

Epidemiology and significance of obstructive sleep
apnoea and snoring in family practice

Ph.D. Thesis

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Introduction

Obstructive Sleep Apnoea Syndrome (OSAS) is the most significant respiratory disorder occurring during sleep and it is one of the most important sleep disorders. Its prevalence is 2 – 4% in the general population; its most important characteristic feature is the partial or total obstruction of the upper airways during sleep that is followed by desaturation of oxygen levels and sudden arousal. The syndrome is suspected when loud snoring with breathing pauses occurs together with excessive daytime sleepiness. However, the possibility of this disorder should also be considered in the presence of therapy-resistant hypertension, heart failure, cardiac arrhythmias, stroke, depression or cognitive disturbances. Studies investigating the epidemiology of snoring stressed the importance of the presence or absence of snoring without investigating the possible significance of different subtypes of this symptom.

Family physicians have an important role in the screening for obstructive sleep apnoea as they can easily identify high-risk patients recognizing the cardinal symptoms and using the Berlin questionnaire. However, data regarding family physicians' knowledge about sleep apnoea and the efficacy of education of sleep disorders are limited.

OSAS is present in 60-80% of patients with therapy-resistant hypertension. Home Blood Pressure Monitoring (HBPM) is an effective tool for family physicians when they screen their patients for the presence of OSAS.

However, in order to fully employ the opportunities provided by HBPM it is important to explore the barriers that limit the use of this method. In addition it is also important to obtain information about the opinions of family physicians regarding the use of this screening tool. According to our knowledge only one study has been performed to investigate this question so far. However, its results are limited by the low number of participants and by the fact that it has been done in United States where the health care system is significantly different from that in Europe and Hungary.

Aims

In recent years I participated in several studies aimed at the investigation of the epidemiology of snoring and the screening of co-morbid depression and hypertension. I also evaluated family physicians' knowledge about and attitude to sleep apnoea.

1. Prevalence of different subtypes of snoring in Hungarian general population

1.1. Sociodemographic background of snoring, health behaviour, occurrence of comorbidities and accidents

In this study we evaluated the sociodemographic characteristics and health behaviour of people with different types of snoring and investigated the association of snoring with accidents in a population representative of the general Hungarian population (Hungarostudy 2002). We aimed to determine, with the use of a questionnaire, whether different types of snoring (such as loud snoring with breathing pauses and quiet snoring) are associated with high-risk health behaviour, increased daytime sleepiness or an increased prevalence of accidents.

The following hypotheses were tested:

- snoring is common in the general population in Hungary
- snoring is associated with lower education
- snoring, particularly the loud snoring with breathing pauses, is associated with high-risk health behaviour
- snoring is associated with an increased prevalence of comorbidities and accidents
- snoring is associated with increased daytime sleepiness.

1.2. Importance and consequence of snoring and its impact on quality of life in the general Hungarian population

Sleep disorders and also depression, which is frequently associated with sleep problems, are associated with impaired quality of life similarly to numerous other chronic medical disorders such as hypertension, diabetes or coronary artery disease. Sforza et al. reported that the factors with the most substantial influence on

quality of life are sleepiness, obesity (which is commonly associated with apnoea), sleep fragmentation, anxiety and depression.

I tested the following hypotheses:

- snoring, particularly loud snoring, is associated with depression
- snoring is associated with increased vital exhaustion

1.3. Assessment of family physicians' knowledge about and attitude to sleep apnoea.

Assessment the knowledge of residents in general practice about OSAS

The literature review made it clear that family physicians often do not recognize OSAS in spite of its high prevalence and clinical significance. Several studies recommended the education of physicians to improve both the diagnosis and the treatment of patients with OSAS.

I tested the following hypotheses:

- Hungarian family physicians' knowledge about sleep apnoea is deficient
- Practitioners working in rural practices have a lower level of knowledge compared to those working in the capital
- Family physicians who completed specialty examinations in several disciplines have a higher level of knowledge than those who did not.
- The Obstructive Sleep Apnoea Knowledge and Attitudes (OSAKA) questionnaire is a useful instrument to monitor the efficacy of education of residents about sleep medicine.

1.4. Family physicians' opinion about the use of home blood pressure monitoring

Finally, in a random sample we assessed the current use of HBPM in Hungarian family practice and the physicians' opinion about the benefits and disadvantages of this method.

