Association between Snoring and Indices of Oropharyngeal Space among Adult in a Community in South West Nigeria

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Abstract: *Background*: Snoring results during sleep when turbulent airflow vibrates the lax soft tissues within the narrowed upper airway. Habitual snoring is a sign of obstructive sleep apnea with resultant daytime and nighttime consequences.

Objective: To determine the prevalence of snoring among apparently healthy adults in Oyo community, and find association between snoring and body mass index, neck circumference, and oropharyngeal inlet.

Method and Materials: This was a community based cross-sectional study of randomly selected adult participants. A structured questionnaire was administered to obtain information on participant's socio-demographics, alcohol intake, smoking habit, sleep duration and posture, snoring and daytime sleepiness. Their height, weight, and neck circumference were measured and body mass indices determined. Oropharynx inlet was graded using Mallampati scoring method and tonsillar enlargement. Statistical analysis was performed with SPSS version 16 (Significance at $P < 0.05$)

Results: Of 408 adults studied [202(49.50%) males and 206(50.50%) females], only 191(46.80%) participants snore consisting 101(24.75%) habitual snorers and 90 (22.05%) non- habitual snorers. There was a significant difference between snorers and non-snorers in neck circumference ($p < 0.001$), body mass index ($p < 0.001$) and Mallampati ($p = 0.001$).

Conclusion: There is high prevalence of snorers in the rural community which is significantly associated with increasing BMI, neck circumference, and Mallampati score.

Keywords: Habitual snoring, Mallampati score, adult population and community.

INTRODUCTION

Snoring results during sleep when turbulent airflow vibrates the lax soft tissues within the narrowed nose and pharynx [1, 2]. During sleep, there is generalised airway resistance because of an overall decrease muscle tone [3, 4]. The effect is more pronounced in individual who ingest alcohol and medication which depresses muscle tone. Snoring is accentuated by collapse of base of tongue, palate and pharynx into the airway during sleep [1, 5]. Nasal pathologies such as septal deviation, polyps, engorged turbinates as well as increased oropharyngeal airway resistance from enlarged tonsils, floppy soft palate and long uvula contribute to upper airway obstruction and snoring [6-8].

Snoring is commoner in males than females, get worse with increasing age and weight [9]. Snorers often wake up not refreshed and unsatisfied from long hours of sleep with tendency to easily fall asleep during the day with loss of concentration and alertness deficit [10]. This has a serious negative day time consequences on their quality of life, work efficiency and performances, personal economy, safety during driving and operation of machines [10, 11]. Also, they have higher risk of developing hypertension, heart attack and stroke [12, 13]. Snoring has also been reported to impact negatively on the partner or neighbours with the loud sound causing them to lose sleep. This can lead to resentment and stress strain relationship among partners [14].

Few studies in United States of America have implicated the black race and African American origin as risk factors for sleep disordered breathing [15, 16]. The previous studies on snoring in adult in Nigeria have been based in hospitals [17, 18]. There is paucity of information on adult snorers in the rural community in sub-Sahara Africa where farming, art and crafting are their major occupations and good alertness is required for their optimal work performance. This study was therefore designed to evaluate snoring among apparently healthy adult in Oyo community in south west Nigeria, and also to determine the prevalence of snoring and its association with body mass index, neck circumference and oropharyngeal inlet.

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MATERIALS AND METHOD

The study was a cross-sectional community based survey of apparently healthy adults in Oyo town, Oyo state of Nigeria. All adults from selected households using multistage random sampling technique that gave consent and fulfilled the inclusion criteria participated in the study. In this study an adult was considered as a person aged 18 years and above. Non- habitual snorer was defined as someone who snores 1–3times per week while habitual snorer was someone who snores more than 3 times per week [19, 20]. The protocol used included structured questionnaires, anthropometric measurement of height, weight & neck circumference and non-invasive nose and throat examinations. The study was approved by the ethics committee of Oyo State Ministry of Health, Nigeria.

Structured questionnaire was administered on the participants in a face to face interview to obtain information on independent variables like age, gender, occupation, daytime sleepiness, alcohol ingestion, smoking, and use of hypnotics / tranquillizers while a different questionnaire was administered on their partners or roommates to obtain information on snoring. The participant's socio-economic status was assessed by their occupation, while the last job was used to assess the economic status of those that had retired [21].

Thereafter, the participants had examination of the nose to identify presence of engorged turbinates, nasal polyp or growth and septal spur. Oropharyngeal examination to evaluate crowdedness of the oropharyngeal inlet using Mallampati grading method [22] to determine the amount of posterior pharyngeal wall that can be visualised, and presence or absence of tonsillar enlargement was determined. In this study, an enlarged tonsil is present if it protrudes out of the tonsillar fossa beyond the medial edge of the anterior faucal pillar. The weight (Kg), height (m) and neck circumference (cm) which was taken at the lower border of thyroid cartilage of the participants were measured and body mass indices calculated in kg/m^2.

