
- Roehrs T, Hollebeck E, Drake C, Roth T. Substance use for insomnia in Metropolitan Detroit. *J Psychosom Res* 2002;53:571-6.
- Owens JF, Matthews KA. Sleep disturbance in healthy middle-aged women. *Maturitas* 1998;30:41-50.
- Ohayon MM. Severe hot flashes are associated with chronic insomnia. *Arch Intern Med* 2006;166:1262-8.
- Ohayon MM, Partinen M. Insomnia and global sleep dissatisfaction in Finland. *J Sleep Res* 2002;11:339-46.
- Ohayon MM, Hong SC. Prevalence of insomnia and associated factors in South Korea. *J Psychosom Res* 2002;53:593-600.
- Ohayon MM, Zulley J. Correlates of global sleep dissatisfaction in the German population. *Sleep* 2001;24:780-7.
- Ohayon MM, Smolensky MH, Roth T. Consequences of shiftworking on sleep duration, sleepiness, and sleep attacks. *Chronobiol Int* 2010; 27:575-89.
- Ohayon MM. From wakefulness to excessive sleepiness: what we know and still need to know. *Sleep Med Rev* 2008;12:129-41.
- Ohayon MM, Priest RG, Zulley J, Smirne S, Paiva T. Prevalence of narcolepsy symptomatology and diagnosis in the European general population. *Neurology* 2002;58:1826-33.
- Baldwin CM, Kapur VK, Holberg CJ, Rosen C, Nieto FJ; Sleep Heart Health Study Group. Associations between gender and measures of daytime somnolence in the Sleep Heart Health Study. *Sleep* 2004;27:305-11.
- Ohayon MM. Epidemiology of narcolepsy. In Bassetti C, Billiard M, Mignot E. Narcolepsy and Hypersomnia. Series: Lung biology in health and disease. New York: Informa Healthcare 2007:125-132.
- Lavie P. Incidence of sleep apnea in a presumably healthy working population: a significant relationship with excessive daytime sleepiness. *Sleep* 1983;6:312-8.
- Gislason T, Almqvist M, Eriksson G, Taube A, Boman G. Prevalence of sleep apnea syndrome among Swedish men--an epidemiological study. *J Clin Epidemiol* 1988;41:571-6.
- Cirignotta F, D'Alessandro R, Partinen M, Zucconi M, Cristina E, Gerardi R, et al. Prevalence of every night snoring and obstructive sleep apnoeas among 30-69-year-old men in Bologna, Italy. *Acta Neurol Scand* 1989;79:366-72.
- Martikainen K, Partinen M, Urponen H, Vuori I, Laippala P, Hasan J. Natural evolution of snoring: a 5-year follow-up study. *Acta Neurol Scand* 1994;90:437-42.
- Ancoli-Israel S, Kripke DE, Klauber MR, Mason WJ, Fell R, Kaplan O. Sleep-disordered breathing in community-dwelling elderly. *Sleep* 1991; 14:486-95.
- Stradling JR, Crosby JH. Predictors and prevalence of obstructive sleep apnoea and snoring in 1001 middle aged men. *Thorax* 1991;46:85-90.
- Gislason T, Benediktsdóttir B, Björnsson JK, Kjartansson G, Kjeld M, Kristbjarnarson H. Snoring, hypertension, and the sleep apnea syndrome. An epidemiologic survey of middle-aged women. *Chest* 1993;103:1147-51.
- Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. *N Engl J Med* 1993;328:1230-5.
- Olson LG, King MT, Hensley MJ, Saunders NA. A community study of snoring and sleep-disordered breathing. Prevalence. *Am J Respir Crit Care Med* 1995;152:711-6.

33. Bearpark H, Elliott L, Grunstein R, Cullen S, Schneider H, Althaus W, et al. Snoring and sleep apnea. A population study in Australian men. *Am J Respir Crit Care Med* 1995;151:1459-65.
34. Bixler EO, Vgontzas AN, Ten Have T, Tyson K, Kales A. Effects of age on sleep apnea in men: I. Prevalence and severity. *Am J Respir Crit Care Med* 1998;157:144-8.
