Gender Differences in Symptoms Related to Sleep Apnea in a General Population and in Relation to Referral to Sleep Clinic*

Lars-Gunnar Larsson, MD, PhD; Anne Lindberg, MD; Karl A. Franklin, MD, PhD, FCCP; and Bo Lundbäck, MD, PhD

Study objectives: To study the prevalence, risk factors, and gender differences in symptoms related to obstructive sleep apnea. A secondary objective was to study gender differences in relation to referral to a sleep clinic for sleep investigations.

Design and setting: A questionnaire study in a representative sample of the general population. A second cohort included patients referred for sleep apnea investigation between 1991 and 2000 in the same geographic region.

Participants: A representative sample of 5,424 subjects aged 20 to 69 years living in northern Sweden. Responses were obtained from 4,648 subjects (85.7%).

Results: Of the male respondents, 17.9% stated that snoring was a problem or said that they had relatives who were concerned about witnessed sleep apnea, and of the female respondents, 7.4%. The prevalence of snoring and witnessed apneas increased with age. In men, there was a peak prevalence rate at 55 to 59 years of age, while the corresponding figure in women the peak prevalence rate was at 60 to 64 years of age. Having snoring as a problem and relatives who were concerned about witnessed sleep apnea were independently associated with male gender, age, and current smoking. Snoring as a problem also was associated with higher education. Women who snored reported significantly more daytime sleepiness than did men who snored. The estimated number of subjects aged 20 to 69 years who had snoring as a problem or had relatives who were concerned about witnessed sleep apnea in the population was 21,160. During the previous decade, 3,955 subjects had been referred to sleep laboratories, so < 20% of the estimated number of symptomatic subjects in the population had been referred during this 10-year period. The referral rate ratio for men/women after correction for population and prevalence of symptoms was 1.25:1 (p = 0.012).

Conclusion: Experiencing snoring as a problem or having relatives who are concerned about witnessed sleep apnea are common findings in the population. However, during the last decade, only about 20% of the subjects with snoring as a problem or with relatives who are concerned about witnessed sleep apnea were referred to sleep laboratories. Women were significantly underrepresented in sleep laboratory referrals, even though women who snored experienced more subjective daytime sleepiness than men.

(CHEST 2003; 124:204–211)

Key words: epidemiology; gender; men; sleep apnea syndromes; sleepiness; snoring; women

Abbreviations: OSA = obstructive sleep apnea; SDB = sleep-disordered breathing

Snoring and sleep apnea are common disorders that affect both men and women. Snoring is a sign of upper airway obstruction and obstructive sleep apnea (OSA), with excessive daytime sleepiness as the most prevalent symptom.1 Habitual snoring is defined as snoring every or

*From the Department of Medicine (Drs. Larsson and Lindberg), Division of Respiratory Medicine and Allergy, and the OLIN study group (Dr. Lundbäck), Sunderby Central Hospital of Norrbotten, Luleå, Sweden; and the Department of Respiratory Medicine and Allergy (Dr. Franklin), University Hospital, Umeå, Sweden.

This study was supported by grants from the Swedish Heart and Lung Foundation, the Swedish Association for Heart and Lung Patients, and the Norrbotten Local Health Authority.

Manuscript received March 25, 2002; revision accepted January 6, 2003.

Reproduction of this article is prohibited without written permission from the American College of Chest Physicians (e-mail: permissions@chestnet.org).

Correspondence to: Lars-Gunnar Larsson, MD, PhD, Department of Medicine, Division of Respiratory Medicine and Allergy, Sunderby Central Hospital of Norrbotten, SE-971 80 Luleå, Sweden; e-mail: lars-gunnar.larsson@nll.se
almost every night, with a reported prevalence of 15 to 48% among middle-aged men, and is estimated to be approximately half as prevalent in women.\textsuperscript{2–5} The prevalence of snoring and OSA increases with age, with a peak between the ages of 55 to 60 years.\textsuperscript{2,6–8} Women start to snore later in life, with an increased prevalence after menopause.\textsuperscript{6} Both Young et al\textsuperscript{9} and Redline et al\textsuperscript{10} reported that women with possible OSA are consistently underdiagnosed in the United States. The prevalence of snoring and sleep apnea in women is about half that in men, but the man/woman ratio found in sleep laboratories has been reported as 8 to 10:1.\textsuperscript{10}

The recognition of sleep apnea as a health problem has grown in the community, and the number of subjects who seek medical help for problems with snoring and with concern about apnea and daytime sleepiness is increasing. It is important to estimate the need for investigations of snoring and sleep apnea, since the cost of investigating and treating snoring and sleep apnea has increased considerably during the last decade. The number of subjects experiencing snoring or sleep apnea as a problem is probably a better marker of the total need for sleep apnea investigations than simply measuring the frequency of habitual snoring.