I tested the following hypotheses:

- Hungarian family physicians know and regularly use HBPM
- family physicians follow the recommendations of European Hypertension Society regarding the use of HBPM
- Family physicians often recommend HBPM to their patients.

Methods

1. Snorers' sociodemographic characteristics, health behaviour, prevalence of comorbidities and accidents

Hungarian population tested (Hungarostudy 2002)

The "Hungarostudy 2002" was a cross-sectional study enrolling a nationally representative sample of 12.643 subjects, representing the adult population of Hungary. The subjects' sociodemographic characteristics and health behaviour including smoking, consumption of alcohol, coffee consumption and exercise were recorded.

Data collection

Snoring was assessed by the following question: "Do you snore?" Answer options were: "No", "Yes, loud snoring with breathing pauses", "Yes, quiet, regular snoring".

2. Parameters of Quality of life

For the assessment of depressive symptoms the short Beck depression questionnaire (BDI) was used as modified by Kopp and co-workers. The scores obtained with the short BDI reflect reliably the scores of the full length questionnaire. Patients can be classified according to score ranges below:

0–9 scores	no depression
10–25 scores	mild or moderate depression syndrome
26 < scores	severe depression

In order to evaluate the vital exhaustion the abbreviated Vital Exhaustion Questionnaire was used that includes 5 items, each of those can be evaluated on a scale that ranged between 0 and 1.

Chronic pain was assessed in accordance with the definition of "International Association for the Study of Chronic Pain" that includes ten kinds of chronic pains classified according to the localization.

Self-rated health was assessed by asking the patients to classify their health status during the past 5 years as: very bad (1), bad (2), moderate (3), good (4), excellent (5).

3. Assessment of family physicians' knowledge about sleep apnoea with the OSAKA questionnaire

For the assessment of family physicians' knowledge about sleep apnoea we used the OSAKA questionnaire (Schotland and Jeffe 2003). This questionnaire contains 18 true-false statements about OSAS and covers the following areas: 1. epidemiology, 2. pathophysiology, 3. clinical practice, 4. diagnosis and 5. treatment.

An additional 5 statements ask about the physicians' attitude as they should indicate the importance of OSAS and their self-confidence in the identification and management of patients with OSAS on a 5-scored Likert-scale.

The questionnaire to family physicians was completed by three further questions:

1. "What is your estimate of the number of patients with sleep apnoea in a usual practice of 1500 subjects?"
2. "What is the number of patients with sleep apnoea in your practice?"
3. "Do you use any questionnaire to screen OSAS in your practice?"

Physicians were asked to complete this questionnaire and to provide personal data including gender, age, number of speciality diplomas they have, location and size of practice and BMI.

A total of 533 practising family physicians completed this questionnaire before two mandatory courses. 21 family physicians filled in the questionnaire incompletely, therefore 512 questionnaires were suitable for the analysis. The response rate was 62%, and the questionnaires were completed anonymously.

In the second phase of our study 50 family physician residents completed the OSAKA questionnaire before and also 3 months after their course about sleep medicine.

4. Family physicians' opinion about the use of home blood pressure monitoring. The questionnaire.

We constructed a questionnaire of 21 questions regarding the routine of HBPM use, the significance attributed to home measurements, aims of monitoring, characteristics of recommended devices, patients' education and data evaluation, and family physicians' doubts about the use of HBPM. The rationale of these questions was that these problems are of high priority in European guidelines or are not clarified

in the literature or were raised during the meetings organized for the family physicians. Questionnaires were completed anonymously. Questionnaire items were single or multiple choice questions. However, family physicians also had an option to give a more detailed answer with comments.

Statistical analysis

Groups were compared with Student t-test, Mann–Whitney U-test, variance analysis (ANOVA) or Kruskal–Wallis test. The independent association between snoring and other variables was evaluated with the use of multivariate logistic and ordinal regression analysis.

Odds ratios (OR) and 95% confidence intervals (CI) for the association of sleep problems with daytime symptoms assessed by the Athens Insomnia Questionnaire and accidents, were calculated for the two subgroups of snorers (quiet snorers and loud snorers). Non-snorers were used as reference population. This statistical model was adjusted for age, gender, BMI, education, smoking habits, heavy drinking (AUDIT over 8 scores) and exercise.

The association between snoring and BDI score, chronic pain, self-rated health and vital exhaustion was tested in multivariate regression models. These models included snoring, age, BMI, education, smoking habits, alcohol consumption (AUDIT over 8 scores) and number of comorbidities.

