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High risk of obstructive sleep apnea among hypertensive patients in two tertiary centers in Nigeria

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ABSTRACT

Objectives: The prevalence of obstructive sleep apnea (OSA) is rising globally with its associated morbidity and mortality. Although OSA is associated with hypertension and is the leading cause of secondary and resistant hypertension, its presence is usually not actively sought during clinical evaluation of hypertensive patients resulting in a missed opportunity to treat the condition. This study assessed the prevalence of high risk of OSA and excessive daytime sleepiness (EDS) among hypertensive patients. It also assessed the pattern of symptoms of OSA among the participants.

Materials and Methods: We used a structured questionnaire to collect data from hypertensive patients aged 18 years and above, who were attending the outpatient clinics of two tertiary hospitals in Enugu state. Data collected include frequency of symptoms of OSA, Epworth sleepiness scale (ESS) score, snoring, tiredness, observed apnea or choking, blood pressure, body mass index, age, neck circumference, and gender (STOPBANG) score, number of comorbidities present, and demography of participants. STOPBANG score of 5–8 classified participants as having high risk of OSA, and ESS >10 as having excessive daytime sleepiness (EDS.).

Results: Three hundred and twenty hypertensive patients were recruited (mean age: 56.0 ± 9.5 years; female: 58.8%). The prevalence of high-risk OSA was 13.8% and that of EDS was 6.3%. Snoring, nocturia, tiredness, and observed apnea were significantly present in 90.9%, 90.9%, 81.8%, and 22.7% of those with high risk of OSA (n = 44), respectively, compared with intermediate (60.6%, 91.5%, 53.2%, and 1.6%) and low risk (12.5%, 77.3%, 19.3%, and 1.1%) groups ($P < 0.001$, $P = 0.003$, $P < 0.001$, and $P < 0.001$, respectively). Gasping, (χ^2 [2] = 8.4, $P = 0.015$); memory loss, (χ^2 [2] = 6, $P = 0.04$); and sleep fragmentation, (χ^2 [2] = 9.9, $P = 0.007$) also showed significant difference between high-, intermediate-, and low-risk OSA groups.

Conclusion: The prevalence of the high risk of OSA among hypertensive patients presenting to our tertiary hospitals are modest. Snoring and nocturia are their most common symptoms. We recommend screening hypertensive patients for OSA to identify those at high risk, as they will likely benefit from sleep study and treatment if confirmed.

Keywords: Obstructive sleep apnea, Prevalence, Stopbang, Epworth sleepiness scale, Nigeria

INTRODUCTION

Obstructive sleep apnea (OSA) is a common sleep-disordered breathing that affects 9–38% of all adults across North America, Europe, and Asia.[1] The prevalence rates of 57% and 69% have been reported in Cameroon and South Africa, respectively.[2,3] In the recent large population, Benin

Society and Sleep study conducted in the Benin Republic among nearly 3000 participants aged 25 years or more, who were evaluated with a level 3 respiratory polygraphy, the investigators found the prevalence of mild-to-severe OSA to be 43.2%.[4] Although no nationwide prevalence rate exists in Nigeria, hospital-based studies have reported that 17–40% of adults are at high risk of OSA.[5-8]

OSA is characterized by collapse of the airways during inspiration leading to hypopnea or apnea, followed by arousal and hyperventilation. Inadequate sleep and repeated fragmentation of sleep associated with OSA lead to excessive daytime sleepiness (EDS), increased cardiovascular disease, stroke, metabolic disease, workplace errors, traffic accidents, and even death.[9] Among risk factors for OSA include advanced age, male sex, and obesity, and these are also risk factors for hypertension and may explain the synergy between OSA and hypertension.[10-12] OSA has a strong association with systemic hypertension more especially poorly controlled hypertension. This is linked through complex interactive mechanisms which include failure of blood pressure (BP) dipping at night. While baseline BP in healthy individuals drops by 10–20% during night sleep, the drop is <10% in persons with OSA, a phenomenon described as non-dipping of the BP.[13] In addition, early morning BP surge occurs in individuals with OSA and results in poor BP control and increased risk of other cardiovascular events.[14] Not only is OSA associated with hypertension but it has also been reported to be the leading cause of secondary and resistant hypertension (RH).[15]

