International Journal of TROPICAL DISEASE & Health
12(1): 1-7, 2016, Article no.IJTDH.22210
ISSN: 2278–1005, NLM ID: 101632866

SCIENCEDOMAIN *international*
www.sciencedomain.org

Daytime Sleepiness among Healthy Adults in South West Nigeria

Ogunkeyede Segun Ayodeji[1*], Fasunla Ayotunde James[1], Arulogun S. Oyedunni[2] and Lasisi Olawale Akeem[2]

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

Authors' contributions

This work was carried out in collaboration between all authors. Authors OSA and ASO did the study design and wrote the protocol. Authors FAJ, OSA and LOA did the statistical analysis and literature searches while analyses of study were by authors OSA and ASO. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJTDH/2016/22210
Editor(s):
(1) C. H. Chu, University of Hong Kong, China.
Reviewers:
(1) Daniela Martins de Souza, Christian Life University Foundation (FUNVIC), Brazil.
(2) Carolina Baraldi Araujo Restini, University of Ribeirão Preto, Brazil.
Complete Peer review History: http://sciencedomain.org/review-history/12044

Original Research Article

Received 23rd September 2015
Accepted 16th October 2015
Published 30th October 2015

ABSTRACT

Aims: Obstruction of the upper airway during overnight sleep is associated with non-refreshing sleep and daytime sleepiness. This may be an antecedent to accidents, declining quality of life, poor concentration, as well as poor academic and work performance. This study determined the prevalence and risk factors for daytime sleepiness among healthy adults in a rural community of South-west Nigeria.
Study Design: A prospective, cross sectional community based study.
Place and Duration of Study: Oyo town, Nigeria between August 2012 and June 2013.
Methodology: Households and adults in the community were selected by multistage random sampling technique. Data on demographics, snoring, and subjective sleepiness (using Epworth Sleeping Scale) were obtained. Mallampati score, tonsillar grade and body mass index of each participant was determined. Statistical analysis was done and level of significance was $p < 0.05$.

**Corresponding author: Email: segunkeyede@yahoo.com;*

Results: There were 408 participants consisting 202 (49.5%) males and 206 (50.5%) females, age ranged from 18 to 82 years with mean of 37 years ±15.2. Only 191 (46.8%) participants snored while daytime sleepiness was observed in 113 (27.70%) participants. Forty two (10.30%) participants had enlarged tonsils. Only 165 (40.4%) participants had high Mallampati score. Mean Body Mass Index for male was 23.79 kg/m^2 ±3.93 and female was 24.86 kg/m^2 ±4.90. Daytime sleepiness was significantly associated with increased age ($p = 0.0018$), female gender ($p = 0.048$), enlarged tonsils ($p < 0.013$), snoring ($p < 0.001$), high Mallampati score ($p < 0.001$) and high body mass index ($p = 0.014$), but no association with overnight sleeping duration ($p = 0.138$).
Conclusion: There prevalence of excessive day time sleepiness is high among the adults in Oyo community, Nigeria and factors associated with narrowed upper airway predispose to daytime sleepiness. Therefore, there is a need for public awareness on its implication on health, productivity and safety.

Keywords: Daytime sleepiness; enlarged tonsil; Mallampati score; obesity; snoring.

1. INTRODUCTION

Sleep is essential for good health and growth. Daytime sleepiness, or difficulty in maintaining a desired level of wakefulness during the day, is a predictable consequence of non-refreshing overnight sleep that can have a serious impact on an individual's health, safety, and quality of life [1]. It is a serious concern at workplaces with its negative effects on productivity and professional relationship [2].

Excessive daytime sleepiness (EDS) is frequent episodes of sleepiness during the day with significant impact on usual activities [3]. It is a symptom of obstructive sleep apnea (OSA), [4] a disorder characterized by loud, habitual snoring, apnea, hypoxaemia, sleep disturbance (fragmented sleep/ sleep deprivation) and excessive daytime sleepiness [5]. Individuals with inadequate sleep are often unaware of the deterioration in their cognitive and general performance [6,7]. This differs from chronic insomnia where the sufferer experience night and daytime hyper arousal rather than excessive daytime sleepiness [8]. Increased age, neck and trunk obesity as well as oropharyngeal crowdedness are risk factors for OSA [9].