We used Pearson correlation for the analyses of the independent association of variables with the OSAKA knowledge scores except gender that was tested by score-biserial correlation.

The statistical model used for the regression analysis of family physicians' knowledge included the gender, age, BMI, number of speciality diplomas and location of practice. Statistical analyses were performed with SPSS 15.0 and STATA 8.0 (STATA Corporation) software packages.

Results

1. Prevalence of different types of snoring in Hungarian population

1.1. Sociodemographic background of snoring

Fifty percent of the investigated population reported snoring. Loud snoring with breathing pauses and quiet snoring were reported by 37% and 23% of men. Loud snoring was more prevalent in all age groups in men compared to women. The frequency of both loud and quiet snoring was 21% in women.

We observed an inverse correlation between education and the occurrence of loud snoring ($p < 0.001$). Subjects with a university degree presented the lowest portion of loud snorers (10%); their prevalence among quiet snorers and non-snorers was 14%, and 16%, respectively.

Loud snorers more frequently reported poor financial status compared to non-snorers (44%, and 38%, $p < 0.001$), while the financial status of non-snorers was better on average (the prevalence of subjects with higher income among non-snorers, quiet and loud snorers was 16%, 13% and 10%, respectively).

Smoking was more prevalent in loud snorers than in quiet and non-snorers (33% versus 29% and 25%, respectively, $p < 0.001$).

Using the score 8 as a cut-off value at AUDIT, 9 per cent of loud snorers can be considered as heavy drinkers; the prevalence of heavy drinkers among quiet and non-snorers was 6% and 4%, respectively ($p < 0.001$).

The prevalence of physical inactivity among loud snorers, quiet snorers and non-snorers was 60%, 50% and 44%, respectively.

The prevalence of overweight and severely obese subjects among loud snorers was 42% and 29%, respectively; these rates were significantly lower in the group of quiet snorers and non-snorers (30% and 11%, respectively, $p < 0.001$).

Twenty per cent of loud snorers consumed at least three cups of coffee per day; this rate among quiet snorers and non-snorers was 17% and 14%, respectively.

The prevalence of self-reported diabetes among loud snorers, quiet snorers and non-snorers was 9%, 7%, and 4%, respectively ($p < 0.001$).

Depression was also more prevalent in loud snorers (10%) than in quiet snorers and non-snorers (8% and 6%, respectively, $p < 0.001$). The prevalence of comorbidities

among loud snorers was significantly higher compared to quiet snorers and non-snorers ($p < 0.001$) as just 19% of loud snorers were free of comorbidities, while 42% presented with at least 3 comorbidities. These rates significantly differed from those observed in quiet snorers and non-snorers (24% and 35% in quiet snorers and 32% and 27% in non-snorers, respectively, $p < 0.001$).

The prevalence of accidents differed significantly in the groups of loud snorers, quiet snorers and non-snorers as it was 24%, 21%, and 17%, respectively $p < 0.001$.

Multivariate analysis

The following factors were independent predictors of snoring in an ordinal regression model: male gender, smoking, presence of at least one co-morbid state and heavy drinking (OR = 1.99; OR = 1.76; OR = 1.21. OR = 1.45; OR = 1.22 in different groups, $p < 0.001$) after the adjustment of association for a number of sociodemographic factors and clinical variables.

Loud snoring was strongly associated with daytime sleepiness (OR = 1.40 (CI = 1.26–1.56)), morning fatigue (OR = 1.49 (CI = 1.35–1.65); while in the group of quiet snorers these odds ratios were lower (OR = 1.28 (CI = 1.15–1.43); and OR = 1.23 (CI = 1.11–1.36), respectively).

1.1.2. Significance and consequence of snoring. The association between snoring and quality of life

Short Beck depression questionnaire revealed a higher average score in loud snorers compared to quiet snorers and non-snorers (9.8 ± 11.1 , 7.6 ± 9.8 and 6.8 ± 9.3 , respectively; $p < 0.001$). A significant positive trend was detected between the severity of depression in non-snorers and loud snorers ($p < 0.001$). Depression score was higher in women versus men. The prevalence of significant depression was significantly higher in women than in men. Similar observations were made regarding the average scores of vital exhaustion as the highest scores were measured in loud snorers, while medium-low scores were obtained in quiet snorers and non-snorers (2.4 ± 1.9 , 1.9 ± 1.9 and 1.7 ± 1.7 , respectively, $p < 0.001$).

