

Comparing the Excessive Daytime Sleepiness of Obese and Non-obese Patients

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Abstract

Background: Obesity, particularly morbid obesity, has various physical and mental complications. Excessive daytime somnolence (EDS) is a sleep disorder that reduces individuals' performance capability and the accuracy of their short-term memory and causes learning problems. This retrospective study aimed to document the presence of EDS in a sample of obese patients in comparison to patients with a normal weight.

Objectives: This article compares the excessive daytime sleepiness of obese and non-obese patients in the minimally invasive surgery research center in Tehran, Iran.

Patients and Methods: In this case-control study, we compared excessive daytime sleepiness in 55 obese patients who were candidates for laparoscopic surgery, with a body mass index (BMI) of equal to or greater than 30 kg/m², with 55 controls with a normal BMI (19.5 - 24.9 kg/m²). The process of selecting the control group in our case-control study is matching in group levels, so that the controls are similar to the case group with regard to certain key characteristics, such as age, sex, and race. The sleep assessment was based on the Epworth sleepiness scale (ESS) questionnaire. Analysis of variance (ANOVA) was used to compare the means of quantitative data, such as the ESS score of groups.

Results: Sleepiness was not affected by gender in cases or controls. The sleepiness prevalence was 29 (52.7%) in the cases group and 17 (30.9%) in the control group (OR = 2.493 (95% CI 1.144 - 5.435)). The mean ESS scores in cases and controls were 7.82 ± 3.86 and 10.54 ± 6.15 , respectively ($P = 0.007$). Moreover, the prevalence of sleepiness and the mean ESS scores in class III of obesity differed significantly from the controls (16 (57.1%) vs. 17 (30.9%)) (OR = 2.980 (95% CI 1.162 - 7.645)) and (11.04 ± 5.93 vs. 7.82 ± 3.86) ($P = 0.013$), respectively.

Conclusions: Our findings suggest a strong relationship between EDS and obesity, particularly morbid obesity. Therefore, physicians must be familiar with EDS as a mixed clinical entity indicating careful assessment and specific treatment planning.

Keywords: Excessive Somnolence Disorders, Obesity, Morbid Obesity

1. Background

The prevalence of obesity has been increasing over the past few centuries (1). Obesity, and specifically morbid obesity, has various medical complications such as diabetes, hypertension, nonalcoholic steato-hepatitis, hyperlipidemia, polycystic ovary syndrome (PCOS), thrombotic problems, and menstrual irregularity (2-4).

In addition to medical problems, obesity is associated with numerous psychiatric complications, such as neurocognitive disturbances, mood disorders, anxiety disorders, eating disorders and sleeping disorders (5-10).

Excessive daytime sleepiness (EDS) is a frequent complaint in obese patients. EDS affects around 20% of the normal population and reduces individuals' performance capability and the accuracy of their short-term memory. Additionally, it causes learning problems and hazardous

events, such as car accidents (11, 12).

There is still controversy regarding the etiology of sleepiness. Some studies have suggested that it might be due to the medications' pharmacological effects and might have serious consequences related to patients' fatigue (13, 14). Other researchers have suggested that reduced hippocampal volume is a risk factor for EDS (15). Regarding the association of sleepiness with obesity, some researchers have proposed that EDS is also independently related to anxiety or depression, and some have suggested that obesity is an independent predictor of sleepiness in this population (16, 17). The reduction in neuro-endocrine factors levels, such as leptin, in obese patients is also suggested as a reason for the changes in sleep quality in obese patients (18).

Previous studies have shown that regular meal pat-

terns in adults and breast feeding in children are important factors for preventing metabolic syndrome criteria in childhood and later years of life (19). In obese patients, the severity of obesity, excessive fat intake, and a higher BMI were associated with a higher prevalence of excessive sleepiness (9, 19-23).

Obesity causes sleep disturbances by affecting ventilation, increasing airway obstructions, and causing critical pressure, which leads to daytime hypercapnia. Daytime sleepiness is associated with mechanical traumas during activities such as driving and working (7, 24).

2. Objectives

The earlier relevant studies were performed on non-obese cases. In contrast, we have evaluated EDS in obese and specifically morbidly obese patients. Moreover, we have compared them to the case group to evaluate the prevalence of the EDS in these patients. In addition, no similar studies have been done on morbidly obese patients in Iran. Our study focused on morbidly obese patients.

