

Insomnia ROUNDS

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Sleepless Women: Insomnia from the Female Perspective

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Throughout the world, across cultures and all ages, more women than men have difficulty getting to sleep and staying asleep. Healthy women report longer sleep times (by 15–20 minutes) than men, suggesting a sex difference in sleep need. Women tend to be larks (morning types) rather than night owls. They may awaken more easily than men and may also have greater difficulty in falling back to sleep when their sleep is disturbed. While this may be of evolutionary advantage in their childbearing years, changing hormone profiles and sociological and psychological factors across the entire adult female lifespan may each play a role in the greater female predisposition for insomnia. This issue of *Insomnia Rounds* explores the potential causes of female insomnia.

Higher rates of insomnia have consistently been reported for women than men.^{1,2} This sex difference in insomnia prevalence is evident after puberty,^{3,4} and becomes even more pronounced at older ages (mid-50s to mid-70s).⁵ The difference is evident even though studies have used various definitions of insomnia; the generally accepted definition for insomnia syndrome is sleep difficulty at least 3 nights per week for a minimum of 1 month with associated impairment or distress.

In a Canadian survey of 2000 adults, 15.6% of women and 11.0% of men met criteria for insomnia, indicating that women are 1.5-fold more likely (95% confidence interval [CI] 1.15–1.95) to present with insomnia syndrome than are men.⁶ Moreover, higher rates of severe and chronic insomnia were reported for women (12%) than for men (6%) in questionnaire-based surveys of the French population (N=12 778 individuals)⁷ and in the USA Penn State Sleep Cohort,⁸ where 1246 adults who did not have chronic insomnia at baseline were followed up after 7.5 years. A meta-analysis of sex differences in insomnia that included 29 epidemiological studies published up to April 2004 and with more than 1.25 million subjects further confirmed the greater predisposition in women for insomnia with a relative risk ratio (RRR) of 1.41 (95% CI 1.28–1.55) in women compared to men.²

Familial predisposition with a stronger maternal association

The female bias for insomnia appears to run in families, with a higher likelihood of occurrence when the mother has or had insomnia. In a study involving 5695 children in Hong Kong (mean age 9.2 years), maternal insomnia contributed to higher odds ratios (ORs) for insomnia in their children (3.42; 95% CI 2.55–4.59) compared to when fathers had insomnia (2.48; 95% CI 1.82–4.37), and was highest when both parents had insomnia (4.42; 95% CI 2.42–8.10).⁴ For adolescents, a high risk for insomnia among first-degree relatives of those with insomnia was found with a stronger maternal than paternal association in the development of insomnia.⁹ A survey among Quebec adults aged 18–83 years found that women were 1.91 times more likely than men to report a family history of insomnia; the mother was the most frequently afflicted first-degree relative with insomnia, followed by a sister.¹⁰

Gender differences are cross-cultural

Gender disparity in insomnia incidence persists cross-culturally. The increased RR for females presenting with insomnia is consistent (1.2–1.7) regardless of where these studies are undertaken, including Asia (1.29), Australia (1.40), the United States and Europe (1.45),^{2,11} and in elderly African women (1.7).¹²



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Increased significance in the elderly

All women have a higher RR of developing insomnia, which increases dramatically with age: 1.28 in young adults (15–30 years), 1.46 in middle-age individuals (31–64 years), and 1.73 in the elderly (≥ 65 years).² Similar age-related changes were reported in the Canadian study by Morin et al.⁶ The experience of “on-call” sleep with an infant in the home can be disruptive to sleep, and many women report that their sleep problems begin with child-rearing.¹³

The increased incidence of insomnia from middle age in women is often attributed to menopause and the menopausal transition (discussed later in this issue); however, this aging effect commences long before menopause. Natural menopause occurs at 42–55 years of age, with an average age of 51 years. Factors other than reproductive hormone profiles likely contribute to this increase in insomnia in middle-aged women, such as life stressors and other health conditions.

Elderly women who complain of sleep disturbance often report difficulty maintaining sleep, particularly in the second half of the night, and then taking a long time to return to sleep, so they often prematurely terminate their night’s sleep.¹⁴ This pattern of insomnia can be attributed to the typical phase advancement of the circadian rhythm (endogenous biological clock) in older age; ie, a tendency to go to bed earlier and wake earlier in the morning. The changes in sleep with aging are described in more detail in the fourth issue of *Insomnia Rounds*. This phase advance is more pronounced in women than men and is probably a contributing factor in subjective reports of reduced sleep quality as discussed below.

