Almost everyone snores at some point or complains about someone who does. Snoring is the principal symptom of obstructive sleep apnea syndrome (OSAS), and narrowing of the upper airway is usually the major reason.\textsuperscript{1} Research on OSAS has increased worldwide. The literature estimates the prevalence of snoring from 25% to 83%.\textsuperscript{2-6} Furthermore, the prevalence of habitual snoring in the general population ranges from 3.6% to 35.7%.\textsuperscript{5,7,8} However, the prevalence of snoring or sleep-disordered breathing in Taiwan is unknown.

The primary objective of this study was to assess the prevalence of snoring and its associated factors including age, gender, occupation, and the degree of daytime sleepiness among residents in the area of Taichung, Taiwan.

METHODS

Sampling

The target population, residents of the Taichung area including Taichung City and 4 towns of Taichung county (included Wu-ri, Wu-feng, Tai-ping, and Da-li.), contained about 1,400,000 people at the end of 2001. The sampling method was actually two-stage. Numbers were systematically selected from the latest version of the Taichung Resident Telephone Directory and entered into a (CATI) Computer Assisted Telephone Interview system. At the second stage, numbers were first randomly selected from the previous set of 6000. Then, along with each selected number, the numbers generated by both adding 1 to and subtracting 1 from the last digit of the selected number were also dialed. The second-stage process, carried out automatically by the CATI system, went on until the desired sample size was filled. We chose a telephone interview because of its convenience and the widespread use of telephones in urban areas of Taiwan. Since the questions were simple and easily understood, we believed the results would be as accurate as a face-to-face interview. From March 1, 2002 to April 12, 2002, we called potential interviewees from 6 to 9 pm. Those who declined to answer or could not give definitive answers were excluded. A total of 1,252 people were included into this study (95% confidence interval [CI], 3% sampling error).

J Chin Med Assoc
2004;67:32-36

Shih-An Liu\textsuperscript{1}
Chia-Yee Liu\textsuperscript{2}

\textsuperscript{1}Department of Otolaryngology, Taichung Veterans General Hospital, Taichung, and \textsuperscript{2}Department of Statistics, Tunghai University, Taichung, Taiwan, R.O.C.

Key Words
prevalence;
sleep apnea syndrome;
snoring

Original Article

Prevalence of Snoring in Taichung Area: An Epidemiological Study

Background. Snoring is the cardinal symptom of obstructive sleep apnea syndrome (OSAS). To our knowledge, no epidemiological data of sleep-disordered breathing in Taiwan is reported in the literature. The aim of this study was to determine the prevalence of snoring in the area of Taichung, Taiwan.

Methods. Data were collected from a random sample of Taichung area residents listed in the Taichung Resident Telephone Directory. Questions were asked by telephone and the answers were recorded and analyzed.

Results. Among the 1,252 people who were successfully interviewed, 606 were males and 646 were females. The overall prevalence of snoring was 46.8%, while habitual snorers accounted for 13.8%. The prevalence of snoring among males was higher than females (57% vs. 37%, \(p < 0.001\)). In addition, adults aged 40-59 years were more likely to snore (\(p < 0.001\)).

Conclusions. Snoring in the area of Taichung, Taiwan is more prevalent in middle-aged adults, especially men. How to ascertain those who have OSAS economically and efficiently requires further investigation.

Received: March 20, 2003.
Accepted: September 2, 2003.

Correspondence to: Shih-An Liu, MD, Department of Otolaryngology, Taichung Veterans General Hospital, 160, Taichung-Kung Road, Sec. 3, Taichung 407, Taiwan.
Tel: +886-4-2359-2525 ext. 5401; Fax: +886-4-2359-6868; E-mail: an1654@seed.net.tw
Questionnaires

The questionnaire (see appendix) was divided into 3 parts. The first collected general data including age, sex, duration of sleep, and occupation. In the second section, the questions assessed if snoring occurred, its frequency, and its severity. The last part asked about the tendency to experience daytime sleepiness. A suitable questionnaire for telephone interviewing is about 15 questions. Thus, we selected only 3 items from Epworth Sleepiness Scale (ESS). Specialists had reviewed the validity of this questionnaire and tended to make it simpler and easily understood. We had conducted a preliminary test for this questionnaire and almost every interviewee could answer without much difficulty. In addition to the original confirmation regarding the reliability and validity of this questionnaire, a further check on the reliability of the translated version of the questionnaire was conducted using a test-retest method on the first question of the second part, which asks the respondents whether they snore. Thirty people were randomly re-selected from those who have been interviewed at least 2 days later. Twenty-eight out of the 30 retested gave the same response, which makes a match rate of 93.3%. This high match rate should provide ample evidence of reliability. Besides, we also collected data on snoring among children less than 10 years.