Many studies have been done in other parts of the world on OSA and its association with hypertension but limited data exist in sub-Saharan Africa. Few studies done in Nigeria evaluated the prevalence of high-risk OSA either among diabetic patients or across a heterogeneous population.[6,7,16] There is scanty data on OSA among the hypertensive population in Nigeria. To the best of our knowledge, the only Nigerian study that recruited and evaluated primarily hypertensive patients found that 52% of them were at high risk of OSA; however, that study was limited by its small sample size of 100 and was probably underpowered as appropriate sample size number for the study was not calculated.[8] In addition, all the previous studies were carried out in southwest, north-central, and south-south geopolitical areas of Nigeria. The prevalence of high-risk OSA among hypertensive patients in the southeastern part of Nigeria is not known and this present study could contribute to providing such data. Furthermore, important is that this study assessed the association between the OSA risk groups and various symptoms of OSA, on the one hand, and the number of anti-hypertensive medications used by the participants.

The objectives of this study were, therefore, to assess the frequency of high-risk OSA and EDS among the hypertensive patients attending the family medicine and medical outpatient clinics at two government tertiary health facilities in Enugu, Nigeria, and to assess the pattern of symptoms of OSA among them.

MATERIALS AND METHODS

Study design and sample size calculation

This was a cross-sectional study carried out from November 2018 to September 2019 at the family medicine clinic of the University of Nigeria Teaching Hospital (UNTH), Ituku/Ozalla, and the medical outpatient clinic of Enugu State University of Science and Technology Teaching Hospital (ESUT-TH), both in Enugu State.

We employed the formula $n = Z^2p(1-p)/d^2$ as recommended for medical science studies to estimate the minimum sample size,[17] where n is the required sample size, Z is the confidence level at 95% (standard value of 1.96), p is the estimated prevalence, and d is the margin of error set at 5%. Using a reported prevalence of high risk of OSA among hypertensive patients which is 23.8% from a similar previous study conducted with an adequate sample size,[18] we obtained a sample size of 280 approximately to the nearest tens.

Setting

UNTH located on the outskirts of Enugu city and ESUT-TH situated in the heart of Enugu city are both tertiary hospitals owned and operated by the Federal Government of Nigeria and Enugu State Government, respectively. They both provide general and specialized medical and surgical services and receive referrals mainly from hospitals in Enugu state and also from nearby states of Anambra, Ebonyi, Abia, Imo, and Delta.

Study participants and recruitment

We included only consenting outpatients, male and female, aged 18 years and above, who had been previously diagnosed with hypertension and were already on prescribed antihypertensive medications. Patients who could not stand up for their heights to be measured, due to the lower limb amputation or other causes were excluded from the study. Participants were recruited consecutively at each clinic day. A total number of 320 participants were eventually recruited.

Hypertension in this study was defined as a systolic BP (SBP) equal to or above 140 mmHg and/or diastolic BP (DBP) equal to or above 90 mmHg.[19] RH was defined as elevated BP (SBP ≥140 mmHg and/or DBP ≥90 mmHg) in a patient despite the concurrent use of three antihypertensive drug classes, or BP of <140/90 mmHg achieved with the concurrent use of ≥4 antihypertensive medications.[20]

Study instruments and measurements

Body height was measured with participants standing barefooted on a wall-mounted stadiometer and the measurement obtained rounded to one decimal place in centimeters (cm). Body weight was measured with the participant wearing minimal clothing and standing erect with face looking forward on a zeroed floor scale; the measurement was rounded to one decimal place in kilogram (kg). Body mass index (BMI) was, then, calculated from weight/(height)^2 in kg/m^2. Neck circumference was measured and also rounded to one decimal place in cm. For the neck circumference, a non-elastic tape was placed at the level of the cricothyroid cartilage and perpendicular to the long axis of the neck with the head in the Frankfurt horizontal plane. All the measurements were taken by trained research staff and closely supervised by the lead author to ensure quality control.

BP was measured with an Accoson mercury sphygmomanometer by the attending consultant physicians, with the participant's right arm resting on the table. The BP was recorded to the nearest even number in millimeter mercury (mmHg).