Sleep subtypes

Based on the results of a 2005 Canadian General Social Survey¹⁵ of 19 500 respondents aged ≥ 15 years, women reported more trouble falling or staying asleep than men (35% versus 25%, respectively). The female preponderance was greatest for difficulty in maintaining sleep (RR 1.62), followed by difficulty initiating sleep (RR 1.50) and early morning awakening (RR 1.19).² Interestingly, women and men reported similar rates of nonrestorative sleep.

Hypnotic medication use

Researchers found a higher frequency of hypnotic use in women, particularly in the elderly, even after adjustment for age, socioeconomic status and comorbidity.^{16,17} A 2002 Canadian Community Health Survey of 35 236 adult men and women found that benzodiazepine and sedative hypnotic use in the 2 days preceding the survey was more common in women (4.2%; 95% CI 3.9–4.6) than in men (2.5%; 95% CI 2.2–2.8);¹⁶ hypnotic use was also associated with the presence of mood or anxiety disorders. The frequency of use increased with age to 8.5% (95% CI 7.7–9.4) of those over the age of 65 compared to 2.4% (95% CI 2.2–2.7) of those aged 18 to 64 years. In a Swedish study of 645,429 elderly (75–89 years), 27.1% of the women and 18.1% of the men were dispensed at least one hypnotic or sedative drug during the 4-month study period in 2005.

Factors Contributing to the Predominance of Insomnia in Women

Compared to men, women may have greater symptom awareness and socialization that encourages them to acknowledge and report distress, including poor sleep and low mood.¹⁸ Another theory proposes that individuals who ruminate about their sleep difficulty are prone to develop associations and maladaptive behaviours, such as extended time in bed and daytime napping, that further contribute to chronic insomnia.¹⁹ Three common explanations for the gender difference in the prevalence of insomnia include mood disorders, sociological factors, and physiological influences, which include hyperarousal and circadian, body mass, and hormonal factors.

Mood disorders

There is evidence that the higher rates of anxiety and depression in women likely contribute to their higher prevalence of insomnia. The reverse is especially true for women: insomnia predicts the onset of depression. Data from 148 938 postmenopausal women enrolled in the Women’s Health Initiative study revealed that the strongest independent risk factors for sleep disturbance were depression, somatic symptoms, lower emotional well-being, and restlessness.²⁰ Mental health problems, including depression and alcohol use disorder, was a strong predictor (OR 2.59; 95% CI 1.68–4.00) of chronic insomnia in the Penn State Sleep Cohort.⁸ However, in a study of young adults (N=5469; ages 20–39 years), after adjusting for lifetime history of mental health conditions, the difference between women’s and men’s risk of insomnia was not significant.²¹

Insomnia symptoms were found to predict depression in a dose-response manner in a prospective cohort study of more than 40 000 Finnish public-sector employees who had no record of depression at study entry and who were followed a mean of 3.5 years.²² Moderate and severe insomnia symptoms were more common in women. Although insomnia symptoms (sleep difficulty 5–7 nights/week) were associated with an increased risk of depression (hazard ratio 1.64; 95% CI 1.44–1.86), no interaction between sex and insomnia symptoms was found. Conversely, the literature shows that the prediction of depression onset with insomnia is especially true for women;²³ this association persists even after taking into account the higher prevalence of anxiety and depression in females.²

Contribution of family and social roles

Balancing obligations between work and family may contribute to sleep difficulties. Women may be more prone than men to have ongoing thoughts and concerns that lead to a cycle of cognitive arousal and sleep impairment. In general, adjustment for socioeconomic factors may attenuate but does not fully explain sex differences in insomnia, as the socioeconomic disadvantage is associated with both poor sleep and being female.⁵ A recent study that included an index of neighbourhood socioeconomic status found that individual-level sociodemographic factors, health behav-

hours, and health status only explained a small portion of the gender disparity in insomnia symptoms.²¹