Telephone interviewers

Four well-trained interviewers who were graduate students of Tunghai University completed the telephone questionnaire.

Statistical analysis

We used SAS software (SAS Institute Inc., Cary, NC, USA) for the data interpretation. Statistical methods used in this study were frequency distribution tabulation, basic descriptive statistics, student’s t-test, and chi-square test ($\chi^2$ test) for cross-tables.

RESULTS

General data

There were 1,382 people interviewed totally of them. 130 refused or could not give definite answer and were then excluded. The 1,252 people successfully inter-viewed consisted mainly of adults aged 20 to 59 years (38.6 ± 16.7), a reflection of the normal population of Taichung area. Males accounted for 48.4% of the group, which is also the same as the normal population distribution. Nearly half study subjects (n = 579) were unemployed, while those who worked nights, had indoor jobs, or worked outdoors constituted about 1%, 29%, and 23%, respectively.

Sleep time

The average sleep time was about 7 hours. Eight-five percent slept 6-8 hours daily while 8% slept less than 6 hours. As age increased, sleep time decreased ($p < 0.001$) (Table 1). No statistically significant differences were observed among sleep time, the presence of snoring, and occupation (Table 2).

Snoring

The overall prevalence of snoring in adults is 46.8%, while adults age 40-59 are more likely to snore when compared with other age groups. In addition, the prevalence of snoring among children is 26.3%. Of the snorers, about three-fourths were self-reported and more than 90% were told by others about their snoring. As to the

| Table 1. The sleep time and prevalence of snoring in 1252 residents of Taichung area |
|-----------------------------|-----------------------------|-----------------------------|
| Age (yr) | Sleep time (hr) | Prevalence of snoring (%) |
| 10 - 19 (n = 179) | 7.27 ± 1.28 | 32.4 |
| 20 - 39 (n = 491) | 7.19 ± 1.12 | 43.8 |
| 40 - 59 (n = 422) | 7.06 ± 1.45 | 56.2 $^a$ |
| > 60 (n = 160) | 6.53 ± 1.55 $^b$ | 47.2 |
| Total (n = 1252) | 7.08 ± 1.34 | 46.8 |

$^a$ $p < 0.001$ as compared with other age groups.

$^b$ $p < 0.001$ as compared with other age groups.

| Table 2. The sleep time and prevalence of snoring in different occupation groups of the residents of Taichung area |
|-----------------------------|-----------------------------|-----------------------------|
| Job | Sleep time (hr) | Prevalence of snoring (%) |
| None (n = 579) | 7.15 ± 1.28 | 41.8 |
| Night shift (n = 18) | 6.77 ± 1.64 | 50.0 |
| In-door (n = 366) | 7.01 ± 1.06 | 49.2 |
| Out-door (n = 289) | 7.00 ± 1.23 | 53.6 |
| Total (n = 1252) | 7.08 ± 1.34 | 46.8 |

$^a$ No significant difference exists among these groups.
frequency of snoring, about 75% answered “occasionally”, 11% “frequently”, and 14% were “almost every night” (Table 3). About 8.7% snored so loudly that it would cause their bed partners to leave the room. Besides, males snore more often than females do (57.1% vs. 37.2%, \(p < 0.001\)) (Table 4).

### Table 3. The frequency of snoring and sleep time in the residents of Taichung area

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Sleep time (hr) *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost every day (n = 81)</td>
<td>6.89 ± 1.52</td>
</tr>
<tr>
<td>Frequently (n = 63)</td>
<td>7.04 ± 1.27</td>
</tr>
<tr>
<td>Occasionally (n = 442)</td>
<td>7.03 ± 1.18</td>
</tr>
<tr>
<td>Total (n = 586)</td>
<td>7.01 ± 1.23</td>
</tr>
</tbody>
</table>

*No significant difference exists among these groups.

### Table 4. The sleep time and prevalence of snoring in male and female residents of Taichung area

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age (yr)</th>
<th>Sleep time (hr)</th>
<th>Prevalence of snoring (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (n = 606)</td>
<td>38.25 ± 17.10</td>
<td>7.09 ± 1.27</td>
<td>57.1*</td>
</tr>
<tr>
<td>Female (n = 646)</td>
<td>38.77 ± 16.37</td>
<td>7.08 ± 1.38</td>
<td>37.2</td>
</tr>
</tbody>
</table>

*\(p < 0.001\) as compared with females.

