British Journal of Medicine & Medical Research
13(1): 1-8, 2016, Article no.BJMMR.22689
ISSN: 2231-0614, NLM ID: 101570965

SCIENCEDOMAIN *international*
www.sciencedomain.org

Contributing Factors to Day Time Sleepiness among Secondary School Students in Ibadan

S. A. Ogunkeyede[1*], A. A. Sanusi[2] and O. A. Lasisi[1]

[1]Department of Otorhinolaryngology, College of Medicine, University of Ibadan and University College Hospital, Ibadan, Nigeria.
[2]Department of Anaesthesia, College of Medicine, University of Ibadan and University College Hospital, Ibadan, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Authors SAO and OAL did the study design and wrote the protocol. Authors SAO and AAS did the statistical analysis and literature searches while analyses of study were by authors SAO and AAS. Authors SAO, AAS and OAL wrote the first draft of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2016/22689
Editor(s):
(1) Xin-an Liu, Neuroscience Department, The Scripps Research Institute, Scripps, Florida, USA.
Reviewers:
(1) Sharmishtha S. Deshpande, Smt. Kashibai Navale Medical College and General Hospital, Pune, India.
(2) Marcos Cezar Ferreira, Universidade Severino Sombra, Brazil.
(3) Ernst Glenda, University of Buenos Aires, Argentina.
Complete Peer review History: http://sciencedomain.org/review-history/12762

Original Research Article

Received 20th October 2015
Accepted 8th December 2015
Published 22nd December 2015

ABSTRACT

Aims: Narrowing of the upper airway during sleep causes snoring, hypoventilation and decreased oxygenation of the brain with recurrent arousal from sleep and a cascade of excessive daytime sleepiness, poor concentration in class and undesirable academic performance. This study determined the prevalence of day time sleepiness among students in secondary schools in Ibadan and establishes its association with body mass index, tonsil size, Mallampati score, and academic performance.
Study Design: A prospective, cross sectional community based study.
Place and Duration of Study: Ibadan town, Nigeria between August 2013 and July 2014.
Methodology: This school-based cross-sectional study recruited the students by systematic random sampling technique. The participants answered an interviewer assisted structured questionnaire and had clinical examination for structural abnormalities of the oropharynx,

**Corresponding author: E-mail: segunkeyede@yahoo.com;*

Mallampati score, tonsillar grade and the BMI. The academic performances were determined using the overall mean average score of all the subjects offered during the first and second term of the academic session. The test of association between daytime sleepiness and other variables were determined. Statistical analysis of the data was done with Statistical Package for Social Sciences (SPSS) version 16.

Results: There were 493 participants consisting 262 (53.1%) males and 231(46.9%) females (M: F ratio of 1.1:1), the mean age was 12.6 years + 2.6 (range = 9-17 years) and the mean BMI was 22.60 kg/m^2±3.0 (range= 15.7 - 35.2 kg/m^2). Daytime sleepiness was encountered in 56 (11.4%) of the students, this was association with high Mallampati score ($p < 0.001$), high BMI ($p < 0.001$), but had no association with academic performance ($p = 0.54$), tonsillar enlargement ($p = 0.35$), gender (0.82) and overnight sleeping duration ($p = 0.21$).

Conclusion: The prevalence of daytime sleepiness among the secondary school students was 11.4%, and had no associated with academic performance. High BMI and Mallampati score were the significant risk factors identified.

Keywords: Daytime sleepiness; secondary school students; academic performance; mallampati score; Tonsil size.

1. INTRODUCTION

Obstructive hypoventilation during sleep is the resultant effect of upper airway muscle hypotonia coupled with the pull of gravity in the supine position which further decreases airway patency, thus impeding air flow during respiration [1]. Partial obstruction may occur and lead to snoring but as the tissues collapse further, the airway may become completely obstructed, with reduction in arterial oxygen level and a rise in carbon dioxide tension [2]. The patient struggles to breathe and is aroused from sleep [2]. Multiple arousals with sleep fragmentation cause excessive daytime sleepiness [3], and such an individual often complain of unrestful sleep. Upper airway obstruction can occur from oropharyngeal crowding, arising from the enlargement in the size of the soft palate, tongue, receding jaw that results in insufficient room for the tongue [4]. These anatomic abnormalities decrease the cross-sectional area of the upper airway, and` obstruction can occur in areas of the nasopharynx, oropharynx and hypopharynx. More commonly, airway obstruction occurs in the oropharynx [5], where redundant parapharyngeal tissue and high Mallampati score reduces the size of the airway.