Hyperarousal: too awake to sleep

Initiation of sleep requires a withdrawal of wake-promoting factors simultaneously with the generation of sleep. The hyperarousal concept of insomnia proposes that deactivation of the arousal system when the sleep system is activated does not take place, rather a person cannot switch off the day's events and thoughts. Hyperarousal in insomnia has been associated with increased sympathetic nervous system activity and/or activation of the hypothalamic-pituitary-adrenal axis.²⁴ In a study designed to simulate a state of hyperarousal by administering caffeine 400 mg 3 times per day to healthy young adult sleepers for a week, the subjects presented with similar traits to those experienced during insomnia, namely an increased metabolic rate increased and a decline in sleep efficiency. The chronic physiological arousal paradoxically led to increased fatigue even while objective sleepiness was decreased. Interestingly, high caffeine intake (≥ 3 cups per day), and a history of subjectively poor sleep has been reported to predict insomnia.⁸

Circadian influences

Two aspects of the circadian sleep-wake rhythm contribute to sleep timing and duration: phase (timing) and period (length). Studies of circadian factors track two markers of circadian rhythms, namely core body temperature that shows a nocturnal nadir (in the early morning hours) and melatonin (the hormone of darkness) that peaks at night. Sex differences in circadian phase and period may have implications in timing and duration of sleep, and the prevalence of insomnia, particularly maintenance insomnia and early morning awakening.

Phase. Women are more likely than men to be morning-types (larks) who typically self-select earlier sleep-wake times, given a predisposition for an earlier circadian phase.^{25,26} To study circadian rhythms, environmental and behavioural conditions are controlled to minimize confounding influences.^{26,27} Under controlled environmental conditions sex differences in the timing of circadian phase was investigated in young adult women and men ($n=28$ each, aged 18–30 years) matched for habitual bed-times.²⁶ Cain et al²⁶ found that the timing of the circadian phase of the melatonin and core body temperature rhythms was earlier by about 36 minutes, relative to self-selected habitual sleep-wake time, in women compared to men.

Period. In a larger group of 157 individuals (52 women, 105 men) aged 18–74 years, the intrinsic circadian period was found to be significantly shorter in women at 24 hours 5 minutes (± 12 minutes) than in men (24 hours 11 minutes ± 12 minutes), and a significantly greater proportion of women had intrinsic circadian periods shorter than 24.0 hours (35% versus 14%; $P<0.01$).²⁷ This 6-minute average difference in intrinsic circadian period between women and men might not seem much, but it may contribute to the nearly half-hour earlier alignment of the entrained melatonin rhythm relative to sleep in women.

Body mass, insomnia, and sleep duration

Several groups have been investigating the links between obesity and sleep. Canadian data indicated that, while women are slightly less likely than men to be obese (body mass index [BMI] ≥ 30 kg/m²; 23.6% versus 24.3%, respectively), their obesity tends to be more severe (10.9% of women versus 6.8% of men have a BMI ≥ 35 kg/m²).²⁸ There is likely a bidirectional association such that obesity may induce poor sleep, and short sleep may induce weight gain and subsequent obesity:

- Obesity has been found to be an independent risk factor for incidence of insomnia symptoms^{8,29}
- Obesity is associated with short sleep duration,³⁰ which in poor sleepers has been found to be a risk factor for chronic insomnia³¹

There should also be a high suspicion for obstructive sleep apnea (OSA) and obesity hypoventilation as possible contributors to sleep maintenance insomnia in this population.

An elevated BMI has been associated with persistent and increasing insomnia symptoms.^{12,29} In a study of 1307 community-dwelling elderly, obese individuals were at the highest risk for insomnia (OR 2.2; 95% CI 0.7–6.6) compared with those with the lowest BMI (<18.5 kg/m²).¹² Among middle-aged women ($N=5273$) at baseline (2000–2002) and follow-up (in 2007), underweight (BMI <20 kg/m²) and severe obesity (BMI ≥ 35 kg/m²) were associated with incidence of insomnia symptoms after adjustment for age.²⁹

Do Women Need More Sleep Than Men?

Studies from around the world suggest that sex differences in sleep duration may relate to higher subjective sleep need in women, particularly in middle age.³² The 2002 “Sleep in America” telephone poll, which included 1010 subjects (511 females) over 18 years of age, found that the mean sleep duration during the week was 7 hours in women and 6 hours 42 minutes in men; women were also more likely to have had symptoms of insomnia at least a few times a week.¹³ In a questionnaire study of 8860 Norwegians (5329 females) aged 40–45 years, mean weekday sleep duration for women was 7 hours 11 minutes and for men was 6 hours 52 minutes; mean subjective sleep need was also higher in women at 7 hours 45 minutes compared with 7 hours 16 minutes in men.³³

Table 1 summarizes the differences in sleep need and patterns between women and men.