We aimed to estimate the prevalence of snoring as a problem, together with relatives’ concerns about witnessed sleep apnea, and to analyze the relationship of the estimated number of subjects with these problems to the number of subjects who are actually referred to sleep laboratories. A second objective was to investigate whether women also were excluded from sleep apnea investigations in Sweden. Furthermore, we aimed to study risk factors for, and gender differences in, snoring, apneas, and daytime sleepiness.

**Materials and Methods**

**Study Population**

The population in Norrbotten, Sweden, of subjects between the ages of 20 and 69 years was 85,414 men and 79,345 women. A questionnaire addressing snoring and other symptoms related to sleep apnea was sent to 5,424 subjects aged 20 to 69 years, who had been born on the 15th day of each month and were living in Norrbotten, the northernmost province of Sweden. Two reminders were sent through the mail. The study was a part of the Obstructive Lung Disease in Northern Sweden Studies. The study was approved by the ethics committee at the University Hospital and the University of Umeå.

The questionnaire was answered by 4,648 subjects (85.7%). Of the women, 88.2% responded, while the participation rate among men was 83.4% (Table 1). Current smoking was reported by 29% of men and 32% of women. Twenty-four percent of men and 16% of women had stopped smoking 1 year before, while 47% of men and 52% of women had never smoked.

**Questionnaire**

A well-established respiratory questionnaire in the Nordic countries\textsuperscript{11–13} was used. It consisted of questions about respiratory symptoms and diseases, family history of asthma, rhinitis, chronic bronchitis, emphysema, smoking habits, and occupation.\textsuperscript{14} Four questions related to OSA were added to the questionnaire.\textsuperscript{15}

1. Do you snore so much that you think it is a problem?
2. Have relatives expressed worry that you are stopping breathing while you are asleep?
3. Do you feel completely rested after a full night’s sleep?
4. Do you fall asleep during breaks in daytime activities?

**Referral to Sleep Laboratory**

The number of men and women aged 20 to 69 years who were referred to the sleep laboratory at the Division of Respiratory Medicine and Allergy, Central Hospital of Norrbotten, between 1991 and 2000 was recorded.

**Statistical Analysis**

Statistical analyses were performed by using a statistical software package (SPSS; SPSS, Inc; Chicago, IL). The $x^2$ test was used for bivariate comparisons. The influence of age, smoking habits, and socioeconomic group on snoring as a problem, together with the influence of age, smoking habits, socioeconomic group, snoring as a problem, and relatives’ worry about witnessed apneas, on daytime sleepiness were examined using multiple logistic regression analysis. All the odds ratios are presented with 95% confidence intervals. A $p$ value of < 0.05 was regarded as statistically significant.

**Results**

**Snoring**

Snoring as a problem was reported by 14.6% of men and 6.7% of women ($p < 0.001$) [Fig 1]. The
prevalence of snoring increased up to the ages of 55 to 59 years among men, 27.7% of whom reported snoring as a problem. For women, the prevalence of snoring as a problem was highest (14.4%) between the ages of 60 and 64 years. For both men and women, there was a sharp decline in prevalence among the oldest subjects, aged 65 to 69 years (men, 8.8%; women, 3.2%; p < 0.001) [Fig 2]. Subjects with a tendency to fall asleep during the day reported snoring as a problem three to five times more often than subjects without this tendency (p < 0.001) [Table 2]. Subjects who were not rested in the morning reported snoring as a problem two to three times as often as subjects who did not report being “not rested” (p < 0.001) [Table 2].

Apneas

Relatives’ concern about witnessed sleep apnea was reported by 11.0% of men and 2.4% of women (p < 0.001) [Fig 1]. The highest prevalence among men was 20.9% in the 55- to 59-year-old age group. The highest prevalence in women was 6.5% in the 60- to 64-year-old age group (Fig 3). Subjects with a tendency to fall asleep reported relatives’ concern about witnessed sleep apnea four to nine times more often than did subjects without a tendency to fall asleep. Subjects who were not rested reported relatives’ concern about witnessed apneas two to five times as often as subjects who did not report being “not rested” (Table 2). Snoring as a problem or relatives’ concern about witnessed sleep apnea were reported by 17.9% of men and 7.4% of women.