Excessive daytime sleepiness can be incapacitating like in an intoxicated individual. It can also adversely affect daily activities [10]. Reduced alertness caused by the daytime sleepiness could predispose an individual to accidents, reduce productivity, decline quality of life, impairs concentration and reduce cognitive function. They easily make mistakes and forget instructions on the job, hence assumed to be unproductive, lazy employees [11-13].

This study was therefore carried out to determine the prevalence of excessive daytime sleepiness among healthy adults in a rural community of South-west Nigeria and to identify the underlying risk factors for it.

2. MATERIALS AND METHODS

2.1 Study Design

This was an observational, cross-sectional, community-based study of apparently healthy adults in households selected by stratified random sampling technique. The study was carried out in Oyo town with a population of 428,798 [14]. Approval was obtained from the ethics committee of Oyo State Ministry of Health, Nigeria before the conduct of the study. Written permission from the community leaders and informed consent form each participant was also obtained.

2.2 Data Collection and Procedure

Fifty percent of the thirty electoral wards in the community were selected by multistage random sampling technique. A total of 420 housing units were selected, by stratified random sampling technique from the 15 electoral wards. The individuals from each household were randomly selected by balloting for the interview. The participants were males in houses with even number while they were females in houses with odd numbers. The participants were then classified as non-snorers (no history of snoring), Non- habitual snorers (snore for ≤ 3times/week), and habitual snorers (snore for more than 3 times/week) [15,16].

2.2.1 Structured questionnaires

Structured questionnaires was administered to obtain information on the participant's socio-

demography, occupation, alcohol, cigarettes and drug use, approximate overnight duration of sleep, snoring, apnea and excessive daytime sleepiness (EDS). The roommates answered questions on snoring and apnea (cessation of breathe during sleep). The participant's socio-economic status was assessed by their occupation [17]. The excessive daytime sleepiness (EDS) was assessed on Epworth Sleepiness Scale (ESS) [18] and a participant with a total score of ≥ 11 has EDS and was advised to consult a specialist. The Epworth's scale assess the degree of daytime sleepiness, it is made up of eight questions about the person's level of subjective daytime sleepiness in given daily activities. The scale goes from 0 to 24: daytime sleepiness is considered when the score is higher than 10 points.

2.2.2 Anthropometric measurements

The weight (kilogram) and height (meter) were measured and body mass indices (BMI) calculated. The BMI was defined as healthy weight (BMI <25 kg/m^2), overweight (BMI ≥25 kg/m^2 and <30 kg/m^2), and obese (BMI ≥30 kg/m^2) [19].

2.2.3 ENT examination

The oral cavity and oropharynx of all the participants were examined by the same otolaryngologist. The degree of oropharyngeal crowdedness was measured using Mallampati scoring method and tonsillar enlargement [20,21]. Mallampati score of I and II were considered normal while Mallampati III and IV were abnormal. Tonsils, which extended medially beyond the medial border of the anterior tonsillar pillars were considered enlarged (Brodsky tonsillar grade I-IV).

2.3 Statistical Analysis

Data obtained from the study was collated and presented in a simple format. Demographic data and clinical variables were presented using percentages, tables and charts as appropriate while summary statistics were done using means and proportions. Statistical analysis of the obtained data was carried out using the Statistical Package for Social Sciences (SPSS) version 16. Chi square test was used to determine the association between excessive daytime sleepiness and other variables and the level of statistical significance was set at p value < 0.05 and 95% confidence interval.

3. RESULTS

Four hundred and eight participants completed the study; consisting 202 (49.5%) males and 206 (50.5%) females with male to female ratio of 1:1. The age ranged from 18 to 82 years with mean age of 37.0 years ±15.23. The overnight duration of sleep ranged from 4 to 11 hours, with a mean duration of 8.2 hours ±1.2. There were 113 (27.70%) participants with excessive daytime sleepiness, with a prevalence of 32.01% among females (66 vs. 206) and 23.26% among males (47 vs. 202), and only 4.44% of them had sleep duration of < 6 hours / night on most days. There was no significant association between duration of overnight sleep and excessive daytime sleepiness (p = 0.179). The ages of the participants with excessive day time sleep ranged from 19 years to 82 years (mean age 48.44 years ±13.39. Excessive daytime sleepiness was found in 24.8% snorers and 2.9% non-snorers. The mean ESS score in habitual snorers was 10.64±3.86 while it was 9.76±4.83 in non- habitual snorers. There was a statistical significant association between excessive daytime sleepiness and snoring (p < 0.001); gender (p = 0.048) and age (p < 0.001). The distribution of the participants' ESS is shown in Table 1.