Hormonal Influences

Hormone variations in sex steroids across the reproductive life cycle may make a large contribution to gender differences in insomnia. Women report increased sleep disturbances at particular phases of the menstrual cycle,^{34,35} during pregnancy and the postpartum period,^{35,36} and menopause.^{37–40} Through their actions on specific sites in the brain, as well as structural, functional, and neurochemical differences of some brain regions, the sex steroid hormones influence gender differences in sleep, circadian processes, and the female predisposition for insomnia.

Table 1. General sleep comparisons between women and men

Women:

- Generally sleep for longer periods
 - Sleep time per night during the week is 7.0 hours in women and 6 hours 42 minutes in men¹³
- May need more sleep in order to feel refreshed on waking; ie, higher subjective sleep need
- Are “larks” and morning-types, typically self-selecting earlier bedtimes^{25,26}
- Are more likely to have shorter intrinsic circadian period²⁷

Menstrual cycle

Cyclical hormone changes across the menstrual cycle bring a predictable worsening of sleep in many young women, particularly those with symptoms of premenstrual syndrome (PMS) and who experience dysmenorrhea. In a study where ovulatory cycles were confirmed in 26 young women without significant menstrual-associated complaints, self-reported sleep quality was reduced during the 3–6 days premenstrually and the first 4 days of menstruation compared to the mid-follicular and mid-luteal phases.³⁴ Similarly, sleep diaries kept over 2 menstrual cycles revealed worsening of sleep quality before menstruation (in the late-luteal phase) in women with PMS. Worse sleep quality during the late-luteal phase compared to the mid-follicular phase during in-laboratory sleep was found in women with mild or no symptoms of PMS as well as women with PMS during confirmed ovulatory cycles.⁴¹ Women with menstrual pain-related conditions (dysmenorrhea and endometriosis) report poorer sleep quality and higher anxiety during menstruation compared to symptom-free women. Dysmenorrheic women had reduced sleep efficiency when experiencing menstrual pain, with increases in wakefulness and movement, lighter sleep, and higher body temperatures compared with pain-free phases of their cycle.⁴²

Pregnancy

Sleep changes during pregnancy are well-recognized.^{35,36} Contributing factors to worsening sleep during this multifaceted period include hormonal changes, fetal movements, gastrointestinal discomfort, vomiting, bladder distension, temperature fluctuations, restless legs syndrome (RLS), and snoring.

Increased sleepiness during the first trimester is likely due to the rise in progesterone and its action at gamma aminobutyric acid (GABA) membrane receptors. However, it also brings on sleep disruption due to morning sickness: waking with nausea, increased urinary frequency, and breast tenderness. Sleep may improve during the second trimester; however, during this time, the pregnant woman may experience an onset of

snoring due to estrogen, some women experience heartburn, and leg cramps or RLS may begin. The third trimester is when sleep is most disrupted, and primary sleep disorders such as RLS and OSA may be more common. Sleep problems include difficulty getting comfortable, heartburn, leg cramps, snoring, increased need to urinate, more time awake, and morning fatigue.

Prior pregnancy and childrearing may have a lasting disruptive impact on sleep with a plateau in the first week postpartum. With maturing of the infant's circadian rhythm, a gradual increase in maternal sleep time occurs, but studies indicate that sleep efficiency continues to be lower than pre-pregnancy.

Menopause

The term “climacteric” is used to refer to the transition, usually 7–10 years in duration, that precedes and follows the last menses when ovarian function decreases, when women experience hormonally induced physical and/or psychological changes. Sleep disturbances during the climacteric include difficulty falling asleep, waking at night and waking up early.³⁷ Menopausal symptoms that can be disruptive to sleep include vasomotor symptoms, urinary problems, vaginal dryness and irritation, and weight gain. Complaints of sleep disruption are higher in perimenopause than in premenopausal women.³⁷ The ORs for developing sleep problems during the peri- and postmenopause compared to premenopause are about 1.3 and 1.2, respectively.³⁸ Trouble sleeping has been associated with increases in depressive symptoms, mood swings, stress levels, tension and anxiety, hot flashes, and palpitations, particularly during perimenopause.^{37,38}

