When sleep fails: the functional impact of obstructive sleep apnea

Original Article

Authors

João Rainha Fernandes
Unidade Local de Saúde Loures-Odivelas, Portugal

Daniela Serras
Unidade Local de Saúde Loures-Odivelas, Portugal

Luís Rio Rodrigues
Unidade Local de Saúde Loures-Odivelas, Portugal

João Barbosa
Unidade Local de Saúde Loures-Odivelas, Portugal

Constança Oom
Unidade Local de Saúde Loures-Odivelas, Portugal

Carlos Macor
Unidade Local de Saúde Loures-Odivelas, Portugal

Correspondence:
João Rainha Fernandes
joaorainhafernandes@gmail.com

Article received on April 9, 2025.
Accepted for publication on December 7, 2025.

Abstract

Objectives: Evaluate the correlation between the functional impact of obstructive sleep apnea syndrome (OSA) and body mass index (BMI), neck circumference (NC), apnea/hypopnea index (AHI), Epworth scale (ESS), and visual analog scale for snoring (VAS).
Study Design: Observational retrospective study.
Material and Methods: Patients diagnosed with OSA between 2020-2024. The functional impact was measured by the Functional Outcomes of Sleep Questionnaire-30(FOSQ-30).
Results: Out of 64 patients, 69% (n = 44) were men and 81% (n = 52) had mild/moderate OSA. A negative correlation was found between the FOSQ-30 and ESS (r = -0,673; p < 0.001) and VAS (r = -0,280; p = 0,025). There was no statistical significance in correlations with BMI, NC, and AHI, as well as between patients with mild, moderate and severe OSAS.
Conclusions: Daytime sleepiness and the intensity of snoring are the main predictors of functional impact in patients with OSA, regardless of polysomnographic severity. Therefore, we should integrate functional and symptomatic scales into the clinical evaluation of these patients, in order to understand the real impact of this condition on their quality of life.

Keywords: obstructive sleep apnea syndrome; snoring; functionality; functional capacity; functional impact; FOSQ-30.

Introduction

Obstructive sleep apnea syndrome (OSAS) is characterized by the recurrent collapse of the upper airway during sleep, resulting in a partial reduction (hypopnea) or total cessation (apnea) of airflow. These recurrent obstructive ventilatory episodes cause a decrease in the blood oxygen levels, leading to micro-arousals and consequently, sleep fragmentation and excessive daytime sleepiness[1], with a significant impact on the quality of life. OSAS is a highly prevalent condition, estimated to affect approximately one in seven people worldwide[2], and is more common in men[3]. The other risk factors include conditions that reduce the diameter of the pharynx or increase its collapsibility during sleep[1]. Obesity is one of the main risk factors as excess tissue deposition increases the extraluminal pressure in the upper aerodigestive tract, promoting airway collapse during sleep[4]. Other risk factors include advanced age, craniofacial abnormalities, alcohol, tobacco, or sedative use, and certain metabolic or genetic diseases. Diagnosis requires polysomnography (PSG) or a home sleep apnea test (HSAT). Severity is defined by the number of apneas/hypopneas per hour of sleep (apnea-hypopnea index - AHI); mild OSAS is defined as an AHI of 5-15 events/hour, moderate OSAS as an AHI of 15-30 events/hour, and severe OSAS as an AHI > 30 events/hour[1,5]. By causing recurrent hypoxemia during sleep, OSAS is associated with increased sympathetic nervous system activation and endothelial dysfunction[5]. This explains its association with a higher risk of cardiovascular, psychiatric, and metabolic diseases[6,7]. In addition to excessive daytime sleepiness and a greater predisposition to occupational and road accidents[5], the high incidence of comorbidities in these patients highlights the impact of OSAS on the performance of basic, instrumental, and advanced activities of daily living. Considering the significant role OSAS can play in reducing the quality of life and causing functional impairment, this study sought to evaluate the correlation between the functional impact of OSAS and body mass index (BMI), neck circumference (NC), AHI, Epworth Sleepiness Scale (ESS), and the visual analogue scale for snoring (VAS).