Not Rested After a Full Night’s Sleep

Not being rested after a full night’s sleep was equally prevalent in men and women (men, 26.0%; women, 24.7%) [Fig 1]. Subjects with snoring as a problem or with relatives’ concern about witnessed apnea reported “not rested” twice as often as subjects without snoring or apneas, and women reported it significantly more often than men (Table 3).

Tendency To Fall Asleep in the Daytime

A tendency to fall asleep during the day was significantly more common among men than among women (6.9% vs 5.3%, respectively; p = 0.02) [Fig 1]. The number of subjects with snoring as a problem or with relatives’ concern about witnessed sleep apnea was equal among men and women, with reporting of “falling asleep” occurring five to seven times more often than in subjects without snoring or concern about witnessed apneas (Table 3).
Multivariate Relationships

When analyzed using multiple logistic regression, having snoring as a problem and relatives’ concern about witnessed sleep apnea were independently associated with male gender, age, current smoking, higher education level, and self-employment. Not being rested after a full night of sleep was associated with relatives’ concern about witnessed sleep apnea, snoring as a problem, and current smoking. A tendency to fall asleep during the day was associated with snoring as a problem, relatives’ concern about witnessed sleep apnea, and age 50 to 69 years (Table 4).

Referral to Sleep Laboratory

Between 1991 and 2000, 3,955 patients (2,991 men and 964 women) in the 20 to 69-year-old age group were referred to the sleep laboratory at the Central Hospital in Norrbotten. In 2000, the estimated number of subjects aged 20 to 69 years in the population who had snoring as a problem or had relatives who were concerned about witnessed sleep apnea was 21,160 (men, 15,289; women, 5,871). The relationship between referred patients and the estimated numbers of subjects with snoring as a problem or relatives’ concern about witnessed sleep apnea is shown in Table 5. The estimated man/woman ratio of subjects in need of sleep apnea investigation was 2.4:1 (Table 5). When adjusted for gender differences in the population, referral notes to a sleep laboratory had a man/woman ratio of 2.9:1 (Table 5). Men were referred to a sleep laboratory 1.25 times more often than women when the hospital admission

![Figure 2: Snoring as a problem in men and women by age.](http://publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21996/ on 06/15/2017)

### Table 2—Prevalence of Snoring as a Problem and Relatives’ Concern About Witnessed Sleep Apnea in Subjects Reporting Not Being Rested and With a Tendency to Fall Asleep*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Snoring as a Problem</th>
<th>Concern About Apnea</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>Not rested</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>22.7</td>
<td>13.5</td>
</tr>
<tr>
<td>No</td>
<td>11.8</td>
<td>4.4</td>
</tr>
<tr>
<td>p Value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Falling asleep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>43.5</td>
<td>29.8</td>
</tr>
<tr>
<td>No</td>
<td>14.6</td>
<td>5.4</td>
</tr>
<tr>
<td>p Value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Values given as %, unless otherwise indicated. All differences between men and women in this table are highly statistically significant (p < 0.001).
rate was compared with the reporting of snoring as a problem or relatives’ concern about witnessed sleep apnea.

**DISCUSSION**

The main finding of this study was that approximately 18% of men and 7% of women aged 20 to 69 years had problems with snoring or had relatives who were concerned about witnessed sleep apneas. Although women with snoring as a problem appear to have more daytime symptoms, they were underrepresented at the sleep laboratory, but on a lesser scale compared with persons in the United States.9,10

This study is the first to have examined the prevalence of sleep disturbances in the general population in northern Sweden. It comprised a large sample with a high response rate, which strengthens the validity of the results. The demand for investigations of snoring and sleep apnea, and the burden on the health-care system imposed by sleep-disordered breathing (SDB) is high. Many studies have investigated habitual snoring. Examining the number of subjects who actually regard their snoring or relatives’ concern about witnessed sleep apnea as a problem probably provides a better measure of the demand for investigations of SDB than simply using the frequency of snoring.