Daytime sleepiness

Among the study cases, 101 (8.1%) answered they would snooze when sitting quietly; 94 (7.5%) responded that they dozed when watching television or reading the newspaper. Surprisingly, 288 (23%) of them answered they would nod off if they stayed in a moving vehicle for more than 1 hour. However, we did not find any correlation between the severity of snoring and excessive daytime sleepiness.

### DISCUSSION

This is to our knowledge the first report about the epidemiology of sleep-disordered breathing in Taiwan area. In this survey, the prevalence of snoring among Taichung area inhabitants was 46.8%, similar to those studies in western countries.\(^4,5\) However, we believe this might be an underestimation because some people snored even if they answered “no”.

Sleep time decreased as the subjects grew older. This is probably due to deterioration of the suprachiasmatic nucleus, with aging altering the circadian rhythm.\(^10\)

Middle-aged adults are the highest risk group for snoring. Our survey showed that 56.2% of adults aged 40 to 59 years snored. Bearpark et al.\(^6\) showed that 80.9% men age 40 to 65 snored while sleeping.\(^6\) We speculate that this group has more work-relates stress that makes them prone to obesity from lack of exercise. Fat will accumulate over the parapharyngeal space. Muscle tone also decreases with age. As a result, the upper airway collapses more easily and snoring occurs.

The reasons why men snore more often than women, a common finding in other studies, are still unknown. Some authors proposed that overweight men have upper body fat distribution while women have lower body fat distribution.\(^11\) The decreased oropharyngeal space predisposes men to snoring. Other researchers have suggested that testosterone promotes apnea,\(^12\) whereas progesterone stimulates the respiratory system\(^13\) and may increase activity of the pharyngeal dilator muscles.\(^14\) The questionnaire did not ask for height and weight, therefore, we could not compare the physical differences between males and females.

A review of the literature revealed that habitual snoring occurs in 6.2-12.1% of children.\(^15-17\) Our survey found that 26.3% of children in Taichung area snore while sleeping. Our higher rate may be explained by the questionnaire that was not targeted for children and a bias of ascertainment may exist. Second, other studies included children age 4 to 5 years\(^15,17\) and 6 to 13 years\(^16\) whereas our study sampled children less than 10 years old. Finally, other studies detected habitual snorers while we only asked if the respondents’ children snored.

To distinguish those who have OSAS from snorers is a current global issue. Some researchers suggested that they could effectively detect snorers from those who are at risk for OSAS by using a simple questionnaire\(^9,18\) However, our study failed to distinguish those who had excessive daytime sleepiness from other snorers. First, we used only 3 of 8 items from the ESS questionnaire, which may not reflect the sleepiness status of the interviewees. In addition, the questions of this section were not as simple. Possibly, the respondents may not have
fully understood the questions. Overall, the heavy snorers who may have OSAS comprise a small group in this survey.

In conclusion, of Taichung area residents, 46.8% were snorers while 13.8% were habitual snorers. Males snored more than females and middle-aged adults were more likely to snore. Our study’s limitations were that we did not assess health factors such as hypertension and obesity that can affect snoring. We did not ask if the interviewees had sought medical treatment for snoring or OSAS. Lastly, a follow-up questionnaire has been planned. To differentiate those who have OSAS from other snorers in a cost effective and efficient manner requires further investigation.

APPENDIX

Questionnaire for study of the prevalence of snoring in Taichung area

General data:
Age (years): □ 10-19 □ 20-39 □ 40-59 □ > 60
Gender: □ Male □ Female
Occupation: □ None/unemployed □ Night shift □ Indoor job □ Outdoor worker
Average sleep time (per day) ______ hours

1. Do you snore? □ No (Then skip to No. 5) □ Yes
2. Did your families mention that you snore? □ No □ Yes
3. What is the frequency of your snoring?
   □ Almost every day □ Frequently □ Occasionally
4. Does your snoring cause other to leave the room? □ No □ Yes
5. Do you have any child less than 10 years? □ No (Then skip to No. 8) □ Yes
6. How many children under 10 years do you have?____
7. How many of these children snore?____

How likely are you to doze off or fall asleep in the following settings?
8. Sitting inactive in a public place (e.g. a theater or a meeting) □ Never □ Seldom □ Frequently □ Almost
9. Sitting and reading, or watching TV □ Never □ Seldom □ Frequently □ Almost
10. As a passenger in a car for an hour without a break □ Never □ Seldom □ Frequently □ Almost

REFERENCES