Materials and Methods

A retrospective observational study was conducted at the Department of Otolaryngology (ENT) of the Loures-Odivelas Local Health Unit (ULSLOD) in Lisbon. The sample included adult patients treated at ENT outpatient clinics with a diagnosis of OSAS by Type I PSG or Type III HSAT between January 2020 and December 2024, whose data were subsequently analyzed.

Sociodemographic and polysomnographic data were collected by reviewing electronic medical records. Patients were subsequently invited to the clinic to obtain clinical and anatomical measurements and complete missing or outdated questionnaires. Exclusion criteria included being under 18 years of age, primary snoring, upper airway resistance syndrome, prior upper airway surgery, or adequate adherence to positive airway pressure (PAP) ventilation. Consequently, the questionnaires were administered to all patients with sleep apnea who were not receiving effective treatment. The following parameters were considered: age, sex, BMI, AHI, NC, ESS, and VAS. The functional impact was measured using the Functional Outcomes of Sleep Questionnaire-30 (FOSQ-30)[6]. This 30-item self-administered questionnaire evaluates the impact of sleepiness on functioning and quality of life across five main domains: activity level (9 items), general productivity (8 items), vigilance (7 items), social relationships (2 items), and intimacy and sexual function (4 items). Each question offers four response options based on the degree of disability or difficulty, where lower scores indicate greater impairment. For most questions, the patients can select 'not applicable' if the activity is not part of their daily routine. The final score is calculated by summing the weighted averages for each domain, ranging from a minimum of 5 to a maximum of 20. Therefore, higher scores indicate better perceived functioning and quality of life[6]. Total scores below 18, or a 2-point change in the total score between assessments of the same patient, indicate that daytime sleepiness is impacting the functioning and quality of life[7,8]. This questionnaire is currently being validated in Portuguese. This assessment was supplemented with standardized evaluation scales for daytime sleepiness (ESS) and snoring intensity (VAS). For the ESS, values greater than 10 were considered indicative of excessive daytime sleepiness[9]. A statistical analysis was implemented using SPSS® version 25 software (Statistical Package for the Social Sciences - IBM Corp. Released 2017, Armonk, NY). The analysis used univariate Spearman correlation coefficients to evaluate the relationship between variables and the Kruskal–Wallis test for group comparison; statistical significance was set at $p < 0.05$.

Results

The sample included 64 patients diagnosed with OSAS aged between 22 and 75 years (mean: 51.89 ± 10.74 years) and was predominantly male (n = 44; 69%).

Most individuals were overweight (BMI: 25–29.9 kg/m^2) [n = 36; 56%], with a mean BMI of 28.14 ± 3.46 kg/m^2. The mean neck circumference was 40.71 ± 3.58 cm. In descending order of frequency, the distribution of OSAS was: moderate OSAS (n = 31; 48%), mild OSAS (n = 21; 33%), and severe OSAS (n = 12; 19%). The mean AHI was 22.47 events/hour (range: 5–109.6). The mean scores for daytime sleepiness (ESS), snoring intensity (VAS), and the functional impact of daytime sleepiness (FOSQ-30) were 10.34 ± 5.21, 8.11 ± 1.66, and 16.40 ± 3.16 points, respectively. Table 1 summarizes the population characteristics.

Spearman's correlation coefficient was used to evaluate the correlation between the variables (BMI, NC, AHI, ESS, VAS) and FOSQ-30 score. A strong negative correlation was observed between the FOSQ-30 and the ESS ($r = -0.714$; $p < 0.001$) and a moderate negative correlation between the FOSQ-30 and the VAS ($r = -0.347$; $p = 0.005$). There were weak, statistically non-significant correlations for AHI, BMI, and NC ($r = -0.029$, $p = 0.821$; $r = 0.137$, $p = 0.283$; $r = 0.115$, $p = 0.368$, respectively).