Data collection

We used a structured questionnaire to collect data from participants. The questionnaire evaluated for symptoms of OSA, Epworth sleepiness scale, snoring, tiredness, observed apnea or choking, BP, BMI, age, neck circumference, gender (STOPBANG) score, presence of co-morbidities, and number of anti-hypertensive medications being taken. Participants' demography and anthropometry measurements were documented. Participants were asked which of the listed 11 symptoms of OSA, they experienced within the previous 4 weeks [Table 1]. Regarding memory loss which might have developed over months to years, participants were simply asked if they were more forgetful in the previous 4 weeks compared to the preceding period. Focused history was taken to evaluate for the presence of comorbidities such as congestive cardiac failure, stroke, transient ischemic attack, diabetes mellitus, hypertension, asthma, chronic obstructive pulmonary disease, peptic ulcer disease (PUD) or gastroesophageal reflux disease (GERD), and chronic kidney disease.

Epworth sleepiness scale (ESS),[21] a validated instrument that assesses the propensity of an individual to fall asleep in eight different scenarios, was used to categorize participants into two groups: Those with a score of ≥10 were considered to have EDS and those with a score of 1–9 were considered normal. STOPBANG sleep apnea questionnaire, previously validated for assessment of the risk of OSA, was used to classify participants into either low risk (score of 0–2), intermediate risk (score of 3–4), or high risk (score of 5–8).[22] While STOPBANG score of ≥3 has a sensitivity of 84%, 93%, and 100% in identifying individuals with any OSA, moderate to severe OSA, and severe OSA, respectively, its low specificity to detect any OSA, moderate to severe OSA, and severe OSA (56.4%, 43%, and 37%, respectively) leads to a high false-positive rate of detection. A STOPBANG score of ≥5 is, however, used to effectively identify patients with a high probability of moderate to severe OSA.[22] Therefore, we defined our high-risk OSA group as participants with STOPBANG score of ≥5.

Ethical considerations

Ethical approval was obtained from the Ethics Committee of the UNTH Ituku-Ozalla, Enugu with the ethical clearance certificate dated September 26, 2018 (Ref: UNTH/CSA/329/OL.5 (NHREC/05/01/2008B-FWA00002458-1RB00002323).

Data management and analysis

Information obtained from the participants on the questionnaire was manually transferred to an Excel spreadsheet. Thereafter, data were transferred and analyzed using SPSS version 29. Categorical variables such as sex, age range, BMI class, occupation, SBP group, and number of anti-hypertensive medications were analyzed as numbers and percentages, while clinical symptoms occurring in OSA risk groups were analyzed as percentages. Continuous variables were tested for normal distribution using Kolmogorov–Smirnov test. Normally distributed variables (age and neck circumference) and skewed variables (BMI, SBP, and DBP) were presented as mean with standard deviation and median with interquartile ranges (IQR), respectively. Differences in symptoms between OSA risk groups, and EDS versus non-EDS groups were tested with Chi-square test. Kruskal–Wallis test was used to examine the differences in BMI, SBP, and DBP across the three OSA risk groups while analysis of variance (ANOVA) was similarly performed for age and neck circumference. *Post hoc* analysis was applied when ANOVA was statistically significant. Bonferroni adjustment was performed following significant Chi-square in examining the relation between OSA risk groups and gender distribution as well as the number of antihypertensive medications used. Statistically significant differences were determined by $P < 0.05$.

RESULTS

Baseline characteristics of study participants

Three hundred and twenty participants were recruited for the study, out of which 58.8% were females. [Table 2] shows the sociodemographic and baseline characteristics of the participants The mean age of the participants was 56 years

Table 1: Comparison of symptoms of OSA among different OSA risk groups.

Symptoms	Low risk *n*=88 (%)	[β]Int risk *n*=188 (%)	High risk *n*=44 (%)	χ^2	*P*-value
Snoring*	11 (12.5)	114 (60.6)	40 (90.9)	87.2	<0.001
Tiredness*	17 (19.3)	100 (53.2)	36 (81.8)	51.2	<0.001
Observed apnea*	1 (1.1)	3 (1.6)	10 (22.7)	41.1	<0.001
Excessive daytime sleepiness*	3 (3.4)	9 (4.8)	8 (18.2)	12.6	0.002
Abrupt awakening accompanied by gasping or choking at night*	5 (5.7)	11 (5.9)	8 (18.2)	8.4	0.015
Non refreshing sleep	28 (31.8)	69 (36.7)	22 (50)	4.2	0.12
Morning headache	49 (55.7)	112 (59.6)	25 (56.8)	0.4	0.82
Memory loss (forgetfulness)*	14 (15.9)	20 (10.6)	11 (25)	6.4	0.04
Decreased libido	8 (9.1)	14 (7.4)	5 (11.4)	0.8	0.68
Nocturia (frequent urination at night)*	68 (77.3)	172 (91.5)	40 (90.9)	11.6	0.003
Sleep fragmentation (excessive waking at night)*	44 (50)	130 (69.1)	30 (68.1)	9.9	0.007
Awakening with a dry mouth or sore throat	17 (19.3)	58 (30.9)	15 (34.1)	4.8	0.09
Difficulty concentrating during the day	4 (4.5)	15 (8.0)	4 (9.1)	1.3	0.51
Experiencing mood changes such as depression or irritability	13 (14.8)	27 (14.4)	5 (11.4)	3.0	0.56
Night time sweating	35 (37.5)	88 (46.8)	17 (38.6)	2.5	0.28