35. Bixler EO, Vgontzas AN, Lin HM, Ten Have T, Rein J, Vela-Bueno A, et al. Prevalence of sleep-disordered breathing in women: effects of gender. *Am J Respir Crit Care Med* 2001;163:608-13.
36. Durán J, Esnaola S, Rubio R, Iztueta A. Obstructive sleep apnea-hypopnea and related clinical features in a population-based sample of subjects aged 30 to 70 yr. *Am J Respir Crit Care Med* 2001;163:685-9.
37. Ip MS, Lam B, Tang LC, Lauder IJ, Ip TY, Lam WK. A community study of sleep-disordered breathing in middle-aged Chinese women in Hong Kong: prevalence and gender differences. *Chest* 2004;125:127-34.
38. Udawadia ZF, Doshi AV, Lonkar SG, Singh CI. Prevalence of sleep-disordered breathing and sleep apnea in middle-aged urban Indian men. *Am J Respir Crit Care Med* 2004;169:168-73.
39. Sharma SK, Kumpawat S, Banga A, Goel A. Prevalence and risk factors of obstructive sleep apnea syndrome in a population of Delhi, India. *Chest* 2006;130:149-56.
40. Reddy EV, Kadiravann T, Mishra HK, Sreenivas V, Handa KK, Sinha S, et al. Prevalence and risk factors of obstructive sleep apnea among middle-aged urban Indians: a community-based study. *Sleep Med* 2009;10:913-8.
41. Lavigne GJ, Montplaisir JY. Restless legs syndrome and sleep bruxism: prevalence and association among Canadians. *Sleep* 1994;17:739-43.
42. Phillips B, Young T, Finn L, Asher K, Hening WA, Purvis C. Epidemiology of restless legs symptoms in adults. *Arch Intern Med* 2000;160:2137-41.
43. Kageyama T, Kabuto M, Nitta H, Kuurokawa Y, Taira K, Suzuki S, et al. Prevalences of periodic limb movement-like and restless legs-like symptoms among Japanese adults. *Psychiatry Clin Neurosci* 2000;54:296-8.
44. Rijsman R, Neven AK, Graffelman W, Kemp B, de Weerd A. Epidemiology of restless legs in The Netherlands. *Eur J Neurol* 2004;11:607-11.
45. Kim J, Choi C, Shin K, Yi H, Park M, Cho N, et al. Prevalence of restless legs syndrome and associated factors in the Korean adult population: the Korean Health and Genome Study. *Psychiatry Clin Neurosci* 2005;59:350-3.
46. Elwood P, Hack M, Pickering J, Hughes J, Gallacher J. Sleep disturbance, stroke, and heart disease events: evidence from the Caerphilly cohort. *J Epidemiol Community Health* 2006;60:69-73.
47. Phillips B, Hening W, Britz P, Mannino D. Prevalence and correlates of restless legs syndrome: results from the 2005 National Sleep Foundation Poll. *Chest* 2006;129:76-80.
48. Yokoyama E, Saito Y, Kaneita Y, Ohida T, Harano S, Tamaki T, et al. Association between subjective well-being and sleep among the elderly in Japan. *Sleep Med* 2008;9:157-64.
49. Juuti AK, Läärä E, Rajala U, Laakso M, Härkänen P, Keinänen-Kiukkaanniemi S, et al. Prevalence and associated factors of restless legs in a 57-year-old urban population in northern Finland. *Acta Neurol Scand* 2010;122:63-9.
50. Rothdach AJ, Trenkwalder C, Habersack J, Keil U, Berger K. Prevalence and risk factors of RLS in an elderly population: the MEMO study. Memory and Morbidity in Augsburg Elderly. *Neurology* 2000;54:1064-8.
51. Ulfberg J, Nyström B, Carter N, Edling C. Prevalence of restless legs syndrome among men aged 18 to 64 years: an association with somatic disease and neuropsychiatric symptoms. *Mov Disord* 2001;16:1159-63.
52. Ulfberg J, Nyström B, Carter N, Edling C. Restless Legs Syndrome among working-aged women. *Eur Neurol* 2001;46:17-9.