During the perimenopausal period, many physiological changes become evident, with the most common associated complaints being hot flashes and increased sleep problems.³⁹ Estrogen deficiency or withdrawal contributes to these symptoms, since women who suffer from hot flashes (vasomotor symptoms) have lower estrogen levels than those who do not, and these symptoms can be ameliorated by estrogen replacement therapy. The Penn Ovarian Aging Study,⁴⁰ a longitudinal population-based study that followed 292 women aged 35–47 years at enrollment over 8 years, found that menopausal stage was not significantly associated with sleep quality, but subjective sleep quality was significantly associated with hot flashes, depressive symptoms, and lower levels of inhibin B, a hormone marker of early menopausal transition.

A number of other factors could contribute to sleep problems around menopause. These include systemic diseases, medications, depressed mood, stress, behavioural or cognitive factors, pain, nocturia, sleep disordered breathing, and age-associated increases in RLS and periodic leg movements. Menopause increases the risk of snoring and OSA by 3–4-fold, even after adjusting for known risk factors such as age and BMI compared to premenopausal women.⁴³ Increased age,

hormone-related changes, and weight gain (including a change in fat distribution with more visceral adiposity) are all contributing factors for increased OSA. Interestingly, women with OSA are more likely to report insomnia, fatigue and nonspecific complaints, to have hypothyroidism, to be treated for depression, and be more overweight than men at the time of diagnosis.⁴³

Hormone replacement and alternative therapy

Hormone therapy is an effective treatment for vasomotor symptoms and sleep problems for some women.³⁹ However, the risks of this treatment need to be considered carefully. Given the serious risks with hormone therapy, the use of herbs, particularly black cohosh, multibotanical supplements, and dietary soy for

menopausal symptoms, has grown. However, there is little evidence for efficacy of the herbal products; vasomotor symptoms with the herbal interventions were the same as placebo but were substantially decreased by estrogens.⁴⁴ Since hot flashes occur more frequently in warmer than cooler environments, reducing ambient temperature (to 16–19°C) may provide some relief from hot flashes and sleep disruption around menopause.

Table 2 lists some practical strategies that may improve sleep.

Conclusion

Women have more difficulty falling and staying asleep than men, and suffer more from the consequences of insomnia, such as depression. They report a greater need for sleep, tend to be larks (morning-types) rather than owls, and may awaken more easily than men do. The causes for this sexual dimorphism remain frustratingly elusive. While many factors likely contribute to this greater propensity for insomnia and for the age-related increase in incidence, multiple factors may mask the underlying mechanisms and indeed complicate the unraveling of the physiological, psychological and environmental factors that influence sex differences in sleep quality and quantity. Optimizing sleep would improve quality of life and yield multiple health benefits to women of all ages, ethnicities and socioeconomic groups.

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Table 2. Practical strategies to improve sleep

1. Keep to a regular routine, especially set a regular rise time for getting up in the morning.
2. Sleep in a dark bedroom and reduce exposure to bright light late at night. This helps to take advantage of the natural onset of melatonin release coinciding with dim light.
3. Avoiding sleeping in the supine position during pregnancy and if overweight or obese, for reasons of comfort and to alleviate snoring and obstructive sleep apnea (OSA).
4. Snoring and OSA are more common in men than in women. A snoring bed-partner can certainly contribute to insomnia. Regardless of gender, assessment and treatment for snoring and OSA should be addressed.
5. Avoid caffeine, especially after midday.
6. Women have a higher incidence of restless legs syndrome (RLS) than men. RLS can contribute to insomnia, usually difficulty falling asleep. RLS can be exacerbated by caffeine and has been associated with low iron levels.
7. Smoking cessation: Compared with nonsmokers, middle-aged women who were chronic heavy smokers were significantly more likely to report insomnia at mean age 65.⁴⁵ Importantly, women who quit smoking in mid-life (43–48 years) did not have any more insomnia symptoms by the age of 65 years than a non-smoking group.
8. Yoga has been found to improve insomnia severity scores and menopausal symptoms after 4 months of practice in 15 post-menopausal women not taking hormone therapy compared to passive stretching and a wait-control group.⁴⁶
9. Evidence-based interventions for insomnia in adults include cognitive behavioural therapy for insomnia and short-term or intermittent use of benzodiazepine receptor agonists.

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Recommended Books on Women's Sleep and Insomnia

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