Table 1
Summary of Population Characteristics

	N (out of 64)	%	Mean ± standard deviation (if applicable)
Age (years)	NA	NA	51,89 ± 10,74
Sex			
Male	44	69%	NA
Female	20	31%	NA
BMI (kg/m2)	NA	NA	28,14 ± 3,46
BMI Classification			
Normal (18 - 24.9)	10	16%	NA
Overweight, 25 - 29.9	36	56%	NA
Obesity, ≥ 30	18	28%	NA
AHI (events/hour)	NA	NA	22,47*
OSAS Severity			
Mild (5-14.9)	21	33%	NA
Moderate (15-29.9)	31	48%	NA
Severe (≥30)	12	19%	NA
Neck Circumference (cm)	NA	NA	40,71 ± 3,58
Epworth Sleepiness Scale	NA	NA	10,34 ± 5,21
Snoring Visual Analogue Scale	NA	NA	8,11 ± 1,66
FOSQ-30	NA	NA	16,40 ± 3,16

N/A – Not applicable.
* The average AHI is presented without standard deviation due to high sample variability, using the minimum and maximum as indicated in the text.

These correlations are shown in Figure 1.

The functional impact of different OSAS severities and BMI categories was studied using the Kruskal–Wallis test. No statistically significant differences were observed in the FOSQ-30 scores between the different OSAS severity groups ($\chi^2 = 1.053$; df = 2; $p = 0.591$) or BMI categories ($\chi^2 = 1.2697$; df = 2; $p = 0.531$). The distribution of the FOSQ-30 in these groups is shown in Figure 2.

Discussion

Several studies demonstrate an improvement in the quality of life following treatment for sleep apnea (including PAP[10], upper airway surgery[11], and/or mandibular advancement devices[12]). However, there are few articles investigating which parameters are associated with the greatest functional impact and poorest quality of life in patients with OSAS, which supports the relevance of this research. Our sample showed a negative correlation between daytime sleepiness and quality of life. Thus, as daytime sleepiness symptoms intensify in the patients' daily lives, their perceived functioning decreases. Che-Morales et al.[13] found that the main predictors of functional impact were daytime sleepiness, supporting our results, and the presence of major depressive disorder. Similarly, to identify the potential confounding factors, Silva et al.[14] compared several quality-of-life scales in patients with OSAS and found that the functional impact of OSAS is driven by

Figure 1
Spearman correlation graphs between the variables considered and the FOSQ-30 score. Only the ESS and VAS showed a statistically significant negative correlation with the FOSQ-30.

