Original Research Paper

Correlation between Predictors of Obstructive Sleep Apnoea

Abstract

Background

Obstructive sleep apnoea is becoming a respiratory disorder of public health concern. Different obesity indices such as Mallampati score, Body Mass Index, neck circumference have been identified in the literature as predictors of obstructive sleep apnoea. Studies on the relationship between these variables is however limited particularly in Nigeria. The aim of this study was to evaluate the correlation between Mallampati score, Body Mass Index and neck circumference which are predictors of obstructive sleep apnoea.

Methods

The study was done among commercial drivers. The risk of obstructive sleep apnoea was assessed with Berlin questionnaire. The participants were assessed for Mallampati score, Body Mass Index; their neck circumference was measured and the correlation between these variables was done. Data collated was analyzed with statistical package for social sciences (SPSS) Version 20.0 software.

Results

There were 105 drivers recruited into this study, they were all males with a mean age of 44.8±12.03years and 50.5% of the drivers had high risk of sleep apnoea. There was a positive correlation between Mallampati score, Body Mass Index and neck circumference.

Conclusion

Mallampati score increase with increase in Body Mass Index and neck circumference which are all predictors of obstructive sleep apnoea.

Keywords: Correlation, Mallampati, BMI, Neck Circumference, Sleep

1. Introduction

Obstructive sleep apnoea is a common respiratory disorder. Although the pathophysiology of obstructive sleep apnoea is yet to be clearly understood, there are anatomical abnormalities that could possibly result to upper airway obstruction during sleep. The onset of inspiration has been demonstrated to trigger a reflex increase in the electromyographic (EMG) activity of the pharyngeal muscles [1]. These muscles are activated during daytime respiration and their normal tone keeps the airway open thereby preventing collapse of the upper airway; but during REM sleep there is hypotonia of these muscles. In patients with obstructive apnoea, the EMG activity of the pharyngeal muscles decreases further during obstructive episode [2]. It is essential to note that any reduction in tone of the upper airway muscles or any incoordination between reflex EMG activity in these muscles and onset of inspiration causes an increase susceptibility of the upper airway to collapse. However, apart from these aforementioned factors, risk factors for obstructive sleep apnoea include increasing age, sex, alcohol, hypertension, diabetes, neck circumference, Mallampati and Body Mass Index (BMI) [3-5]. These are the predictors of obstructive sleep apnoea. Of these factors, neck circumference, Mallampati and Body Mass Index (BMI) are obesity indices [6-7]. Screening for Obstructive sleep apnoea in drivers is very important as undiagnosed cases among them poses risk for the society due to their job. Several studies in Nigeria have shown that commercial car drivers are particularly at risk of Obstructive sleep apnoea [8-10]. However, these studies did not consider the relationship between these obesity indices. Hence, the aim of this study was to examine the correlation between neck circumference, Mallampati and Body Mass Index which are all predictors of Obstructive sleep apnoea and using commercial car drivers as case study.

2. Method

2.1 Study design

This is a prospective, descriptive study involving commercial car drivers in Ile-Ife, Nigeria.

2.2 Study setting

Study was done in Ile-Ife in Osun state in the south western part of Nigeria.

2.3 Study protocol

All commercial drivers in Ile-Ife who gave consent were recruited into the study. The Berlin questionnaire was administered to all the participants and this was used to assess the risk of obstructive sleep apnoea. The neck circumference, Mallampati and BMI of all participants were assessed and recorded. Their mouths were inspected with the participant sitting upright, with the mouth widely open and the tongue fully extruded and Mallampati classification of what is visible was done as follows:

- Class I – soft palate, anterior and posterior faucial pillars and uvula.
- Class II – faucial pillars, soft palate and uvula.
- Class III – soft palate and base of uvula.
- Class IV – soft palate not visible.

Their weight, height and blood pressure were measured using a weighing scale, Stadiometer and sphygmomanometer respectively. The Body Mass Index (BMI) was calculated and graded as underweight if less than 18.5, normal from 18.5 - 24.9, overweight from 25.0 - 29.9, obese from 30.0 - 39.9 and from 40 and above that was regarded as morbidly obese. Their neck circumference was measured in centimetres using a metric tape at the level of the thyrohyoid membrane. Neck circumference greater than 43.35cm (17 inches) was regarded as abnormal.

2.4 Ethical Approval

The study was done in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Consent was obtained from all participants.

2.5 Data management

Data collected was analyzed using Statistical Package for Social Sciences version 20.0 and a 'p' value of less than 0.05 was accepted as statistically significant. Results were subsequently presented in descriptive format.