3. Patients and Methods

In this case-control study, we compared excessive daytime sleepiness in 55 obese and morbidly obese patients who were candidates for laparoscopic surgery, in the minimally invasive surgery research center in Tehran, Iran with 55 controls of normal weight (BMI: 19.5 - 24.9 kg/m²). Obesity was defined as a body mass index (BMI) ≥ 30 kg/m² and patients were categorized into three groups according to their BMI: 30 - 34.9 = class I, 35 - 39.9 = class II, and BMI ≥ 40 = class III or morbidly obese. Normal weight was defined as a BMI of 19.5 - 24.9 kg/m² (25).

The sample size was calculated using The G \times Power software with the use of the following sample size (Formula 1):

$$\frac{2 \times (z_{1-\alpha} + z_{1-\beta})^2 \times \sigma^2}{d^2} \quad (1)$$

The process of selecting the control group in our case-control study is matching in group levels. In other words, participants in the case group are not matched to the control group individually; instead, they are matched at the group level. The control group is similar to the case group with regard to certain key characteristics, such as age, sex, and race. Among 68 patients who entered into our study, 11 patients had a history of using sedative drugs, such as benzodiazepines and other psychiatric medications, and 2 patients who had hypothyroidism were excluded from the study. Demographic data, including age, sex, BMI, and duration of obesity, were collected through a questionnaire.

The sleep assessment was based on the 8-item Epworth sleepiness scale (ESS) questionnaire, which has been designed to determine a subject's likelihood to doze off or fall asleep in different situations. Responses to each item are ranked from 0 to 3 according to the probability of dozing off during a task (0 = never, 1 = low probability, 2 = moderate probability, 3 = high probability), which results in a total score of 24 for the questionnaire; a score of 0 - 9 was categorized as normal, 10 - 15 intermediate, and ≥ 16 as a symptom of severe sleep disorders (11). The Iranian version of the ESS is a reliable and valid measure for evaluating daytime sleepiness. Its reliability for use with students was reported as being over 0.70 in Masoudzade's and Sadeghnia's studies (26, 27).

Statistical analysis was performed with SPSS 11.5 for Windows. Analysis of the data distribution was assessed by the Kolmogorov-Smirnov test for normally distributed data. To determine whether the variances of data in groups were equal, the Levene test was used. The chi-square or Fisher's exact test was used to compare the qualitative data and prevalence of sleepiness in all three groups. Analysis of variance (ANOVA) was used to compare the means of quantitative data, such as age and the ESS scores of BMI groups. To evaluate the odds of sleep disturbances in the case group, logistic regression analysis was used; therefore, odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated. The quantitative data were expressed as mean \pm standard deviation (SD); in contrast, for the qualitative data, frequencies (percentages) were used. A P value of less than 0.05 indicated statistical significance.

4. Results

We recruited 55 obese patients in the case group with a mean age of 39.47 ± 10.61 years and a mean BMI of 40.32 ± 7.47 kg/m² and 55 non-obese controls with a mean age of 38.94 ± 10.66 and a mean BMI of 23.10 ± 1.32 .

Forty-four patients (80%) in the obese group and 40 patients (72.7%) in the control group were married. Forty-five patients (83.3%) in the obese group and 49 patients (89.1%) in the control group were women. Both groups were compared according to mean age ($P = 0.795$), gender ($P = 0.383$), and marital status ($P = 0.369$); the data are shown in Table 1.

Sleepiness was not affected by gender in the case or control group. The prevalence of sleepiness in females and males was 23 (51.1%) versus 6 (66.7%) ($P = 0.480$) in the case group and 15 (30.6%) versus 2 (33.3%) ($P = 0.892$) in the control group. Therefore, no significant difference was found.

The prevalence of sleepiness in the case group was 29 (52.7%) and in the control group was 17 (30.9%) (OR = 2.493 (95% CI 1.144 - 5.435)). In addition, the mean ESS scores in

Table 1. Comparison of the Prevalence of Sleep Disturbances in Cases and Controls^a