53. Sevim S, Dogu O, Camdeviren H, Bugdayci R, Sasmaz T, Kaleagasi H, et al. Unexpectedly low prevalence and unusual characteristics of RLS in Mersin, Turkey. *Neurology* 2003;61:1562-9.
54. Berger K, Luedemann J, Trenkwalder C, John U, Kessler C. Sex and the risk of restless legs syndrome in the general population. *Arch Intern Med* 2004;164:196-202.
55. Högl B, Kiechl S, Willeit J, Saletu M, Frauscher B, Seppi K, et al. Restless legs syndrome: a community-based study of prevalence, severity, and risk factors. *Neurology* 2005;64:1920-4.
56. Mizuno S, Miyaoka T, Inagaki T, Horiguchi J. Prevalence of restless legs syndrome in non-institutionalized Japanese elderly. *Psychiatry Clin Neurosci* 2005;59:461-5.
57. Tison F, Crochard A, Léger D, Bouée S, Lainey E, El Hasnaoui A. Epidemiology of restless legs syndrome in French adults: a nationwide survey: the INSTANT Study. *Neurology* 2005;65:239-46.
58. Gao X, Schwarzschild MA, Wang H, Ascherio A. Obesity and restless legs syndrome in men and women. *Neurology* 2009;72:1255-61.
59. Tsuboi Y, Imamura A, Sugimura M, Nakano S, Shirakawa S, Yamada T. Prevalence of restless legs syndrome in a Japanese elderly population. *Parkinsonism Relat Disord* 2009;15:598-601.
60. Allen RP, Walters AS, Montplaisir J, Hening W, Myers A, Bell TJ, et al. Restless legs syndrome prevalence and impact: REST general population study. *Arch Intern Med* 2005;165:1286-92.
61. Bjorvatn B, Leissner L, Ulfberg J, Gyiring J, Karlsborg M, Regeur L, et al. Prevalence, severity and risk factors of restless legs syndrome in the general adult population in two Scandinavian countries. *Sleep Med* 2005;6:307-12.
62. Castillo PR, Kaplan J, Lin SC, Fredrickson PA, Mahowald MW. Prevalence of restless legs syndrome among native South Americans residing in coastal and mountainous areas. *Mayo Clin Proc* 2006;81:1345-7.
63. Lee HB, Hening WA, Allen RP, Earley CJ, Eaton WW, Lyketsos CG. Race and restless legs syndrome symptoms in an adult community sample in east Baltimore. *Sleep Med* 2006;7:642-5.
64. Vogl FD, Pichler I, Adel S, Pinggera GK, Bracco S, De Grandi A, et al. Restless legs syndrome: epidemiological and clinicogenetic study in a South Tyrolean population isolate. *Mov Disord* 2006;21:1189-95.
65. Hadjigeorgiou GM, Stefanidis I, Dardiotis E, Aggellakis K, Sakkas GK, Xiromerisiou G, et al. Low RLS prevalence and awareness in central Greece: an epidemiological survey. *Eur J Neurol* 2007;14:1275-80.
66. Rangarajan S, Rangarajan S, D'Souza GA. Restless legs syndrome in an Indian urban population. *Sleep Med* 2007;9:88-93.
67. Ulfberg J, Bjorvatn B, Leissner L, Gyiring J, Karlsborg M, Regeur L, et al. Comorbidity in restless legs syndrome among a sample of Swedish adults. *Sleep Med* 2007;8:768-72.
68. Broman JE, Mallon L, Hetta J. Restless legs syndrome and its relationship with insomnia symptoms and daytime distress: epidemiological survey in Sweden. *Psychiatry Clin Neurosci* 2008;62:472-5.
69. Cho YW, Shin WC, Yun CH, Hong SB, Kim JH, Allen RP, et al. Epidemiology of restless legs syndrome in Korean adults. *Sleep* 2008;31:219-23.
70. Froese CL, Butt A, Mulgrew A, Cheema R, Speirs MA, Gosnell C, et al. Depression and sleep-related symptoms in an adult, indigenous, North American population. *J Clin Sleep Med* 2008;4:356-61.