Snoring as a problem had a prevalence of 14.6% among men and 6.7% among women. In other studies,2,3,5,6,16,17 habitual snoring prevalence has ranged from 9 to 48% in men and from 4 to 34% in women. Our results confirm the findings in other studies2,3,5,6,16,17 that have demonstrated that snoring is twice as common in men as in women. In men, snoring as a problem increased with age to a peak prevalence at 55 to 59 years. In women, snoring was a minor problem until the ages of 55 to 59 years, at which point the prevalence of problems with snoring doubled. The questionnaire did not ask about menopause, but it is possible that menopause may be responsible for the increased frequency of snoring at that age.18,19 In this study, as has also been found by others,17–20 the oldest men and women had fewer problems with snoring. The reason for this decline in snoring prevalence in older subjects is still unclear. It could reflect higher mortality among those with snoring or OSA or it may be more common for older subjects to live or sleep alone, thereby lacking someone to register their snoring, although the

![](https://example.com/filename.png)

**Figure 3.** Relatives’ concern about witnessed sleep apnea in men and women by age.

---

208 Clinical Investigations

Downloaded From: http://publications.chestnet.org/pdfaccess.ashx?url=data/journals/chest/21996/ on 06/15/2017
decline with advanced age is probably not exclusively due to reporting bias.21,22 Others23 have found a similar decline in OSA prevalence in older subjects, at least when adjusted for symptoms and central apneas.

Relatives’ concern about witnessed sleep apnea was less common in women than in men. In both men and women, the change in prevalence followed almost the same age pattern as snoring. In men, the occurrence of apnea decreased less than snoring among the oldest group and was just as prevalent as snoring as a problem in men aged 65 to 69 years. This could reflect a higher prevalence of central nonobstructive apneas in this age group, perhaps related to left heart failure and cardiovascular disease.23–25 It is unclear why witnessed apneas were uncommon in women. As the snoring sound in women is usually less intense, it may be harder to notice women’s apneas.26 An alternative explanation could be that husbands may be less prone to observe apneas than wives.

Daytime sleepiness symptoms were far more common in subjects reporting snoring and apneas. Not being rested after a full night’s sleep was about twice as common, and a tendency to fall asleep was five to seven times as common in subjects with snoring as a problem. Others3,27 also have found daytime sleepiness to be more prevalent in snorers, and especially

<table>
<thead>
<tr>
<th>Variables</th>
<th>Not Rested</th>
<th>Tendency to Fall Asleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snoring as a problem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>40.4</td>
<td>20.3</td>
</tr>
<tr>
<td>No</td>
<td>23.5</td>
<td>4.5</td>
</tr>
<tr>
<td>p Value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Relatives’ concern about apnea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>43.8</td>
<td>24.0</td>
</tr>
<tr>
<td>No</td>
<td>23.8</td>
<td>4.7</td>
</tr>
<tr>
<td>p Value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Values given as %, unless otherwise indicated.

It is unclear why witnessed apneas were uncommon in women. As the snoring sound in women is usually less intense, it may be harder to notice women’s apneas. An alternative explanation could be that husbands may be less prone to observe apneas than wives.

Daytime sleepiness symptoms were far more common in subjects reporting snoring and apneas. Not being rested after a full night’s sleep was about twice as common, and a tendency to fall asleep was five to seven times as common in subjects with snoring as a problem. Others3,27 also have found daytime sleepiness to be more prevalent in snorers, and especially

<table>
<thead>
<tr>
<th>Variables</th>
<th>Snoring as a Problem</th>
<th>Worry Over Apneas</th>
<th>Not Rested</th>
<th>Falling Asleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>0.96</td>
<td>0.96</td>
<td>0.73–1.27</td>
</tr>
<tr>
<td>Male</td>
<td>2.44 (1.98–3.01)</td>
<td>5.02 (3.69–6.83)</td>
<td>1.06 (0.80–1.43)</td>
<td>1.73 (1.05–2.82)</td>
</tr>
</tbody>
</table>

| Age class, yr | | | | |
| 20–29 | 1 | 1 | 1 | 1 |
| 30–39 | 2.74 (1.77–4.24) | 1.18 (0.69–2.02) | 1.08 (0.83–1.41) | 1.34 (0.87–2.02) |
| 40–49 | 4.22 (2.77–6.44) | 2.73 (1.69–4.39) | 1.03 (0.84–1.28) | 1.73 (1.20–2.50) |
| 50–59 | 5.94 (3.89–9.07) | 4.27 (2.65–6.89) | 0.90 (0.70–1.13) | 1.96 (1.04–3.67) |
| 60–69 | 4.21 (2.70–6.55) | 4.28 (2.61–7.03) | 0.89 (0.70–1.13) | 1.62 (1.16–2.25) |