Variable	Control, n = 55	Case Group, n = 55				OR (95 % CI)
		30 - 34.9, n = 15	35 - 39.9, n = 12	≥ 40, n = 28	Total	
Age	38.94 ± 10.66	37.3 ± 12.17	43.83 ± 9.78	38.53 ± 9.91	39.47 ± 10.61	0.795
Sex						0.383
Female	49 (89.1)	12 (80)	9 (81.8)	24 (85.7)	45 (83.3)	
Male	6 (10.9)	3 (20)	2 (18.2)	4 (14.3)	9 (16.7)	
Marital status						0.369
Single	15 (27.3)	4 (26.7)	1 (8.3)	6 (21.4)	11 (20)	
Married	40 (72.7)	11 (73.3)	11 (91.7)	22 (78.6)	44 (80)	
Sleepiness						OR = 2.493 (95% CI 1.144 - 5.435) ^c
No	37 (69.1)	9 (60)	5 (41.7)	12 (42.9) ^b	26 (47.3) ^b	
Yes	17 (30.9)	6 (40)	7 (58.3)	16 (57.1)	29 (52.7)	
ESS score	7.82 ± 3.86	8.67 ± 5.20	11.75 ± 7.62 ^b	11.04 ± 5.93 ^b	10.54 ± 6.14 ^b	OR = 2.980 (95% CI 1.162-7.645) ^b

^aValues are expressed as No (%) or mean ± SD.^cOR between case (without categorization) and control groups.^bCompared with the control group, P < 0.05.

the case and control groups were 7.82 ± 3.86 and 10.54 ± 6.15 . This difference between the two groups was statistically significant ($P = 0.007$).

Among the case group patients who reported sleepiness, 15 (27.3%) had intermediate and 14 (25.5%) had severe sleep disturbances. Alternatively, among the control group patients who expressed sleepiness, 15 (27.3%) had intermediate and 2 (3.6%) had severe disturbances.

We found a significant association between BMI and sleepiness in cases; their likelihood of reporting sleepiness increased significantly as their BMI increased (OR = 1.01 (95% CI 1.01 - 1.20)).

We divided cases into three groups based on patients' BMI: 30 - 34.9 = class I, 35 - 39.9 = class II, and ≥ 40 = class III of obesity (23); patients did not differ between the three BMI categories in respect to their mean age ($P = 0.270$), gender ($P = 0.881$), marital status ($P = 0.476$), sleepiness ($P = 0.510$), and their mean ESS score ($P = 0.368$) (Table 2). Comparing these results, we noted that neither sleep disturbances nor ESS scores were statistically significantly different between the three groups of obesity.

There was no significant difference between class I obesity and the control group in respect to their prevalence of sleepiness (6 (40%) vs. 17 (30.9%)) ($P = 0.545$) and mean ESS scores (8.67 ± 5.20 vs. 7.82 ± 3.86) ($P = 0.487$). We found a similar result for class II obese patients in their prevalence of sleepiness, (7 (58.3%) vs. 17 (30.9%)) ($P = 0.510$); the mean ESS scores of this obesity class and the control group significantly differed (11.75 ± 7.62 vs. 7.82 ± 3.86) ($P = 0.011$).

However, the prevalence of sleepiness and the mean

ESS scores statistically significantly differed for class III obese patients and the control group, respectively (16 (57.1%) vs. 17 (30.9%)) (OR = 2.980 (95% CI 1.162 - 7.645)) and (11.04 ± 5.93 vs. 7.82 ± 3.86) ($P = 0.013$).

5. Discussion

The prevalence of sleepiness was 29 (52.7%) in the case group and 17 (30.9%) in the control group. The mean ESS scores in the case group and the control group were 7.82 ± 3.86 and 10.54 ± 6.15 , respectively ($P = 0.007$). The prevalence of EDS in patients with obesity has been reported to range from 4% to 31% in earlier studies (12, 28-30). In this study, a high prevalence of EDS was revealed among obese patients, consistent with several prior studies. Roth T's study showed a higher prevalence of sleep disorders in obese patients (23, 24, 28, 31). Dixon showed that an average weight loss of 48% after bariatric surgery (SD = 16%) reduced the prevalence of daytime sleepiness (from 39% pre-operation to 4% post-operation ($P = 0.001$)) (24). In another study by Krieger et al. (31) AC, 12 months after bariatric surgery, patients' mean excess weight loss was $44.4 \pm 14\%$ and the apnea-hypopnea index decreased from 34.2 ± 35 to 19.0 ± 21.7 events per hour ($P < 0.0001$). In Mendes et al. study, daytime excessive sleepiness was one of the most common symptoms in OSA, and the distribution of OSA according to weight was as follows: 7% had normal weight, 2% were overweight (BMI 25 - 30), 37% grade I obesity (BMI 25.1 - 30); 9% grade II obesity (BMI 30.1 - 35), and grade III obesity (BMI greater than 35) in 45% of cases (32).