Table 1. The participants Epworth Sleeping Scale score

Epworth scoring score	Frequency	Percentage (%)
0 – 5 (Supernormal)	152	37.3
6 – 10 (Normal)	143	35.0
11 -15 (Sleepy)	102	25.0
16 – 20 (Very sleepy)	11	2.7
>20 (Dangerously sleepy)	0	0
Total	408	100.0

There were 165 (40.4%) participants with high Mallampati score and 64 (15.7%) of them experienced excessive daytime sleepiness. Of the 115 (28.2%) participants with tonsillar enlargement, only 42 (37.2%) of them experienced excessive daytime sleepiness while 71 (17.4%) of the 293 with no tonsillar enlargement have EDS. The risk factors for daytime sleepiness are shown in Table 2.

There were more participants with excessive daytime sleepiness as the body mass index increases and this observation was statistically significant (p = 0.014).

Table 2. Risk factors for daytime sleepiness

		Daytime sleepiness		Total	p - value
		Yes	No		
Gender	Male	47 (11.5%)	155 (38.0%)	202 (49.5%)	p = 0.048
	Female	66 (16.2%)	140 (34.3%)	206 (50.5%)	
	Total	113 (27.7%)	295 (72.3%)	408 (100.0%)	
Tonsillar enlargement	Yes	42 (10.3%)	73 (17.9%)	115 (28.2%	p = 0.013
	No	71 (17.4%)	222 (54.4%)	293 (71.8%)	
	Total	113 (27.7%)	295 (72.3%)	408 (100.0%)	
Mallampati score	High	64 (15.7%)	101 (24.8%)	165 (40.4%)	p < 0.001
	Low (normal)	49 (12.0%)	194 (47.5%)	243 (59.6%)	
	Total	113 (27.7%)	295 (72.3%)	408 (100.0%)	
Snoring	Snorers	101 (24.8%)	90 (22.0%)	191 (46.8%)	p < 0.001
	Non-snorers	12 (2.9%)	205 (50.3%)	217 (53.2 %)	
	TOTAL	113 (27.7%)	295 (72.3%)	408 (100%)	
BMI	Under weight	0 (0.0%)	11 (2.7%)	11 (2.7%)	p = 0.014
	Normal weight	59 (14.4%)	197 (48.3%)	256 (62.7%)	
	Overweight	26 (6.4%)	66 (16.2%)	92 (22.5%)	
	Obese	18 (4.4%)	21 (5.1%)	39 (9.6%)	
	Morbidly obese	10 (2.5%)	0 (0.0%)	10 (2.5%)	
Total		113 (27.7%)	295 (72.3%)	408 (100.0%)	

The proportion of participants with daytime sleepiness increases with age, with a peak at 7th decade of life, p =0.001 as shown the in Table 3.

4. DISCUSSION

There are few epidemiological studies on sleep loss at night and excessive daytime sleepiness in the general adult population in Nigeria [22,23]. Previous studies were done among sections of the people in the community; commercial drivers and among patients in the hospital, but this study cross across all apparently healthy adults in the community. In this present study, the prevalence of excessive daytime sleepiness was 27.70%. This is higher than the prevalence from the earlier study in Nigeria which reported 14.4% [22]. The prevalence is also higher than 16.8% in Brazil[2] and 15% in Japan [24]. In similar studies from America, one in every five adults investigated had excessive daytime sleepiness [25,26]. The EDS prevalence in earlier study among male commercial drivers may be lower than this study because, these drivers routinely abuse psychostimulants that keep them awake and active during the day. This present study also included female gender, which was not investigated in the previous study. Studies have shown that females experienced EDS more than men and the finding is similar to what was found in this study [2,27,28]. This may be related to the hormonal changes during menstrual flow, pregnancy and lactation. High oestrogen and oxytocin in women could cause mucosal oedema and hyper-secretion with resultant upper airway resistance [29]. In addition, the sedentary lifestyle among the participants from this study could make them easily fall asleep during the day hence the higher prevalence reported than what was reported in America, Brazil and Japan where the people do more attention required work, and consume psycho-stimulants such as coffee and smoke cigarette.