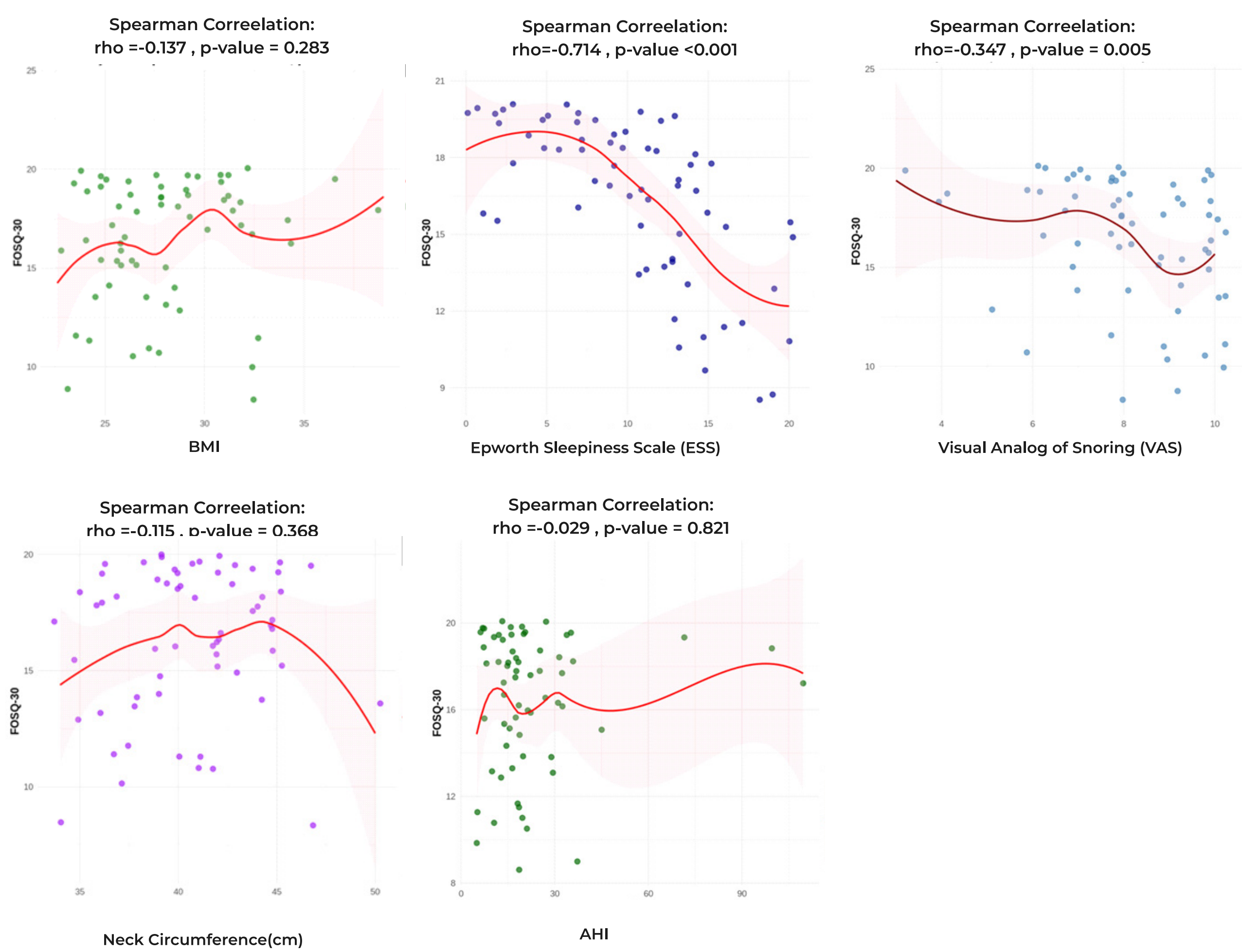
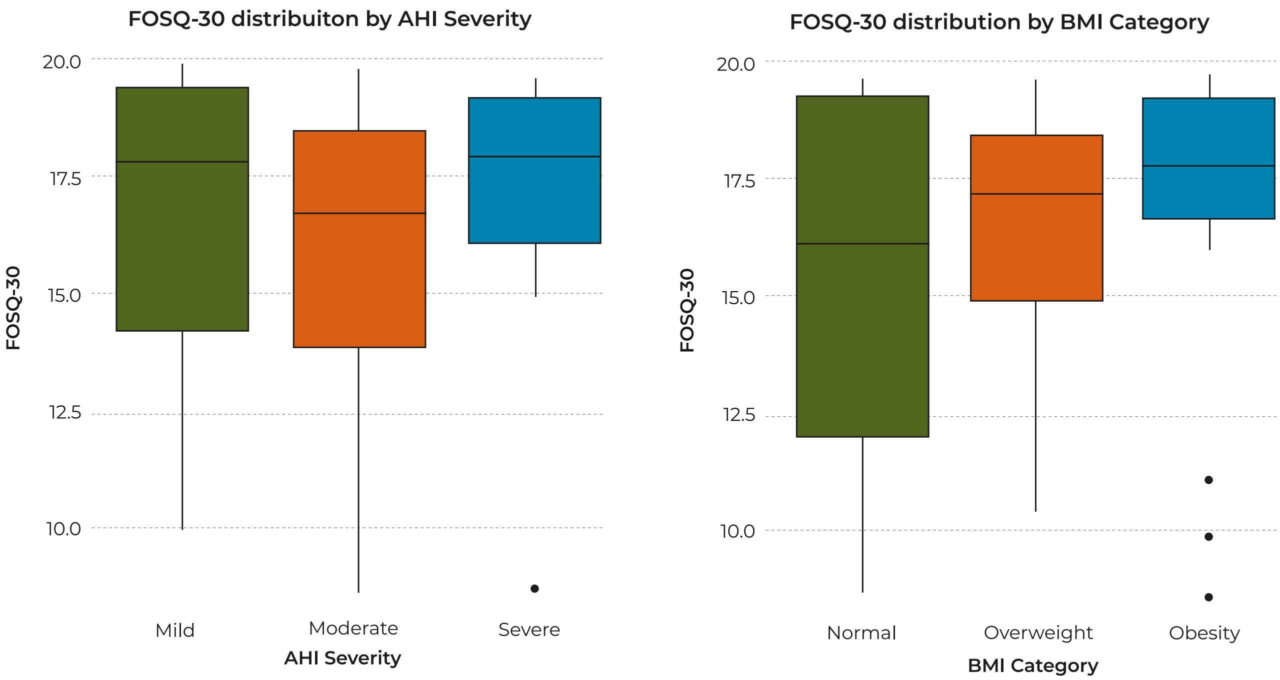