3. Results

One hundred and five commercial car drivers were included in the study. They were all males and the mean age was 44.8±12.03years. Average Neck circumference (cm) and BMI (Kg/m^2) were 39.0±3.3 and 25.4±4.6 respectively. A total of 53(50.5%) drivers had high risk of sleep apnoea while 52(49.5) of them had low risk. Table 1 shows the correlation between neck circumference, Mallampati and BMI and it reveals that Mallampati increases with increase in neck circumference and BMI. Table 2 shows that as BMI increases there is higher percentage of participants with neck circumference above 43.35cm and Table 3 shows that as Mallampati score increases, there are more proportion of participants with neck circumference above 43.35cm.

Table 1: Showing the correlations between Mallampati, BMI and Neck Circumference

Variable	**Mallampati**	**BMI**	**Neck Circumference**
Mallampati	1		
BMI	0.594**	1	
Neck Circumference	0.596**	0.792**	1

**** Correlation is significant at the 0.01 level (2-tailed)**

Table 2: Association between Neck circumference and BMI

BMI	Neck Circumference ≤43.35cm (n, %)	>43.35cm (n, %)	Chi-square	P-value
<18.5	5 (100)	0	6.200	0.001
18.5 -24.9	48 (98.0)	1(2.0)		
25.0-29.9	32 (97.0)	1(3.0)		
30.0-39.9	11 (61.1)	7(38.9)		

Table 3: Association between neck circumference and Mallampati score

Mallampati score	Neck circumference ≤43.35cm (n, %)	>43.35cm (n, %)	Chi-square	P-value
I	49(98.0)	1(2.0)	39.000	0.001
II	32(97)	1(3)		
III	14(66.7)	6(33.3)		
IV	1(50)	1(50)		

4. Discussion

Findings from this study showed that a significant proportion of the participants had high risk of sleep apnoea. Of all the several predisposing factors to obstructive sleep apnoea, Mallampati, neck circumference and BMI have been shown to contribute more when compared to others [8]. This suggests that there is a relationship between the body anthropometry and obstructive sleep apnoea [11,12]. Increasing neck circumference, BMI and Mallampati is associated with a potential crowding of the oropharynx which consequently result in a narrowing of the air column

which in conjunction with hypotonia of the pharyngeal muscles during sleep, could cause obstructive sleep apnoea.

Results from this study shows that there is a positive correlation between Mallampati, BMI and neck circumference. This shows that even as these obesity indices such as Mallampati, BMI, and neck circumference predict obstructive sleep apnoea, they also predict and interrelate with each other as well. There is paucity of comparable local studies. However, community based study from India shows that neck circumference is a predictor of BMI [13]. Kumar *et al* in another study in India also corroborate these findings [14]. Studies from Iran and United States of America also had similar results [15,16]. Table 2 from this study showed that there was an increase in the percentage of participants with neck circumference greater than 43.35cm as BMI increases. Consequently, neck circumference being an indicator of upper body fat distribution can be used as measure obesity. Neck circumference has a positive correlation with Mallampati scores as found in this study. Table 3 shows that the percentage of participants with neck circumference above 17 inches increases with higher Mallampati scores. Higher Mallampati scores indicate crowding of the oropharynx which has been seen to be related to neck circumference and other obesity indices. This probably explains the positive correlation between these variables demonstrated in this study. Menon *et al* also demonstrated that neck circumference has positive correlation with Body Mass Index and Mallampati [7]. Apart from neck circumference having a positive correlation with Body Mass Index and Mallampati, both Body Mass Index and Mallampati also correlate with each other positively as shown in Table 1. The same study by Menon *et al* showed that Body Mass Index has positive correlation with Mallampati scores [7]. This shows that neck circumference, BMI and Mallampati all correlate with each other and can predict each other even as they are also predictors of obstructive sleep

apnoea. Hence, each of these variables can serve as a guide when assessing obesity, obstructive sleep apnoea. They can also serve when assessing the airway for possibility of difficulty in endotracheal intubation. Though Mallampati scoring may require some level of clinical training, neck circumference and Body Mass Index can easily be measured and calculated respectively by anyone who is conversant with figures and measurements. Any of these variables could be measured and used to predict obstructive sleep apnoea among commercial car drivers as used in this study. Studies have shown that these variables are risk factors for obstructive sleep apnoea among drivers in this study location [8,9]. However, the correlation between other possible predictors of obstructive sleep apnoea such as age, sex, blood glucose, blood pressure were not considered in this study. Polysomnography is the gold standard for the diagnosis of obstructive sleep apnoea [17]. This was also not done in this study. Indeed, nevertheless polysomnography is costly and now Obstructive sleep apnoea is often diagnosed with cheaper methods [18]. Questionnaires are becoming more widely used [19]. However, this study considered the correlation between some of the possible predictors of obstructive sleep apnoea which to the best of the authors' knowledge was not done in other previous similar local studies.

5. Conclusion

This study found that there are positive correlations between Mallampati, BMI and neck circumference. Therefore, any of these indices could be measured and easily be used as a predictor of obstructive sleep apnoea. We recommend study of the correlations between Mallampati, BMI, neck circumference and other predictors of obstructive sleep apnoea such as blood sugar, blood pressure, sex.

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