Insufficient overnight sleep is a risk factor for excessive day time sleepiness. Even though excessive daytime sleepiness was present in all the age groups in this study, it was more associated with older age groups. This is different from previous study where young age was associated with daytime sleepiness [24,30,31]. Aging is associated with disturbed circadian rhythm with habitual sleeping pattern, disturbed sleep, reduced daytime cognitive performance due to neurophysiological factors [32,33]. Van Cauter et al. [34] observed that the total sleep-time decreased with age from mid-life until the eighth decade, and the elderly have deterioration in both the quality and quantity of sleep. All of these changes can lead to excessive daytime sleepiness.

Daytime sleepiness increases within the group as the participant's age also increases [9,35,36], this was also observed from this present study. This may be because of the rapid weight gain with the age. Bixler et al. [31] reported higher prevalence of EDS in people that are less than 30 years and people older than 75 years. Hara et al. [36] in Brazil reported no association between daytime sleepiness and age.

Table 3. Daytime sleepiness and age

Age	No eds	Eds	Total
18-29	138 (33.8%)	23 (5.6%)	161 (39.5%)
30-39	60 (14.7%)	35 (8.6%)	95 (23.3%)
40-49	33 (8.1%)	30 (7.4%)	63 (15.4%)
50-59	26 (6.4%)	10 (2.5%)	36 (8.9%)
60-69	26 (6.4%)	12 (2.9%)	38 (9.3%)
70-79	3 (0.7%)	3 (0.7%)	6 (1.4%)
80-89	9 (2.2%)	0 (0%)	9 (2.2%)
	295(72.3%)	113(27.7%)	408(100.0%)

X^2 = 38.94; df = 6; p= 0. 001 (proportion of daytime sleepiness increase with age)

Obesity had been reported to significantly contribute to excessive daytime sleepiness [31,37] and the findings from this present study agreed with it, but Dixon et al observed that daytime sleepiness is not associated with the degree of obesity, or anthropometric measurements, but nocturnal sleep disturbance [38]. However daytime sleepiness increases with the degree of obesity in this study. The primary underlying mechanism that makes obese people feel overly tired is chronic inflammation of the fat cells that produce cytokines that promote sleepiness [39]. Obesity is a known risk factor for OSA with resultant sleep-disordered breathing or sleep disruption and day time sleepiness [40]. Obese individuals have fat deposition around the neck/ pharynx which contribute to the upper air way obstruction and generalized hypotonia during sleep [41-44]. The obstruction causes snoring and restlessness or frequent awakening during sleep with accumulation of carbon dioxide with low oxygen concentration in the blood circulation resulting in non-refreshing sleep [45,46]. The metabolic response to hypoxemia arising from airway obstruction might contribute to the long hour of overnight sleep seen in these participants [24]. The higher rate of excessive daytime sleepiness among the habitual snorers than the non-habitual snorers in this study is similar to the report by Takegami et al. [35]. However, the lack of EDS in some patients that snore could be a factor of degree/severity of upper airway obstruction during sleep.

The high Mallampati score and enlarged tonsils observed in some of the participants might have contributed to excessive daytime sleepiness. Previous studies [47,48] reported that high Mallampati score is associated with snoring and sleep apnea.

5. CONCLUSION

Excessive daytime sleepiness is common in the apparently healthy adult in Nigeria and the risk factors included increased BMI, age, female gender, high Mallampati score and tonsillar enlargement. Health education to enlighten the people on the health risk of EDS should be carried out and weight reduction should be part of measure in the management of daytime sleepiness.

CONSENT

The participants gave consent before participating in the study.

ETHICAL APPROVAL

It was obtained before the commencement of the study from Oyo State Ministry of Health.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Young TB. Epidemiology of daytime sleepiness: Definitions, symptomatology, and prevalence. J Clin Psychiatry. 2004; 65(Suppl 16):12-16.
2. Doi Y, Minowa M. Gender differences in excessive daytime sleepiness among Japanese workers. Soc Sci Med. 2003; 56(4):883-894.
3. International classification of sleep disorders ICSD - International classification of sleep disorders, revised: Diagnostic and coding manual. American Academy of Sleep Medicine; 2001.
4. Barcena JA, Fang JC. Diagnosis and treatment of sleep apnea in heart disease. Curr Treat Options Cardiovasc Med. 2007;9:501-509.
5. Report of a task force of the American academy of sleep medicine. Sleep-related

breathing disorders in adults: Recommendations for syndrome definition and measurement techniques in clinical research. Sleep. 1999;22:667-689.