Table 2. Comparison of the Prevalence of Sleep Disturbances in Three Classes of Obesity^a

Variable	BMI			P Value
	30 - 34.9, n = 15	35 - 39.9, n = 12	≥ 40, n = 28	
Age	37.3 ± 12.17	43.83 ± 9.78	38.53 ± 9.91	0.270
Sex				
Female	12 (80)	9 (81.8)	24 (85.7)	0.881
Male	3 (20)	2 (18.2)	4 (14.3)	
Marital status				
Single	4 (26.7)	1 (8.3)	6 (21.4)	0.476
Married	11 (73.3)	11 (91.7)	22 (78.6)	
Sleepiness				
No	9 (60)	5 (41.7)	12 (42.9)	0.510
Yes	6 (40)	7 (58.3)	16 (57.1)	
ESS score	8.67 ± 5.20	11.75 ± 7.62	11.04 ± 5.93	0.368

^aValues are expressed as No (%) or mean ± SD.

Noticeably, there is no significant association between obesity and sleep breathing disorder, according to Esteller-More et al.'s study (33) and the prevalence of daytime sleepiness is 22.3% versus 23.8% in children with and without sleep breathing disorder, respectively. In addition, Palm found no independent association between the BMI level at baseline and the development of new sleep problems (34).

Moreover, we demonstrated that the differences in the prevalence of sleepiness and the mean ESS scores in class III obesity and controls were statistically significant ($P = 0.013$). This means that morbidly obese patients have higher ESS scores and a higher risk of severe daytime sleepiness, which was not highlighted in earlier studies.

In our study, similar to an earlier study (35), the case and control groups did not differ in terms of their mean age ($P = 0.270$), gender ($P = 0.881$), and marital status ($P = 0.476$); in contrast, other studies have shown gender differences in the prevalence of daytime sleepiness (36). In addition, several studies, including a cross-sectional survey by Kachikis et al. (37), have reported several socioeconomic factors including age, education, marital status, and employment status associated with sleep characteristics such as short sleep and inadequate sleep.

Several studies have demonstrated a strong correlation between daytime sleepiness and obstructive sleep apnea (OSA) (38). The Canadian public health agency has also reported the prevalence of self-reported OSA in 2009 (39). These findings highlight the need for studies investigating the effectiveness of the ESS as a screening tool to measure OSA. Although not assessing OSA might be a limitation of

our study, polysomnography is not a practical screening method, as it requires 24-hour hospitalization.

Our findings suggest a strong relationship between EDS and obesity, specifically morbid obesity. This study showed that morbidly obese patients have higher ESS scores and a higher risk of severe daytime sleepiness. Therefore, physicians need to be familiar with EDS as a mixed clinical entity that indicates careful assessment and specific treatment planning. Different methods such as dietary modifications in obese patients and surgical procedures in morbidly obese patients result in less EDS and fewer sleep disturbances.

Footnote

Authors' Contribution: Study concept and design: Abdolreza Pazouki, Fatemeh Jesmi, Paria Zargham, Somayyeh Mokhber; acquisition of the data: Somayyeh Mokhber, Paria Zargham; analysis and interpretation of the data: Mohadeseh Pishgahroudsari, Abdolreza Pazouki, Fatemeh Jesmi, Paria Zargham, Mokhber; drafting of the manuscript: Paria Zargham, Fatemeh Jesmi; critical revision of the manuscript for important intellectual content: Abdolreza Pazouki, Atefeh Ghanbari Jolfaei; statistical analysis: Mohadeseh Pishgahroudsari; administrative, technical, and material support: Abdolreza Pazouki; study supervision: Paria Zargham, Somayyeh Mokhber, Abdolreza Pazouki.