The prevalence of chronic pain was the highest in loud snorers, while it was lower in quiet snorers and non-snorers (60%, 52% and 40%, respectively, $p < 0.001$).

Loud snorers classified their health status as being significantly worse than non-snorers ($p < 0.001$). 23% of loud snorers described their health status as bad or very bad, while this rate was 14% among non-snorers. The proportion of subjects describing their health status as good or excellent was significantly lower in the group of loud snorers than in quiet snorers and non-snorers (31%, 42% and 53%, respectively).

Multivariate analysis

In a multivariate analysis snoring was used as the independent variable and loud snoring with breathing pauses associated significantly with self-rated health in men (after the adjustment of association for age, BMI, education, smoking and drinking habits) (OR = 1.34; CI = 1.17–1.54. $p < 0.001$), while this association was weaker in women (OR = 1.14; CI = 0.99–1.30. $p = 0.062$).

Similar associations with BDI scores, pain and fatigue were observed in both genders (OR = 1.44; CI = 1.24–1.67, $p < 0.001$, OR = 1.51; CI = 1.29–1.75, $p < 0.001$, and OR = 1.67; CI = 1.48–1.89, $p < 0.001$, respectively, in men and OR = 1.17; CI = 0.99–1.37. $p = 0.06$, OR = 1.45; CI = 1.24–1.70. $p < 0.001$ and OR = 1.58; CI = 1.39–1.78. $p < 0.001$, respectively, in women).

1.2 Family physicians' knowledge about and attitude to sleep apnoea

1.2.1. Family physicians' knowledge about sleep apnoea

We evaluated 512 questionnaires. Sixty-one percent of responders were female ($n = 311$). Responders' average age was 54 ± 9 years (range: 27–79).

Responders practised for 20 ± 10 years in average (range: 1–45 years); average size of practices was 1699 persons (median value: 1750). Sixty-one percent of responders had at least two speciality diplomas.

Average score of female responders was significantly higher compared to that of male responders (12.5 ± 2.4 vs. 11.4 ± 3.1 , $p < 0.001$). Average score was also associated with the number of speciality diplomas: the score increased with increasing number of speciality diplomas. Responders, who did not complete any specialty exams and responders with one, two, three and four specialities, had 7.7 ± 4.4 , 11.0 ± 2.9 , 12.6 ± 2.3 , 13.3 ± 1.8 and 13.9 ± 1.9 scores, respectively ($p < 0.001$).

The score was lower in responders with higher BMI categories; responders with normal body weight had 13.0 ± 2.4 points in average, while those with BMI above 35 kg/m^2 had 9.9 ± 2.6 points in average ($p < 0.001$).

Responders with no pediatric patients in their practice had higher scores than those who had both adult and pediatric patients (12.6 ± 2.7 vs. 11.1 ± 2.9 , $p < 0.01$). Physicians working in the capital and in larger cities had the highest scores (12.8 ± 1.8 points), while physicians practising in small villages had the lowest scores (10.4 ± 3.6 point, $p < 0.01$).

The size of practice and the scores gained did not correlate significantly.

Multivariate analysis

The inverse correlation between scores of family physicians' knowledge and responders' age and BMI value remained significant after adjustment for variables of the statistical model. A highly significant correlation was demonstrated between the number of specialities and physicians' knowledge (regression coefficient: 1.28 (0.99–1.57, $p < 0.001$).

1.2.2. Family physicians' opinion about clinical significance and treatment of OSAS

Regarding the scores related to physicians' attitude to OSAS, female responders' average scores at each question and their total score were higher compared to male responders' scores (3.3 ± 0.6 versus 3.0 ± 0.6 , $p = 0.065$). In addition to the cumulative scores of responses to 5 questions we also analyzed separately the cumulative scores given to the first two questions about the importance of the problem (A1-2), and the 3-5 questions about responders' self-confidence (A3-5). We found a tendency that female responders gave higher scores for questions (A1-2) about the importance of OSAS (3.9 ± 0.7 vs. 3.5 ± 0.5 , $p = 0.09$) than men. In the questions about responders' self-confidence (A3-5) there was no significant difference between women and men as this score was low in both sexes (2.8 ± 0.4 and 2.7 ± 0.5).