6. Van Dongen H, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: Dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. Sleep. 2003;26(2):117–126.
7. Sforza E, de Saint Hilaire Z, Pelissolo A, Rochat T, Ibanez V. Personality, anxiety and mood traits in patients with sleep-related breathing disorders: Effect of reduced daytime alertness. Sleep Med. 2002;3(2):139–145.
8. Pagel JF. Sleep disorders in primary care: evidence-based clinical practice. In: Pagel JF, Pandi-Perumal SR, eds. Primary Care Sleep Medicine: A Practical Guide. Totowa NJ: Humana Press. 2007;1–14.
9. World Health Organization. Obesity and overweight. Fact sheet 311. September 2006.
   Available:http://www.who.int/mediacentre/factsheets/fs311/en/print.html (Accessed October 27, 2014)
10. Sleep Disorders in Adults Current diagnosis and treatment in Otolaryngology 2nd edition Chapter 40. McGraw-Hill Companies.
11. Grunstein RR, Banerjee D. The case of "Judge Nodd" and other sleeping judges—media, society, and judicial sleepiness. Sleep. 2007;30(5):625–632.
12. Chen I, Vorona R, Chiu R, Ware JC. A survey of subjective sleepiness and consequences in attending physicians. Behav Sleep Med. 2008;6(1):1–15.
13. Gooneratne NS, Weaver TE, Cater JR, Pack FM, Arner HM, Greenberg AS, et al. Functional outcomes of excessive daytime sleepiness in older adults. J Am Geriatr Soc. 200;51(5):642-649.
14. Federal republic of Nigeria official gazette Abuja. 2009;96(2).
15. Fujita S. Pharyngeal surgery for obstructive sleep apnea and snoring. New York: Raven Press. 1987;101.
16. Mary SMI, Bing L, Ian JL, Kenneth WTT, Ka-Fai C, Yuk-Wan M, et al. Community study of sleep-disordered breathing in middle-aged Chinese men in Hong Kong. CHEST. 2001;119:62-69.
17. Famuyiwa OO, Olorunshola DA, Derin A. Some family factors in Sickle cell anaemia in Lagos, Nigeria. Nig Med Practitioner. 1998;35:70-73.
18. Murray WJ. A new method for measuring daytime sleepiness: The Epworth sleepiness scale. Sleep. 1991;14:540-545.
19. World Health Organization. BMI classification.
   Available:http://apps.who.int/bmi/index.jps? into Page=intro_3.html
20. Mallampati SR, Gatt SP, Gugino LD. A clinical sign to predict difficulty intubation; A prospective study. Can Anaesth Soc J. 1985;32:429-463.
21. Brodsky L. Modern assessment of tonsils and adenoids. Pediatr Clin North Am. 1989;36(6):1551-1569.
22. Ozoh OB, Okubadejo NU, Akanbi MO, Dania MG. High‑risk of obstructive sleep apnea and excessive daytime sleepiness among commercial intra‑city drivers in Lagos metropolis. Nigerian Med J. 2013; 54(4):224-229.
23. Sogebi OA, Oyewole EA, Olusoga-Peters OO. Sleep disordered breathing (SDB) experiences associated with snoring in adult Nigerians. Afr. Health Sci. 2011; 11(3):309–314.
24. Liu X, Uchiyama M, Kim K, Okawa M, Shibui K, Kudo Y, et al. Sleep loss and daytime sleepiness in the general adult population of Japan. Psychiatry Research. 2000;93:1-11.
25. Young TB. Epidemiology of daytime sleepiness: Definitions, symptomatology, and prevalence. J Clin Psychiatry. 2004; 65(Suppl 16):12-16.
26. Johnson EO. Sleep in America: 2000. Results from the National Sleep Foundation's 2000 Omnibus sleep poll. Washington, DC: The National Sleep Foundation; 2000.
   Available:http://www.sleepfoundation.org/atf/cf/{F6BF2668-A1B4-4FE8-8D1A-A5D39340D9CB}/2000_poll.pdf
27. Hara C, Lopes Rocha F, Lima-Costa MF. Prevalence of excessive daytime sleepiness and associated factors in a Brazilian community: The Bambuí study. Sleep Med. 2004;5(1):31-36.
28. Lindberg E, Janson C, Gislason T, Björnsson E, Hetta J, Boman G. Sleep disturbances in a young adult population: can gender differences be explained by differences in psychological status? Sleep. 1997;20(6):381-387.