Figure 2
FOSQ-30 distribution graphs based on OSAS severity/BMI. No statistically significant difference was found between FOSQ-30 scores based on OSAS severity groups and BMI categories



daytime sleepiness as measured by the ESS.
We also found that the snoring intensity, as measured by the VAS, correlates negatively with FOSQ-30 scores, indicating that the subjective perception of intense snoring is associated with a lower quality of life. This association may be explained by the inherent stigma and negative social perceptions attached to individuals who snore.
In our sample, we identified no significant relationship between AHI and overall FOSQ-30 scores, questioning whether the OSAS severity accurately predicts the functional impact in these patients. Studies from Portugal on the quality of life in patients with OSAS are limited. Notably, Gonçalves et al.[15] used the Short Form-36 Health Survey (SF-36) and sought to understand if quality of life correlated with AHI and minimum oxygen saturation during sleep. Similarly to our results, these authors also found no correlation between a higher AHI and worse quality of life. Comparisons between OSAS severity groups also failed to show a link between increased severity and worse FOSQ-30 results, as previously mentioned. Consequently, AHI appears to be an insufficient marker of OSAS severity as it does not fully capture the disease's impact on patients' daily lives.
Consistent with the findings of Izci et al.[16] we found no statistically significant correlation regarding the impact of BMI. Additionally the neck circumference seems to have no functional impact and there is no literature available on this association.
Our results highlight the need to consider multiple clinical and polysomnographic parameters when evaluating patients with OSAS. These findings support growing evidence that sleep apnea severity is multidimensional, requiring an approach that integrates different pathophysiological and clinical phenotypes along with the real-world functional impairment of patients. This complexity is not captured by the AHI-based severity alone; therefore, the systematic use of functional questionnaires, such as the FOSQ-30 is essential during routine clinic visits. This will allow for a more personalized approach centered on the actual impact this disease

has on the patients' daily lives. This study has some drawbacks. Its retrospective design and small sample size (particularly regarding patients with severe OSAS) may introduce a selection bias and limit the statistical power of the associations. Additionally, the scale used to evaluate the functional impact is currently being validated for the Portuguese language, which may limit its applicability. It is also important for future research to account for uncontrolled confounding factors, such as sleep habits and hygiene, insomnia or depressive symptoms, alcohol and sedative consumption, and the burden of comorbid cardiovascular, respiratory, and metabolic conditions. This more comprehensive approach will be critical to understanding other factors contributing to functional impairment in OSAS.

Conclusion

This study highlights that daytime sleepiness and snoring intensity are the main predictors of the functional impact in patients with OSAS, regardless of the disease severity as measured by PSG using the AHI. These findings underscore the limitations of relying solely on the AHI when assessing the disease severity. Therefore, functional assessment scales (such as the FOSQ-30) and symptoms-based measures (such as the ESS) should be incorporated into routine clinical evaluation, promoting an approach that more accurately reflects the real impact of sleep apnea on the patients' quality of life.

Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

Data Confidentiality

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

Protection of humans and animals

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the 2013 Helsinki Declaration of the World Medical Association.

Privacy policy, informed consent and Ethics Committee Authorization

The authors declare that they have written consent for the use of photographs of patients in this article.

Funding Sources

This work did not receive any contribution, funding or scholarship.

Availability of scientific data

There are no datasets available, publicly related to this work.

Statement on the Use of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used the ChatGPT tool to review the language. Following the use of this tool/service, the authors reviewed and edited the content as necessary and assume full responsibility for the content of the publication.