Patients with upper air way obstruction during sleep often have poor memory, impaired concentration, poor academic performance, behavioral and cognitive deficits [6-8]. The aim of this work is to find the prevalence of day time sleepiness among students in secondary schools in Ibadan and determine its association with body mass index, tonsil size, Mallampati score, and its impact on academic performance.

2. METHODS AND MATERIALS

2.1 Study Design

This study was a community based observational, cross-sectional study of secondary school students in Ibadan. Out of the 11 local government areas in Ibadan, two local governments' areas were selected at random by balloting; Ibadan North and Ibadan South West local government areas where the study was carried out.

Following this, a simple random sampling technique was used to select 10 public secondary schools in the two local government areas (5 in each local government area) and students in the selected schools were recruited using multistage random sampling technique: alternate blocks of classroom were selected for the study in each secondary school and the participants in selected classrooms were recruited by asking the students to pick a ballot - yes or no. Thirty three participants that pick yes were recruited in each School. Ethical approval was obtained from the ethics committee of Oyo State Ministry of Health, Nigeria and permission to conduct the study was also obtained from the school authorities before the conduct of the study, and informed consent was given by the participant's parents/guardians.

2.2 Data Collection and Procedure

A thorough history as preliminary assessment to the inclusion and exclusion criteria was done in the study participants. Thereafter the participants were assisted to answer the structured questionnaire on dependable variables such as

age, gender, daytime sleepiness, lifestyle factors and some related aspects of sleep: Onset of daytime sleepiness complaint and use of sleeping pills.

The Epworth Sleepiness Scale (ESS) is a screening tool for measuring the degree of daytime sleepiness, it consist of questions about the likelihood of dozing in any of these 8 situations: Sitting and reading, watching TV, sitting, inactive in a public place (e.g. a theater or a meeting), as a passenger in a car for an hour without a break, lying down to rest in the afternoon when circumstances permit, sitting and talking to someone, sitting quietly after a lunch without alcohol, in a car while stopped for a few minutes in the traffic. Response categories include: 0 (would never doze), 1 (slight chance of dozing), 2 (moderate chance of dozing), and 3 (high chance of dozing). Subjects are instructed to respond specifically in relation to dozing off, as opposed to just feeling tired [9].

The questionnaires were administered in face to face interviews, which took place in the participant's school, and all the participants had detailed clinical examination performed by the same Otorhinolaryngologist. The degree of oropharyngeal crowdedness was measured using Mallampati scoring method and tonsillar enlargement. Mallampati score of I and II were considered normal (low grade) while Mallampati III and IV were abnormal (high grade) [10]. Tonsils which extended medially beyond the medial border of the anterior tonsillar pillars were considered enlarged (Brodsky tonsillar grade I-IV) [11]. Other structural anomalies of the soft palate and uvula, retrognathia and macroglossia that may contribute to upper air way obstruction during sleep were noted. Anthropometric measurements of weight, height and the body mass indices were determined. In this study, the socio economic status was assessed by the parent`s or the guardian`s occupation [12]. The academic performance was assessed using the mean average score of all the subjects in the individual classes. The average score of each student in individual classes from each school was grouped into percentiles. A score of 50th percentile and above was considered as a good academic performance while a score below the 50th percentile was considered as poor academic performance. Statistical analysis of the obtained data was carried out using the Statistical Package for Social Sciences (SPSS) version 16. The association between excessive daytime sleepiness and other variables were determined, and the level of statistical significance was set at p value < 0.05 and 95% confidence interval.