| Smoking habit | | | | |
| Nonsmokers | 1 | 1 | 1 | 1 |
| Ex-smokers | 1.11 (0.85–1.43) | 1.10 (0.79–1.53) | 1.04 (0.86–1.25) | 1.19 (0.86–1.65) |
| Smokers | 1.61 (1.26–2.02) | 2.00 (1.51–2.63) | 1.27 (1.08–1.49) | 0.88 (0.64–1.20) |

| Socioeconomic group | | | | |
| Workers in service or industry | 1 | 1 | 1 | 1 |
| Professionals, higher civil servants, and self-employed | 1.28 (1.02–1.60) | 0.83 (0.62–1.11) | 0.91 (0.77–1.08) | 0.83 (0.60–1.16) |

| Snoring as a problem | 1.82 (1.44–2.30) | 3.44 (2.43–4.86) |
| Concern about apnea | 1.88 (1.41–2.51) | 2.80 (1.90–4.13) |

*OR = odds ratio; CI = confidence interval. Adjustment was also made for other socioeconomic groups such as housewives, military service, and students.
in snorers with significant OSA. In this study, women with snoring as a problem, with or relatives’ concern about witnessed sleep apnea, reported not being rested after a full night’s sleep significantly more often than men did. This has also been found by others.28

Concerning risk factors associated with OSA, current smoking was associated with an increased risk of snoring as a problem, with relatives’ concern about witnessed sleep apnea, and with not being rested after a full night’s sleep. Subjects in the more highly educated and self-employed socioeconomic groups were independently associated with snoring as a problem. Young et al9 found that subjects with a lower socioeconomic status were underrepresented in sleep laboratory examinations and were less likely to have clinically detected OSA.

Probably the most important factors that incite patients to seek medical advice for symptoms related to OSA are snoring or relatives’ concern about witnessed sleep apnea. Between 1991 and 2000, 3,955 patients, which was <20% of the estimated number of 21,160 subjects with snoring or apneas in the population, were referred to the sleep clinic. The man/woman ratio for referral in relation to symptoms was 1.25:1, suggesting that women were underrepresented, but on a lesser scale than reported in previous studies by Young et al9 and Redline et al10. Those investigators found that men experienced SDB two to three times more frequently in the population than did women. However, in the sleep laboratory sample, the man/woman ratio was 8 to 10:1.10 In these studies, women were underrepresented, with a man/woman ratio of 3:1. It appears that snoring in women is being acknowledged more frequently, and that doctors in northern Sweden are referring more women for sleep investigations.

These results give cause for optimism with the improved identification of SDB in women. The reason for women having been systematically underrepresented in sleep apnea investigations is not clear. Women may have different symptoms of SDB,29 they may complain less, or health-care providers may disregard the symptoms of SDB in women.

If all the subjects with snoring as a problem or with relatives’ concern about witnessed sleep apnea seek medical advice for their symptoms, we can expect that 13% of the population aged 20 to 69 years will be in need of sleep apnea investigations. Although this high prevalence will impose a burden on health-care resources, it has been shown that the diagnosis and treatment of patients with SDB actually reduces medical costs.30

In summary, snoring as a problem or relatives’ concern about witnessed sleep apnea were reported by 18% of men and 7% of women in this study population in northern Sweden. In both men and women, a peak in prevalence rate was found in men aged 55 to 59 years and in women aged 60 to 64 years. Daytime sleepiness was independently related to both snoring as a problem and witnessed apneas, and women with snoring as a problem reported significantly more daytime sleepiness than did men. During the last decade, <20% of the estimated number of subjects with snoring as a problem or relatives’ concern about witnessed sleep apnea were referred to sleep laboratories, and women were significantly underrepresented with a ratio of 1.25:1. We conclude that there are gender and age differences in the reporting and evaluation of OSA symptoms, and that further attention must be given to prevent the underdetection and undertreatment of OSA in women.
ACKNOWLEDGMENTS: We acknowledge Ann-Christin Jonsson, SRN, for epidemiologic fieldwork when collecting data, and Hillevi SandstroÈmm, SRN, for her work with the sleep laboratory and the sleep laboratory register.

REFERENCES