Referências bibliográficas

1. Veasey SC, Rosen IM. Obstructive sleep apnea in adults. N Engl J Med. 2019 Apr 11;380(15):1442-1449. doi: 10.1056/NEJMcp1816152.
2. Benjafield AV, Ayas NT, Eastwood PR, Heinzer R, Ip MSM, Morrell MJ. et al. Estimation of the global prevalence and burden of obstructive sleep apnoea: a literature-based analysis. Lancet Respir Med. 2019 Aug;7(8):687-698. doi: 10.1016/S2213-2600(19)30198-5.
3. Kim S, Lee KY, Siddiquee AT, Kim HJ, Nam HR, Ko CS. et al. Gender differences in association between expiratory dynamic airway collapse and severity of obstructive sleep apnea. Eur Radiol. 2024 Jun;34(6):3730-3741. doi: 10.1007/s00330-023-10322-x.
4. Romero-Corral A, Caples SM, Lopez-Jimenez F, Somers VK. Interactions between obesity and obstructive sleep apnea: implications for treatment. Chest. 2010 Mar;137(3):711-9. doi: 10.1378/chest.09-0360.
5. Abbasi A, Gupta SS, Sabharwal N, Meghrajani V, Sharma S, Kamholz S. et al. A comprehensive review of obstructive sleep apnea. Sleep Sci. 2021 Apr-Jun;14(2):142-154. doi: 10.5935/1984-0063.20200056.
6. Weaver TE, Laizner AM, Evans LK, Maislin G, Chugh DK, Lyon K. et al. An Instrument to measure functional status outcomes for disorders of excessive sleepiness. Sleep [Internet]. 1997 Oct 1 [cited 2025 Apr 6];20(10):835–43.

Available from: https://dx.doi.org/10.1093/sleep/20.10.835
7. Chasens ER, Ratcliffe SJ, Weaver TE. Development of the FOSQ-10: a short version of the functional outcomes of sleep questionnaire. Sleep. 2009 Jul;32(7):915-9. doi: 10.1093/sleep/32.7.915.
8. Walia HK, Thompson NR, Katzan I, Foldvary-Schaefer N, Moul DE, Mehra R. Impact of sleep-disordered breathing treatment on quality of life measures in a large clinic-based cohort. J Clin Sleep Med. 2017 Nov 15;13(11):1255-1263. doi: 10.5664/jcsm.6792.
9. Johns M, Hocking B. Daytime sleepiness and sleep habits of Australian workers. Sleep. 1997 Oct;20(10):844-9. doi: 10.1093/sleep/20.10.844.
10. Bjornsdottir E, Keenan BT, Eysteinsdottir B, Arnardottir ES, Janson C, Gislason T. et al. Quality of life among untreated sleep apnea patients compared to the general population and changes after treatment with positive airway pressure. J Sleep Res. 2015 Jun;24(3):328-38. doi: 10.1111/jsr.12262.
11. Iannella G, Magliulo G, Lo Iacono CAM, Visconti IC, Lechien JR, Perrone T. et al. Quality of life and excessive daytime sleepiness in adults with obstructive sleep apnea who are treated with multilevel surgery or adherent to continuous positive airway pressure. J Clin Med. 2022 Apr 23;11(9):2375. doi: 10.3390/jcm11092375.
12. Rangarajan H, Padmanabhan S, Ranganathan S, Kailasam V. Impact of oral appliance therapy on quality of life (QoL) in patients with obstructive sleep apnea - a systematic review and meta-analysis. Sleep Breath. 2022 Sep;26(3):983-996. doi: 10.1007/s11325-021-02483-0.
13. Che-Morales JL, Carrillo-Alduenda JL. Functional outcomes in patients with obstructive sleep apnea residing in Southeastern Mexico. Sleep Med Res 2022; 13(3): 132-139. doi.org/10.17241/smr.2022.01473
14. Silva GE, Goodwin JL, Vana KD, Quan SF. Obstructive sleep apnea and quality of life: comparison of the SAQLI, FOSQ, and SF-36 questionnaires. Southwest J Pulm Crit Care. 2016;13(3):137-149. doi: 10.13175/swjpcc082-16.
15. Goncalves MA, Paiva T, Ramos E, Guilleminault C. Obstructive sleep apnea syndrome, sleepiness, and quality of life. Chest. 2004 Jun;125(6):2091-6. doi: 10.1378/chest.125.6.2091.
16. Izci B, Firat H, Ardiç S, Köktürk O, Gelir E, Altinörs M. Adaptation of functional outcomes of sleep questionnaire (FOSQ) to Turkish population. Tuberk Toraks. 2004;52(3):224-30.