3. RESULTS

The consent forms signed by the parents/guardians were returned by 493 (82.2%) students out of 600 Students who were recruited, and they completed the study, of which 262 (53.1%) were males and 231(46.9%) were females with male to female ratio of 1.1:1. The age ranged from 9 to 17 years (mean age of 12.6 year±2.6). Daytime sleepiness was encountered among 11.4% participants. The gender (p = 0.83) and age (p= 0.12) had no association with occurrence of daytime sleepiness in this study.

The students were from different socioeconomic background. Thirty four (6.9%) were from high socioeconomic class, and 17.6 % (6 vs. 34) of them had daytime sleepiness, 249(50.55%) were from middle class and daytime sleepiness occurred in 11.2% (28 vs. 249) of them. While 10.4% of the students (22 vs. 210) in low socioeconomic class had daytime sleepiness. There was no association between daytime sleepiness and socioeconomic class (p = 0.47), although there were more participants in high Socioeconomic class with day time sleepiness.

The body mass indices of the participants ranged from 15.7 kg/m^2 to 35.2 kg/m^2 (mean of 22.60 kg/m^2±3.0). The BMI was 22.7 kg/m^2 ±3.2 and 22.4 kg/m^2±2.8 for males and females respectively. The mean BMI was significantly higher among students with daytime sleepiness, 25.2 kg/m^2 ± 4.9 than those without day time somnolence, 22.2 kg/m^2±2.5(p<0.001). as shown in Table 1. There was no association between BMI, age (p = 0.59) and gender (p = 0.26).

Table 1. Daytime sleepiness and Body Mass Indices

Daytime sleepiness	Underweight	Normal weight	Over weight	Obesity	Morbid obesity	Total
No	27(5.5%)	369(74.8%)	40(8.1%)	1(0.2%)	0(0.0%)	437(88.6%)
Yes	0(0.0%)	34(6.9%)	10(2.0%)	9 (1.8%)	3(0.6%)	56(11.4%)
Total	27(5.5%)	403(81.7%	50(10.1%)	10(2.0%)	3(0.6%)	493(100.0%)

p < 0.001 (Proportion of daytime sleepiness increase with increase in BMI and it is significant)

Similarly, the mean Mallampati score was significantly higher among the participants with daytime sleepiness compared with those without daytime sleepiness ($p < 0.001$) as shown in Table 2.

Three hundred and eighteen (64.5%) participants had no tonsillar enlargement, while grade 1 tonsillar enlargement was observed in 89 (18.1%) participants, grade II and III were observed in 68 (8.1%) and 16 (2.5%) of the participants respectively, while 2 (0.4%) of the participants had grade 4 tonsillar enlargement. There was no association between daytime sleepiness and tonsillar grade in this study ($p = 0.35$).

Four hundred and eighteen (84.8%) students had good academic performance while 75(15.2%) had poor performance as shown in Table 4. The prevalence of daytime sleepiness among the students with good academic performance was 11.5% (48 vs. 418), and it was 10.7% (8 vs. 75) among students with poor academic performance. There was no association between daytime sleepiness and poor academic performance ($p = 0.23$).

Table 2. Mallampati score and daytime sleepiness

Daytime sleepiness	Mallampati score		Total
	Low	High	
No	283 (57.4%)	154 (31.2%)	437 (88.6%)
Yes	15 (3.0%)	41 (8.4%)	56 (11.4%)
Total	298 (60.4%)	195 (39.6%)	493 (100.0%)

p < 0 .001 (occurrence of daytime sleepiness is higher among those with high Mallampati score and it is significant

Table 3. Daytime sleepiness and tonsillar grade

Tonsillar enlargement	Daytime sleepiness		Total
	No	Yes	
No	285(57.8%)	33(6.7%)	318(64.5%)
Yes	152(30.8%)	23(4.7%)	175(35.5%)
Total	437(88.6%)	56(11.4%)	493(100.0%)

p = 0.35

Table 4. Daytime sleepiness and academic performance

Academic performance		No daytime sleepiness	Daytime sleepiness	Total
Grade	Percentile			
Grade A (Excellent)	(≥70%)	62(12.6%)	9(1.8%)	72(14.4%)
GRADE B(Very Good)	(56-69%)	61(12.4%)	4(0.8%)	65(13.2%)
GRADE C (Good)	(50-55%)	246(49.9%)	35(7.1%)	281(57.0%)
GRADE D (fair)	(46-49%)	23(4.7%)	5(1.0%)	28(5.7%)
GRADE E (poor)	(40-45%)	23(4.7%)	2(0.4%)	25(5.1%)
GRADE F (Fail)	(<40%)	22(4.5%)	1(0.2%)	23(4.7%)
Total		437(88.6%)	56(11.4%)	493(100.0%)