[β]Int: intermediate. χ^2 tested differences across the three risk groups. *Symptoms that show statistically significant differences across the three risk groups (*P*<0.05). EDS: Excessive daytime sleepiness, OSA: Obstructive sleep apnea, *n*: Number of participants

Table 2: Sociodemographic and other characteristics of the participants.

Variables	*n*=320 (*n*)	100% (%)
Sex		
Female	188	58.8
Male	132	41.2
Age (years)		
Mean; 56±9.5		
18–44	31	9.7
45–65	244	76.3
66–82	45	14.1
Occupation		
Business/trading	71	22.2
Civil servant	50	15.6
Farming	46	14.4
House wife	42	13.1
Retired civil servant	28	8.8
Retired farmer	11	3.4
Teaching	11	3.4
Others β	61	19.1
BMI (kg/m^2)		
Median BMI, 28.4 (IQR: 26–31.6)		
Underweight (16.7–18.4)	4	1.3
Normal (18.5–24.9)	55	17.2
Overweight (25–29.9)	136	42.5
Obesity (30–50.2)	125	39.1
Comorbidities		
Dyspepsia	143	44.7
Asthma	40	12.5
Diabetes mellitus	37	11.6
Stroke	10	3.1
Transient ischemic attack	9	2.8
Congestive cardiac failure	9	2.8
Chronic obstructive pulmonary disease	8	2.5
Chronic kidney disease	1	0.3
BP (mmHg)		
Median SBP, 140 (IQR: 130–150)		
Median DBP, 90 (IQR: 72–90)		
SBP (mmHg)		
100–119	11	3.4
120–139	127	39.7
140–159	120	37.5
160–240	62	19.4
Hypertension		
Controlled, SBP <140 and DBP <90 (mmHg)	98	30.6
Uncontrolled, SBP ≥140 or DBP ≥90 (mmHg)	222	69.4
*Resistant hypertension	95	29.7
Number of antihypertensive medications being taken by patient		
None	15	4.7
One	29	9.1
Two	153	47.8
Three	123	38.4

Data are in number and percentages. *Defined as participants on three anti-hypertensive medications with uncontrolled blood pressure. [β]Others include lawyer, mason, mechanic, politician, contractor, driver, Engineer, police, soldier, shoemaker, student, and tailor. IQR: Interquartile ranges, COPD: Chronic obstructive pulmonary disease, BMI: Body mass index, BP: Blood pressure, DBP: Diastolic blood pressure, SBP: Systolic blood pressure, *n*: Number of participants

± 9.5 (18–82). We found most of them to be overweight (BMI: 25–29.9) with a median BMI of 28.4 kg/m² IQR 26.1–31.6 kg/m². Median SBP was 140 mmHg, IQR 130–150, and median DBP, 90 mmHg, and IQR 72–90. Ninety-five (29.7%) participants had RH. We found that 38.4% of the participants were on three medications while 4.7% received none. Snoring, tiredness, and observed apnea occurred in 51.6%, 47.8%, and 4.4% of the participants, respectively.

Risk of OSA and comparison of OSA symptoms across risk categories

Using STOPBANG score of ≥5 to identify the high-risk group, we found that 44 (13.8%) participants were at high risk of OSA, while 188 (58.8%) and 88 (27.5%) of them were at intermediate and low-risk levels, respectively. If a score of ≥3 was used as the cutoff (at the risk of high false-positive detection), 72.5% would have been classified as having a high risk of OSA. There was a statistically significant difference in most of the OSA symptoms across the OSA risk categories, as shown in [Table 1].

Comparison of anthropometric and demographic characteristics across OSA risk categories

Using Kruskal–Wallis, ANOVA, and Chi-square as appropriate, we examined the differences in the BMI, age, neck circumference, and gender distribution across the three OSA risk groups and found the differences to be statistically significant. A larger BMI was significantly associated with a high risk of OSA [Table 3].