The statistical analysis was performed using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) Version 16. The continuous variables were presented as the mean (Standard deviation) for all participants. Proportions were compared using Chi-square with Yates' correction or Fisher's exact tests. Normally distributed, continuous variables were compared by Student's *t*-test for independent group. The associations between snoring and body mass index, neck circumference, Mallampati score and tonsillar enlargement were tested using Pearson correlation or Fisher's exact tests. Level of significance was determined at $P < 0.05$, two-tailed level at 95% Confidence Interval (CI).

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 from18 to 82 years with mean age of 37.0 years±15.23. The male mean age was 38.87 years ± 1.55 while the female mean age was 35.17years ±1.52. Only 191 (46.80%) participants snore consisting 103 (53.93%) males and 88 (46.07%) females making up 101 (24.75%) habitual snorers with a mean age of 43.28 years ±1.16 and 90 (22.06%) non-habitual snorers with a mean age of 37.45years±1.15. Snoring was associated with increased age ($p < 0.0001$). Although there were more males than females that snore (See Table **1**), the observed difference is not statistically significant ($p = 0.094$).

The overnight sleeping hour duration ranged from 4 hours to 11 hours, with a mean duration of 8.2 hours±1.2. The mean sleeping duration for habitual snorers was 8.32 hours±1.17, non- habitual snorers was 8.42 hours ± 1.37 and non-snorers was 8.11 hours ± 1.61. Snorers sleep for a longer duration than the non-snorers. During sleep, 176 (92.14%) participants snore only in supine position, 11 (5.76%) participants snore in both supine and lateral position while only 4 (2.09%) participants snore in any position (supine, lateral and prone position) with or without pillow usage. There was no association with snoring and the use of

Table 1: Gender Distribution of Snorers

	Snorers	Non-Snores	Total
Male	103 (25.20%)	99 (24.30%)	202 (49.50%)
Female	88 (21.60%)	114 (28.90%)	206 (50.50%)
Total	191 (46.80%)	217 (53.20%)	408 (100%)

Table 2: Socioeconomic Status of the Participants

	Snorers	Non-Snores	Total
High Socioeconomic	14 (3.43%)	12 (2.87%)	26 (6.30%)
Middle Socioeconomic	49 (12.00%)	59 (14.70%)	108 (26.70%)
Low Socioeconomic	128 (31.37%)	146 (35.63%)	274 (67.00%)
Total	191(46.80%)	227 (53.20%)	408 (100%)

sleeping pillow (p = 0.06). Table **2** showed that the participants were from different socioeconomic classes and there was no significant relationship with snoring (p = 0.12).

The mean BMI for males was 23.79 kg/m^2 ± 3.93 and females was 24.86 kg/m^2 ± 4.9 (Table **3**). The snorers mean BMI was 25.39 kg/m^2 ± 2.34 (The habitual snorers had a mean BMI of 26.48 kg/m^2 and non-habitual snorers had 24.31 kg/m^2±4.07), while non-snorers had 23.32 kg/m^2 ± 3.81. Snorers have higher BMI than the non-snores and the difference is significant (p < 0.001).

The neck circumference ranged from 23.0 cm to 40.5 cm with mean of 34.1cm ± 2.7. The mean neck circumference for males was 34.5 cm ± 2.9 and the mean for females was 33.5 cm ± 2.3. The snorers mean neck circumference was 34.8cm ± 3.1 (The habitual snorers had a mean neck circumference of 35.4 cm ±2.8 and non-habitual snorers had mean neck circumference of 34.2 cm ± 3.3) while non-snorers had a mean neck circumference of 33.4cm ± 2.4. Snorers have thicker neck than the non-snorers and the difference is significant (p < 0.001).

Table **4** showed that as the Mallampati score increases, the frequency of snorers' increases (p <0.001). Sixty (14.7%) snorers had enlarged tonsils as against 55 (13.5%) non-snorers, the difference is not significant (p = 0.174). There was also no significant difference in alcohol consumption (p = 0.102) and smoking (p = 1.85) between snorers and non-snorers.