X2 = 6.849, df= 5; P = 0.23

Table 5. The participants' academic level and daytime sleepiness

Participants academic level	Daytime sleepiness		Total
	No	Yes	
JSS1 (Junior secondary school class 1)	68(13.8%)	19(3.9%)	87(17.6%)
JSS2 (Junior secondary school class 2)	75(15.2%)	8(1.6%)	83(16.8%)
JSS3 (Junior secondary school class 3)	88(17.8%)	7(1.4%)	95(19.3%)
SS1 (Senior secondary school class 1)	88(17.8%)	4(0.8%)	92(18.7%)
SS2 (senior secondary school class 2)	60(12.2%)	9(1.8%)	69(14.0%)
SS3 (Senior secondary school class 3)	58(11.8%)	9(1.8%)	67(13.6%)
Total	437(88.6%)	56(11.4%)	493(100.0%)

p = 0.007

Out of the Seventy five students that had poor academic performance; 65 (86.6%) of the students slept less than 10 hours in overnight sleep (p = 0.109), while 36(48%) of the students with poor academic performance were from low economic class (p = 0.142). Four (7.1%) students with daytime sleepiness used stimulants to stay awake.

There is a significant association between daytime sleepiness and the academic class of the participants (p = 0.007), participants in junior classes experienced daytime sleepiness more than those in higher classes.

4. DISCUSSION

Secondary school students are a unique population of adolescents, passing through a variety of dramatic bio-psychosocial transitions from childhood to adulthood [13]. They are affected by sleeping problems and this result in loss of productivity [14]. In this study 11.4% had daytime sleepiness; this is within the prevalence of 6% to 12% among the general population that regularly experiences subjective sleepiness, as measured with the Epworth Sleepiness Scale [15]. The prevalence of 11.2% and 15.9 % were observed among students' in high school in South Korea [16,17], which is similar to the finding in this study, however the prevalence in this study is lower than 25.2% and 28.6% among secondary school students in Japan and Spain respectively [18,19]. This difference might be due to the difference in the age group of the participants. Students in junior classes were studied in Japan and students in class one and four of the high school were studied in Spain while those in class 5 of the high school were studied in South Korea, unlike this study that evaluated all the age groups of students in all the classes in the secondary schools.

Daytime sleepiness occurred more among the students in the junior secondary classes than those in senior classes in this study, unlike the study by Garcia et al. [19]. who observed excessive daytime sleepiness among senior classes. In this study, daytime sleepiness had no association with gender, though previous studies observed that males have a larger change in pharyngeal area with changing lung volume than females, thus a greater tendency for the airway to collapse [20] and consequence day time sleepiness [21].

The occurrence of daytime sleepiness increase with increasing BMI (p < 0.001) and this is in agreement with previous studies [15,22], probably because obese people have excess fat deposition around the neck/ pharynx which contribute to the reduction in pharyngeal airway diameter during sleep and obstructive sleep apnoea (OSA), with consequent day time sleepiness [23]. Age has no association with BMI and daytime sleepiness in this study probably because the participants are within the same age group, though studies had shown that BMI increase with increasing age, [24] and Upper air way collapsibility worsen with aging due to preferential deposition of fat around the pharynx with aging, independent of systemic fat, and deterioration in the genioglossus negative pressure reflex with aging [25,26]. There was no association between gender BMI, and daytime sleepiness in this study, this may be due to the fact that in adolescent period both males and females gains weight rapidly. Study had shown that boys experience lengthening of their airway during puberty compared with girls, independent of systemic growth [27], also elevated hormonal level of androgen leads to increase soft tissue deposition in the pharynx [28,29], and these change the size and compliance characteristics of the pharyngeal airway, making it more likely to collapse. Obesity and male gender is a risk factor for obstructive sleep apnoea and consequence daytime sleepiness. Although obesity is more prevalent in females [30]; it has been described that the prevalence of OSA is higher in males. The male predisposition has been attributed to inherent structural and functional differences in upper airway during sleep between males and females with more favorable airway mechanics in females [31], also there is more fat deposition around the pharyngeal airway in males than in females, as well as hormonal differences.