References

- Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999-2010. *JAMA*. 2012;307(5):491-7. doi: [10.1001/jama.2012.39](#). [PubMed: [22253363](#)].
- American College of Obstetricians and Gynecologists . Practice Bulletin. 107. Obstet Gynecol; 2006.
- Abdollahi M, Cushman M, Rosendaal FR. Obesity: risk of venous thrombosis and the interaction with coagulation factor levels and oral contraceptive use. *Thromb Haemost*. 2003;89(3):493-8. doi: [10.1267/THRO03030493](#). [PubMed: [12624633](#)].
- Must A, Spadano J, Coakley EH, Field AE, Colditz G, Dietz WH. The disease burden associated with overweight and obesity. *JAMA*. 1999;282(16):1523-9. [PubMed: [10546691](#)].
- Rhodes SK, Shimoda KC, Waid LR, O'Neil PM, Oexmann MJ, Collop NA, et al. Neurocognitive deficits in morbidly obese children with obstructive sleep apnea. *J Pediatr*. 1995;127(5):741-4. [PubMed: [7472827](#)].
- Scott KM, McGee MA, Wells JE, Oakley Browne MA. Obesity and mental disorders in the adult general population. *J Psychosom Res*. 2008;64(1):99.
- Tauman R, Gozal D. Obesity and obstructive sleep apnea in children. *Paediatr Respir Rev*. 2006;7(4):247-59. doi: [10.1016/j.prrv.2006.08.003](#). [PubMed: [17098639](#)].
- Stunkard AJ, Faith MS, Allison KC. Depression and obesity. *Biol Psychiatry*. 2003;54:330-7.
- Lin HY, Huang CK, Tai CM, Lin HY, Kao YH, Tsai CC, et al. Psychiatric disorders of patients seeking obesity treatment. *BMC Psychiatry*. 2013;13:1. doi: [10.1186/1471-244X-13-1](#). [PubMed: [23281653](#)].
- Crabtree VM, Varni JW, Gozal D. Health-related quality of life and depressive symptoms in children with suspected sleep-disordered breathing. *Sleep*. 2004;27(6):1131-8. [PubMed: [15532207](#)].
- Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep*. 1991;14(6):540-5. [PubMed: [1798888](#)].
- Dinges DF, Pack F, Williams K, Gillen KA, Powell JW, Ott GE, et al. Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. *Sleep*. 1997;20(4):267-77. [PubMed: [9231952](#)].
- Pagel JF. Excessive daytime sleepiness. *Am Fam Physician*. 2009;79(5):391-6. [PubMed: [19275068](#)].
- Vgontzas AN, Papanicolaou DA, Bixler EO, Kales A, Tyson K, Chrousos GP. Elevation of plasma cytokines in disorders of excessive daytime sleepiness: role of sleep disturbance and obesity. *J Clin Endocrinol Metab*. 1997;82(5):1313-6. doi: [10.1210/jcem.82.5.3950](#). [PubMed: [9141509](#)].
- Dusak A, Ursavas A, Hakymez B, Gokalp G, Taskapiloglu O, Parlak M. Correlation between hippocampal volume and excessive daytime sleepiness in obstructive sleep apnea syndrome. *Eur Rev Med Pharmacol Sci*. 2013;17(9):1198-204. [PubMed: [23690189](#)].
- Slater G, Pengo MF, Kosky C, Steier J. Obesity as an independent predictor of subjective excessive daytime sleepiness. *Respir Med*. 2013;107(2):305-9. doi: [10.1016/j.rmed.2012.10.013](#). [PubMed: [23159457](#)].
- Panosian LA, Veasey SC. Daytime sleepiness in obesity: mechanisms beyond obstructive sleep apnea-a review. *Sleep*. 2012;35(5):605-15. doi: [10.5665/sleep.1812](#). [PubMed: [22547886](#)].
- Leibel RL. The role of leptin in the control of body weight. *Nutr Rev*. 2002;60(10 Pt 2):S15-9. [PubMed: [12403079](#)] discussion S68-84, 85-7.
- Zarrati M, Shidfar F, Moradof M, Nasiri Nejad F, Keyvani H, Rezaei Hemami M, et al. Relationship between Breast Feeding and Obesity in Children with Low Birth Weight. *Iran Red Crescent Med J*. 2013;15(8):676-82. doi: [10.5812/ircmj.11120](#). [PubMed: [24578834](#)].
- Redline S, Storer-Isser A, Rosen CL, Johnson NL, Kirchner HL, Emancipator J, et al. Association between metabolic syndrome and sleep-disordered breathing in adolescents. *Am J Respir Crit Care Med*. 2007;176(4):401-8. doi: [10.1164/rccm.200703-375OC](#). [PubMed: [17541017](#)].
- Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea: a population health perspective. *Am J Respir Crit Care Med*. 2002;165(9):1217-39. [PubMed: [11991871](#)].
- Grandner MA, Kripke DF, Naidoo N, Langer RD. Relationships among dietary nutrients and subjective sleep, objective sleep, and napping in women. *Sleep Med*. 2010;11(2):180-4. doi: [10.1016/j.sleep.2009.07.014](#). [PubMed: [20005774](#)].
- Hicks RA, McTighe S, Juarez M. Sleep duration and eating behaviors of college students. *Percept Mot Skills*. 1986;62(1):25-6. doi: [10.2466/pms.1986.62.1.25](#). [PubMed: [3960667](#)].
- Dixon JB, Schachter LM, O'Brien PE. Sleep disturbance and obesity: changes following surgically induced weight loss. *Arch Intern Med*. 2001;161(1):102-6. [PubMed: [11146705](#)].
- WHO . Obesity: preventing and managing the global epidemic. Report of a WHO consultation. *World Health Organ Tech Rep Ser*. 2000;894:i-xii. [PubMed: [11234459](#)] 1-253.
- Sadeghniiat Haghighi K, Montazeri A, Khajeh Mehrizi A, Aminian O, Rahimi Golkhandan A, Sarai M. The Epworth Sleepiness Scale: translation and validation study of the Iranian version. *Sleep Breath*. 2013;17(1):419-26.
- Masoodzadeh A, Zanganeh A, Shahbaznezhad L. Daytime sleepiness in Medical students at Mazandaran university of medical sciences. *J Mazandaran Uni Med Sci*. 2006;16(52):75-80.
- Roth T, Roehrs TA. Etiologies and sequelae of excessive daytime sleepiness. *Clin Ther*. 1996;18(4):562-76. [PubMed: [8879887](#)] discussion 561.
- Johns M, Hocking B. Daytime sleepiness and sleep habits of Australian workers. *Sleep*. 1997;20(10):844-9. [PubMed: [9415943](#)].
- Lavie P. Incidence of sleep apnea in a presumably healthy working population: a significant relationship with excessive daytime sleepiness. *Sleep*. 1983;6(4):312-8. [PubMed: [6665393](#)].
- Krieger AC, Youn H, Modersitzki F, Chiu YL, Gerber LM, Weinshel E. Effects of laparoscopic adjustable gastric banding on sleep and metabolism: a 12-month follow-up study. *Int J Gen Med*. 2012;975-81. doi: [10.2147/IJGM.S35566](#).
- Mendes FA, Marone SA, Duarte BB, Arenas AC. Epidemiologic profile of patients with snoring and obstructive sleep apnea in a university hospital. *Int Arch Otorhinolaryngol*. 2014;18(2):142-5. doi: [10.1055/s-0033-1359309](#).
- Esteller-More E, Castells-Vilella L, Segarra-Isern F, Argemi-Renom J. [Childhood obesity and sleep-related breathing disorders]. *Acta Otorinolaringol Esp*. 2012;63(3):180-6. doi: [10.1016/j.otorri.2011.10.006](#). [PubMed: [22197456](#)].
- Palm A, Janson C, Lindberg E. The impact of obesity and weight gain on development of sleep problems in a population-based sample. *Sleep Med*. 2015;16(5):593-7. doi: [10.1016/j.sleep.2015.01.016](#). [PubMed: [25819416](#)].
- Pahwa P, Karunanayake C, Hagel L, Gjevre JA, Rennie D, Lawson J. Prevalence of high Epworth Sleepiness Scale scores in a rural population. *J Canadian Thoracic Society*. 2012;19(2):10.
- Valipour A, Lothaller H, Rauscher H, Zwick H, Burghuber OC, Lavie P. Gender-related differences in symptoms of patients with suspected breathing disorders in sleep: a clinical population study using the sleep disorders questionnaire. *Sleep*. 2007;30(3):312-9. [PubMed: [17425227](#)].
- Kachikis AB, Breitkopf CR. Predictors of sleep characteristics among women in southeast Texas. *Women's Health Issues*. 2012;22(1):e99-109. doi: [10.1016/j.whi.2011.07.004](#). [PubMed: [21875813](#)].
- Johns MW. Reliability and factor analysis of the Epworth Sleepiness Scale. *Sleep*. 1992;15(4):376-81. [PubMed: [1519015](#)].
- Evans J, Rusu C, McRae L, Driver H, Fleetham J, Graham B. The prevalence rate and risk of obstructive sleep apnea in Canada. *Chest*. 2010;13870 doi: [10.1378/chest.10037](#).