71. Happe S, Vennemann M, Evers S, Berger K. Treatment wish of individuals with known and unknown restless legs syndrome in the community. *J Neurol* 2008;255:1365-71.
72. Nomura T, Inoue Y, Kusumi M, Uemura Y, Nakashima K. Prevalence of restless legs syndrome in a rural community in Japan. *Mov Disord* 2008;23:2363-9.
73. Westrom J, Nilsson S, Sundstrom-Poromaa I, Ulfberg J. Restless legs syndrome among women: prevalence, co-morbidity and possible relationship to menopause. *Climacteric* 2008;11:422-8.
74. Winkelman JW, Shahar E, Sharief I, Gottlieb DJ. Association of restless legs syndrome and cardiovascular disease in the Sleep Heart Health Study. *Neurology* 2008;70:35-42.
75. Cho SJ, Hong JP, Hahm BJ, Jeon HJ, Chang SM, Cho MJ, et al. Restless legs syndrome in a community sample of Korean adults: prevalence, impact on quality of life, and association with DSM-IV psychiatric disorders. *Sleep* 2009;32:1069-76.
76. Erer S, Karli N, Zarifoglu M, Ozcakir A, Yildiz D. The prevalence and clinical features of restless legs syndrome: a door to door population study



- in Orhangazi, Bursa in Turkey. *Neurol India* 2009;57:729-33.
77. Benediktsdottir B, Janson C, Lindberg E, Arnardóttir ES, Olafsson I, Cook E, et al. Prevalence of restless legs syndrome among adults in Iceland and Sweden: Lung function, comorbidity, ferritin, biomarkers and quality of life. *Sleep Med* 2010;11:1043-8.
  78. Celle S, Roche F, Kerleroux J, Thomas-Anterion C, Laurent B, Rouch I, et al. Prevalence and clinical correlates of restless legs syndrome in an elderly French population: the synapse study. *J Gerontol A Biol Sci Med Sci* 2010;65:167-73.
  79. Chen NH, Chuang LP, Yang CT, Kushida CA, Hsu SC, Wang PC, et al. The prevalence of restless legs syndrome in Taiwanese adults. *Psychiatry Clin Neurosci* 2010;64:170-8.
  80. Kim KW, Yoon IY, Chung S, Shin YK, Lee SB, Choi EA, et al. Prevalence, comorbidities and risk factors of restless legs syndrome in the Korean elderly population - results from the Korean Longitudinal Study on Health and Aging. *J Sleep Res* 2010;19:87-92.
  81. Park YM, Lee HJ, Kang SG, Choi HS, Choi JE, Cho JH, et al. Prevalence of idiopathic and secondary restless legs syndrome in Korean Women. *Gen Hosp Psychiatry* 2010;32:164-8.
  82. Taşdemir M, Erdoğan H, Börü UT, Dilaver E, Kumaş A. Epidemiology of restless legs syndrome in Turkish adults on the western Black Sea coast of Turkey: a door-to-door study in a rural area. *Sleep Med* 2010;11:82-6.
  83. Winkler AS, Trendafilova A, Meindl M, Kaaya J, Schmutzhard E, Kasubek J. Restless legs syndrome in a population of northern Tanzania: a community-based study. *Mov Disord* 2010;25:596-601.
  84. Yilmaz K, Kilincaslan A, Aydin N, Kor D. Prevalence and correlates of restless legs syndrome in adolescents. *Dev Med Child Neurol* 2011;53:40-7.
  85. Ohayon MM, Roth T. Prevalence of restless legs syndrome and periodic limb movement disorder in the general population. *J Psychosom Res* 2002;53:547-54.
  86. Picchietti D, Allen RP, Walters AS, Davidson JE, Myers A, Ferini-Strambi L. Restless legs syndrome: prevalence and impact in children and adolescents--the Peds REST study. *Pediatrics* 2007;120:253-66.
  87. Ram S, Seirawan H, Kumar SK, Clark GT. Prevalence and impact of sleep disorders and sleep habits in the United States. *Sleep Breath* 2010;14:63-70.