High Mallampati score was encountered among students with daytime sleepiness than those without daytime sleepiness in this study (p < 0 .0001). The high Mallampati score is indicative of upper airway obstruction during sleep with resultant obstructive sleep apnea, ineffective sleep and resultant daytime sleepiness [32]. Mallampati score changes with posture due to the change in anatomical structures; it is higher in the supine position while sleeping compared to the upright position [33], and thus contributing to retropalatal obstruction during sleep [34]. This might result in obstructive hypoventilation during sleep in individuals with previously low Mallampati scores, with consequent daytime sleepiness. Daytime Sleepiness was encountered in 15 (3.0%) students with low Mallampati score

in this study, probably due to variation in Mallampati score with different posture during sleep.

This study found no association between daytime sleepiness and tonsillar size, probably because few of the students had tonsillar enlargement, though Acar et al. [33] revealed that the grade of the tonsillar hypertrophy correlate with severity of obstructive hypoventilation. Similarly, Acer et al. [33] and Friedman et al. [35] and shows a positive association between tonsillar enlargement and upper airway obstruction during sleep. The method of accessing tonsillar size and Mallampati scoring is subjective and this makes it difficult to compare the results of different investigators.

Despite long overnight sleeping hours, some of the students had daytime sleepiness; this may be due to insufficient refreshing sleep at night from repeated awakenings from airway obstruction and hypoxemia. Nevertheless, some students with short overnight sleeping time (4-6hours) did not experience daytime sleepiness, this may be due to the fact that the inadequate sleep is not the only factor responsible for daytime sleepiness and these students might have had adequate refreshing sleep without any upper airway obstruction within the short hour of sleep. Inadequate sleep in addition to resultant excessive daytime sleepiness is associated with impaired academic performance [36]. Amigo et al. [37] observed that daytime sleepiness is a significant predictor of academic performance among secondary school students and this association can potentially be bi-directional as poor academic performance may adversely affect sleep through concomitant stress or other mechanisms. However, there was no association between daytime sleepiness and academic performance ($p = 0.23$) in this study. The non-association of daytime sleepiness with academic performance in this study may be due to the fact that other factors influence the academic performance such as parental educational level, school environment, childhood mental health problems and the individual intelligent ability which cannot be controlled in this study.

There was no association between daytime sleepiness and socioeconomic class ($p = 0.47$) in this study probably because few students from high socioeconomic class participated in the study, however Jarrin et al. [38], observed that socioeconomic class is inversely associated with sleep duration and daytime sleepiness in children, because children from low socioeconomic family are prone to stress and have poor quality of sleep at night.

5. LIMITATIONS

The use of questionnaire to access daytime sleepiness in this study might be fraught with some probability of under-reporting compared to method such as direct observation and corroboration of daytime sleepiness with relations which provide objective assessment of daytime sleepiness sleep, also sleep endoscopy study was not used to confirm upper airway obstruction during sleep which may cause OSA with consequences daytime sleepiness. Depression, anxiety disorder, childhood mental health problems and psychosocial problems were not accessed in these children, and they might be an important contributing factor to daytime sleepiness. However our impression is that despite these, the data were not significantly affected by the limitations and this study has been able to provide a template data in black Africans, on daytime sleepiness among secondary schools students in Nigeria on which further research may be built.