Responders' gender, age and BMI values correlated with responses to importance (A1-2) and self-confidence questions. There was a positive correlation between scores and the responders' gender, while an inverse association was observed between scores and responders' age and BMI. Physicians' attitude to OSAS was not associated with the

number of specialities and type of practices (F statistics [degree of freedom: 3;503]: 2.2; $p = 0.09$) and [degree of freedom: 2;504]: 1.8; $p = 0.16$ in both groups).

Responders estimated the number of patients with OSAS in an average practice of 1500 patients to be 35 (median value). In their own practice the responders estimated that on average 10 patients suffered from sleep apnoea. However, 30 percent of the responders' did not think they had any patient with OSAS in their practice. Seven per cent of the responders reported using questionnaires to screen for OSAS in their practice.

1.2.3. Family physician residents' knowledge about OSAS

Fifty family physician residents (of those, 70% are female; mean age 26 ± 1 years) completed the OSAKA questionnaire before and also 3 months after their course about sleep medicine.

Residents scored 9 – 17 out of the maximum 18 points. Their average score was 13.5 ± 1.8 that did not differ significantly from that of practising family physicians. Residents' cumulative scores of questions about attitude (A1-5) did not differ significantly from family physicians' scores (3.0 ± 0.3 vs. 3.1 ± 0.5), but they exhibited a lower self-confidence about recognition and treatment of OSAS (1.8 ± 0.6 vs. 2.7 ± 0.4 , $p < 0.05$).

Knowledge scores increased significantly after education (13.5 ± 1.8 vs 15.4 ± 1.9 , $p < 0.001$), the A1-5 scores increased by 1,2 points (3.0 ± 0.3 vs 4.2 ± 0.5 , $p < 0.05$). Their scores related to self-confidence exceeded those of practicing family physicians (3.8 ± 0.6 vs. 2.7 ± 0.4 , $p < 0.05$), but did not reach the characteristic/fully characteristic category.

1.3. Family physicians' opinion about home blood pressure-monitoring

We evaluated 405 (57.9%) questionnaires.

Sixty percent of the physicians estimated they had more than 50 patients and only 11% to have 20 or less patients using HBPM in their practices.

The popularity of HBPM is evidenced by the response rates given to the following single-choice question: "*Do you ask/reassure your patients with hypertension to*

measure their blood pressure at home?" The following responses were given: *"never or just in isolated cases"* 1.2% (n = 5), *"in some cases"* 1.7% (n = 7), *"sometimes"* 2.7% (n = 11), *"commonly"* 37.3% (n = 151) and *"almost always"* 57.1% (n = 231). To the question *"How do you evaluate home blood pressure data?"* two-thirds of responders (65%) gave the following response: *"I just review the data to gain a general impression"* and just one-third of responders (33.5%) marked the response *"I evaluate blood pressure data in order to establish the average and tendencies."*

Summary of results and conclusions

- Snoring is common in the Hungarian general population. The prevalence of loud snoring with breathing pauses and quiet snoring is 37% and 23% in men and 21% and 21% in women, respectively.
- Snoring is associated with lower education and worse financial status in the general Hungarian population.
- Snoring, particularly loud snoring with breathing pauses is strongly correlated with high-risk health behaviour and there is a significant increasing trend between the prevalence of smoking, heavy drinking and coffee consumption in non-snorers, quiet snorers and loud snorers.
- Male gender, smoking, presence of comorbidities and heavy drinking are independent predictors of snoring.
- Snoring is associated with increased daytime sleepiness and increased prevalence of accidents.
- Snoring, particularly loud snoring is frequently associated with an increased occurrence of depressive symptoms and worse overall health status.
- The prevalence of patients grading their health status as bad was the highest among loud snorers; these patients presented with the highest level of vital exhaustion. These findings indicate a significant impairment of the quality of life.
- Hungarian family physicians, particularly male physicians have a lack of knowledge about sleep apnoea.
- There is an inverse correlation between physicians' BMI and age versus knowledge.
- Knowledge of sleep apnoea in physicians working in villages is lower than that of those working in the capital.
- Knowledge scores of sleep apnoea and number of speciality exams completed by the physician correlated significantly.

- The OSAKA questionnaire is suitable for the follow-up of the efficacy of the educational intervention in interdisciplinary sleep medicine.
- Hungarian family physicians know and use HBPM in their practice.
- Family physicians follow the guidelines of European Hypertension Society on the use of HBPM.

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List of publications

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