29. Shneerson JM. Nature of sleep and its disorders in sleep medicine: A guide to sleep and its disorders Second ed. Blackwell 2005;chap.1:13-14.
30. Pagel JF. Excessive daytime sleepiness. Am Fam Physician. 2009;79(5):391-396.
31. Bixler EO, Vgontzas AN, Lin HM, Calhoun SL, Vela-Bueno A, Kales A. Excessive daytime sleepiness in a general population sample: The role of sleep apnea, age, obesity, diabetes, and depression. The Journal of Clinical Endocrinology & Metabolism. 2005;90(8):4510–4515.
32. Yoon IY, Kripke DF, Elliott JA, Youngstedt SD, Rex KM, Hauger RL. Age-related changes of circadian rhythms and sleep-wake cycles. J Am Geriatr Soc. 2003;51: 1085–1091.
33. Brock MA. Chronobiology and aging. J Am Geriatr Soc. 1991;39(1):74–91.
34. Van Cauter EV, Leproult R, Plat L. Age-related changes in slow wave sleep and REM sleep and relationship with growth hormone and cortisol levels in healthy men. Journal of the American Medical Association. 2000;284(7):861–868.
35. Takegami M, Sokejima S, Yamazaki S, Nakayama T, Fukuhara S. An estimation of the prevalence of excessive daytime sleepiness based on age and sex distribution of epworth sleepiness scale scores: A population based survey. Nihon Koshu Eisei Zasshi. 2005;52(2):137-145.
36. Hara C, Lopes Rocha F, Lima-Costa MF. Prevalence of excessive daytime sleepiness and associated factors in a Brazilian community: The Bambuí study. Sleep Med. 2004;5(1):31-36.
37. 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.
38. Dixon JB1, Dixon ME, Anderson ML, Schachter L, O'brien PE. Daytime sleepiness in the obese: not as simple as obstructive sleep apnea. Obesity (Silver Spring). 2007;15(10):2504-2511.
39. Julio Fernandez-Mendoza, Alexandros N Vgontzas, Ilia Kritikou, Susan L Calhoun, Duanping Liao, Edward O Bixler. Natural history of excessive daytime sleepiness: Role of obesity, weight loss, depression, and sleep propensity. Sleep. 2015;38(3): 351–360.
40. Panossian LA, Veasey SC. Daytime sleepiness in obesity: Mechanisms beyond obstructive sleep apnea - A review. Sleep. 2012;35(5):605-615.
41. Koenig JE, Thach BT. Effects of mass loading on the upper airway. J Appl Physiol. 1988;64:2294–2299.
42. Davies RJ, Ali NJ, Stradling JR. Neck circumference and other clinical features in the diagnosis of the obstructive sleep apnoea syndrome. Thorax. 1992;47(2): 101–105.
43. Davies RJO, Stradling JR. The relationship between neck circumference, radiographic pharyngeal anatomy, and the constructive sleep apnea syndrome. Eur Respir J. 1990;3:509–514.
44. Stradling JR, Crosby JH. Predictors and prevalence of obstructive sleep apnoea and snoring in 1001 middle aged men. Thorax. 1991;46:85–89.
45. Eckert DJ, Malhotra A. Pathophysiology of adult obstructive sleep apnea. Am Thorac Soc. 2008;5(2):144–153.
46. Ulfberg J, Carter N, Talback M, Edling C. Excessive daytime sleepiness at work and subjective work performance in the general population and among heavy snorers and patients with obstructive sleep apnea. Chest. 1996;110(3):659–663.
47. Nuckton TJ, Glidden DV, Browner WS, Claman DM. Physical examination: Mallampati score as an independent predictor of obstructive sleep apnea. Sleep. 2006;29(7):903–908.
48. 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.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/12044