6. CONCLUSION

In conclusion, the prevalence of daytime sleepiness among Nigerian secondary school students was 11.4%. Daytime sleepiness was associated with increase in BMI and high Mallampati score, but not associated with poor academic performances, tonsillar enlargement and overnight sleeping duration.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Marcus CL, McColley SA, Carroll JL, Loughlin GM, Smith PL, Schwartz AR. Upper airway collapsibility in children with obstructive sleep apnea syndrome. J Appl Physiol. 1994;77:918–24.
2. Lyle DV. Obstructive sleep apnea. Am Fam Physician. 1999;60:2279-2375.
3. Colt HG, Haas H, Rich GB. Hypoxemia vs sleep fragmentation as cause of excessive daytime sleepiness in obstructive sleep apnea. Chest. 1991;100:1542-1550.

4. Lowe AA, Ono T, Ferguson KA, Pae EK, Ryan CF, Fleetham JA. Cephalometric comparisons of craniofacial and upper airway structure by skeletal subtype and gender in patients with obstructive sleep apnea. Am J Orthod Dentofacial Orthop. 1996;110:653-64.
5. Donnelly LF. Obstructive sleep apnea in pediatric patients: Evaluation with cine MR sleep studies. Radiology. 2005;236:768-778.
6. Young T, Finn L, Peppard PE. Sleep disordered breathing and mortality: Eighteen-year follow-up of the Wisconsin sleep cohort. Sleep. 2008;31(8):1071-1078.
7. Blunden S, Lushington K, Kennedy D, Martin J, Dawson D. Behavior and neurocognitive performance in children aged 5–10 years who snore compared to controls. J Clin Exp Neuropsychol. 2000; 22:554–568.
8. Gozal D, Pope DW Jr. Snoring during early childhood and academic performance at ages thirteen to fourteen years. Pediatrics. 2001;107:1394–1404.
9. Murray W. Johns - A new method for measuring daytime sleepiness: The Epworth Sleepiness Scale – Sleep. 1991; 14:540-545.
10. Mallampati SR, Gatt SP, Gugino LD. A clinical sign to predict difficulty intubation; A prospective study. Can Anaesth. Soc. J. 1985;32:429-463.
11. Brodsky L. Modern assessment of tonsils and adenoids. Pediatr Clin North Am. 1989;36(6):1551-1569.
12. Famuyiwa OO, Olorunshola DA, Derin A.Some family factors in Sickle cell anaemia in Lagos, Nigeria. Nig Med Practitioner. 1998;35:70-73.
13. Joffe A. Why adolescent medicine? Med Clin North Am. 2000;84:769–85
14. Shapiro CM, Dement WC. Impact and epidemiology of sleep disorders. B.M.J. 1993;306:1604-1607.
15. Panossian LA, Veasey SC. Daytime sleepiness in obesity: Mechanisms beyond obstructive sleep apnea. Sleep. 2012; 35(5):605-615.
16. Joo S, Shin C, Kim J, Yi H, Ahn Y, Park M, Kim J, Lee S. Prevalence and correlates of excessive daytime sleepiness in high school students in Korea. Psychiatry Clin Neurosci. 2005;59(4):433-440.
17. Kwisook Choi, Hyunsook Son, Myunghee Park, Jinkyu Han, Kitai Kim, Byungkoo Lee, Hyesun Gwak Pharmd. Internet overuse and excessive daytime sleepiness in adolescents. Psychiatry and Clinical Neurosciences. 2009;63(4):455–462.
18. Alexandru Gaina, Michikazu Sekine, Shimako Hamanishi, Xiaoli Chen, Hongbing Wang, Takashi Yamagami, Sadanobu Kagamimori. Daytime sleepiness and associated factors in Japanese school children. Journal of Pediatrics. 2007;151(5):518-522.
19. García-Jiménez MA, Salcedo-Aguilar F, Rodríguez-Almonacid FM, Redondo-Martínez MP, Monterde-Aznar ML, Marcos-Navarro AI, et al. The prevalence of sleep disorders among adolescents in Cuenca, Spain. Rev Neurol. 2004; 39(1):18-24.
20. Whittle AT, Marshall I, Mortimore IL, Wraith PK, Sellar RJ, Douglas NJ. Neck soft tissue and fat distribution: Comparison between normal men and women by magnetic resonance imaging. Thorax 1999;54:323–328.
21. Perez-Chada D, Perez-Lloret S, Videla AJ, Cardinali D, Bergna MA, Fernández-Acquier M, Larrateguy L, Zabert GE, Drake C. Sleep disordered breathing and daytime sleepiness are associated with poor academic performance in teenagers. A study using the pediatric daytime sleepiness scale (PDSS). Sleep. 2007;30 (12):1698-1703.
22. Gemma Slater, Martino F. Pengo, Chris Kosky, Joerg Steier. Obesity as an independent predictor of subjective excessive daytime sleepiness. Respiratory Medicine. 2013;(107)2:305-309.
23. Bloom JW, Kaltenborn WT, Quan SF. Risk factors in a general population for snoring: Importance of cigarette smoking and obesity. Chest. 1988;93:678-683.
24. Ogunkeyede SA, Fasunla AJ, Arulogun OS, Lasisi OA. Association between snoring and indices of oropharyngeal space among adult in a community in South West Nigeria Journal of Rhinolaryngo-Otologies. 2014;2(2):28-33.
25. Jordan AS, Eckert DJ, Catcheside PG, McEvoy RD. Ventilatory response to brief arousal from non-rapid eye movement sleep is greater in men than in women. Am J Respir Crit Care Med. 2003;168:1512–1519.
26. Martin SE, Mathur R, Marshall I, Douglas NJ. The effect of age, sex, obesity and