DISCUSSION

The prevalence of snoring in the study population was 46.80%. It is similar to 42.80% prevalence reported in a community in Brazil [23] and 46.80% in China [24] but lower than the report from a community in North-Eastern part of Spain where a prevalence of 63.80% was reported [25] and higher than the prevalence of 32% in a sample of French males which utilized self-completed questionnaire [26]. However, the prevalence of snoring from this study is higher than the earlier reports of 37.90% and 31.60% from hospital

Table 3: Snoring and Body Mass Indices of the Participants

BMI(Kg/m^2)	Habitual Snorers	Non-Habitual Snorers	Non-Snorers	Total
Under weight	0 (0%)	1 (0.27%)	10 (2.45%)	11 (2.75%)
Normal weight	17 (4.17%	16 (3.92%)	157 (38.50%)	190 (46.59%)
Over weight	35 (8.58%)	67 (16.41%)	50 (12.25%)	152 (37.24%)
Obesity	39 (9.55%)	6 (1.47%)	0 (0%)	45 (11.02%)
Morbid obesity I	10 (2.45%)	0 (0%)	0 (0%)	10 (2.45%)
Total	101 (24.75%)	90 (22.05%)	217 (53.20%)	408 (100.00%)

Table 4: Snoring and Mallampati Scores of the Participants

	Mallampati Score 1	Mallampati Score II	Mallampati Score III	Mallampati Score IV	Total
Snorers	18 (4.40%)	59 (14.50%)	73 (17.90%)	41 (10.00%)	191 (46.80%)
Non- Snorers	76 (18.60%)	89(21.80%)	48 (11.80%)	4 (1.00%)	217 (53.20%)
Total	94 (23.00%)	148(36.30%)	121(29.70%)	45 (11.00%)	408 (100%)

based studies in Nigeria [17, 18]. This difference may be explained by the fact that many people in the community with snoring did not see it as a medical problem hence did not seek medical interventions in the hospital. In addition, partners or room-mates also gave information on snoring unlike in the previous hospital based study by Sogebi *et al*. [18] where information on snoring was solely provided by the participants hence might be incomplete.

This present study agrees with reports from previous similar studies that snoring increases with increased age [17, 18, 25]. The rapid increase in weight during the early adulthood contributed to more people having snoring during this period [27]. The reduced muscle tone due to aging might be responsible for the increased vibration tendency when air moves in and out of the upper airway during sleep thereby causing snoring [28]. The preponderance of male snorers in this study is similar to the reports from previous similar studies [17, 18, 25]. This might be because men have larger change in pharyngeal area and lung volume than women thus implying a greater tendency to develop airway collapse during sleep [29].

This study found that snorers have higher BMI values than the non-snorers implying an association with snoring and this agrees with previous studies [30, 31]. This study also found a significant relationship between snoring and increased neck size or circumference which is similar to the reports from previous similar studies [32, 33]. Neck obesity predisposes to increased airway resistance as a result of compression by lax adipose tissue on the pharynx during sleep [34-36]. Neck obesity has been reported to be a more predictor of snoring and obstructive sleep apnea than general obesity [34].

Crowdedness of the oropharyngeal inlet and ease of oropharyngeal intubation during anaesthesia is estimated by using Mallampati score [22]. High Mallampati score has been reportedly associated with snoring and sleep apnea [37]. Similar finding was observed in this present study where high Mallampati scores were associated with snoring. All the snorers snore when they assumed supine position during sleep. Relaxed large tongue base, floppy soft palate and long uvula fall into the pharyngeal space in supine position during sleep. This causes a significant change in pharyngeal airway thereby contributing to increased airway resistance at the oropharynx [38, 39]. This worsened snoring in snorers and caused snoring in participants with lower Mallampati score. Although this study did not found any association of snoring with enlarged tonsils, this finding is similar to reports from a similar previous study by Dreher *et al.* [40] but in contrast to the report from Friedman *et al*. [41] and Acar *et al.* [42]. One would have expected a significant association between snoring and enlarged tonsils as enlarged tonsils would contribute to increased crowdedness of oropharynx resulting in snoring. The small proportion of participants with enlarged tonsils in this study might be responsible for the no significant association.

Alcohol consumption especially near bed time has been reportedly associated with snoring because it reduces muscle tone and depresses central nervous system [43-45]. The no association of snoring with alcohol consumption and smoking in this study might be because majority of people in the studied environment do not consume alcohol for religious reason. This present study reported no association between smoking and snoring as against the report from Australia [30]. Only 4% participants smoked as against heavy smoking habit in Australia. Smoking has been shown to cause dryness, irritation, oedema and inflammation of the pharyngeal mucosa thereby contributing to increased airway resistance and leading to an increased risk of snoring [31].

We concluded that the prevalence of snoring is high in the rural community and it is significantly associated with overweight, neck obesity, high Mallampati score and sleeping in supine position. These indices can reliably predict snoring in individuals in rural area. A larger epidemiological community based study to determine the daytime and night time consequences of snoring in adult is recommended.

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