posture on upper airway size. 1997;10: 2087–2090.
27. Lowe AA, Ono T, Ferguson KA, Pae EK, Ryan CF, Fleetham JA. Cephalometric comparisons of craniofacial and upper airway structure by skeletal subtype and gender in patients with obstructive sleep apnea. Am J Orthod Dentofacial Orthop. 1996;110:653-64.
28. Matsumoto AM, Sandblom RE, Schoene RB. Testosterone replacement in hypogonadal men: Effects on obstructive sleep apnoea, respiratory drives, and sleep. Clin Endocrinol. 1985;22:713–721.
29. Mohamed G, Lopata M, Kukreja J, Schraufnagel D. Androgen levels in women with sleep apnea syndrome. Am Rev Respir Dis. 1983;127:237-241.
30. Pudrovska T, Reither EN, Logan ES, Sherman-Wilkins KJ. Gender and reinforcing association between socioeconomic disadvantage and body mass over the life course. Journal of Health and Social Behavior. 2014; 55(3):283.
31. Mohsenin V. Gender differences in the expression of sleep-disordered breathing: Role of upper airway dimensions. Chest. 2001;120(5):1442-1447.
32. Tham EJ, Gildersleve CD, Sanders LD, Mapleson WW, Vaughan RS. Effects of posture, phonation and observer on Mallampati classification. Br J Anaesth. 1992;68:32-38.
33. Acar B, Babademez MA, Karabulut H, Ciftçi B, Günbey E, Karaşen RM. Otorhinolaryngologic examination in obstructive sleep apnea syndrome: The correlation between the severity of sleep disorder and physical examination. Kulak Burun BogazIhtis Derg. 2009;19(5):246-298.
34. Redline S, Leitner J, Arnold J, Tishler PV, Altose MD. Ventilatory-control abnormalities in familial sleep apnea. Am J Respir Crit Care Med. 1997;156: 155–160.
35. Friedman M, Tanyeri H, LaRosa M, Landsberg R, Vaidyanathan K, Pieri S, et al. Clinical predictors of obstructive sleep apnea. Laryngoscope. 1999;109:1901-1907.
36. Wolfson AR, Carskadon MA. Sleep schedules and daytime functioning in adolescents. Child Dev. 1998;69:875-887.
37. Amigo H. Obesity in Latin American children: Situation, diagnostic criteria and challenge. Cad Saude Publica. 2003; 19(1):16370-16371.
38. Jarrin DC, Objective and subjective socioeconomic gradients exist for sleep in children and adolescents. Health. Psychol. 2014;(33):30-35.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/12762