We performed *post hoc* analysis (Tukey HSD) for age and neck circumference and found that for age, the statistically significant mean difference was actually between the low risk and intermediate risk (−5.2 95% confidence interval, CI [−8.0, −2.4], $P < 0.001$) and also between the low-risk and high-risk (−7.6, 95% CI [−11.6, −3.7], $P < 0.001$) groups. Therefore, older participants were significantly more likely to have a higher and intermediate risk of OSA than lower risk. For neck circumference, the significant difference was between the low- and high-risk (−4.9 95% CI [−7.7, −2.0], $P < 0.001$) and between the intermediate- and high-risk (−3.6 95% CI [−6.2, −1.0], $P < 0.001$) groups. This indicates that participants with larger mean neck circumference were significantly more likely to be at high risk of OSA. Bonferroni test for gender distribution showed that males were more significantly likely to present with a high risk of OSA while females were significantly more likely to present with a low risk of OSA. There was no statistically significant difference in the systolic and DBP between the risk groups.

Excessive daytime sleepiness (EDS) among participants

Only 20 participants (6.25%) presented with a history of EDS. EDS occurred in 8 (18.2%) out of 44 participants with a high risk of OSA, 9 (4.8%) of 188 participants with intermediate risk, and 3 (3.4%) out of 88 with a low risk of OSA [Table 1]. When the frequency of symptoms such as snoring, abrupt awakening accompanied by gasping or choking at night, non-refreshing sleep, morning headache, memory loss, decreased libido, nocturia, and difficulty concentrating during the day were compared between EDS and non-EDS groups, the difference in the frequency was found to be statistically significant. Other symptoms did not show statistical significance between the two groups. The details are shown in [Table 4].

Table 3: Comparison of anthropometric and demographic characteristics across OSA risk groups.

STOPBANG Components	Low risk *n*=88 (%)	*Int risk *n*=188 (%)	High risk *n*=44 (%)	Statistic	*P*-value
SBP mmHg Median (IQR)	150 (130.0–150.0)	140.0 (130.0-150.0)	135.0 (130.0–148.8)	4.43[k]	0.11
DBP mmHg median (IQR)	80.0 (70.0–90.0)	90.0 (78.5–90.0)	82.5 (80.0–90.0)	1.08[k]	0.58
BMI kg/m² median (IQR)	28.1 (25.5–31.2)	28.3 (25.8–30.9)	33.7 (28.6–40.2)	26.36[k]	<0.001[β]
Age year Mean±SD	51.9±9.5	57.1±8.7	59.6±10.2	13.55[a]	<0.001[β]
Neck circumference cm; mean±SD	33.1±3.6	34.4±7.8	38±5.0	8.33[a]	<0.001[β]
Gender[η]					
Male *n* (%)	12 (9.1)	88 (66.7)	32 (24.2)	48.08[c]	<0.001[β]
Female *n* (%)	76 (40.4)	100 (53.2)	12 (6.4)		

P-values were calculated by three-way comparisons (Kruskal–Wallis for non-parametric data, analysis of variance for parametric data and χ^2 for categorical data) across all groups. IQR: Interquartile range, SD: Standard deviation, k: Kruskal–Wallis H, [a]Analysis of variance, [c]Chi-square. *Int: Intermediate. [β]Statistically significance between groups ($P<0.05$). *Post hoc* (Tukey) test indicates that statistically significant difference in age was between low- and intermediate/high-risk groups; and for neck between low- and high-risk groups and intermediate- and high-risk groups. [η]Bonferroni test indicates that males are more likely to have high risk of OSA than females. ANOVA: Analysis of variance, OSA: Obstructive sleep apnea, DBP: Diastolic blood pressure, SBP: Systolic blood pressure, SD: Standard deviation, BMI: Body mass index, *n*: Number of participants

Table 4: Comparison of symptoms of OSA between non-EDS and EDS groups.

Symptoms	Non-EDS group *n*=300 *n*(%)	EDS group *n*=20 *n*(%)	χ^2	*P*-value
Snoring*	159 (53.0)	6 (30.0)	3.9	0.046
Tiredness	141 (47.0)	12 (60.0)	1.3	0.26
Observed apnea	13 (4.3)	1 (5.0)	0.02	0.89
Abrupt awakening accompanied by gasping or choking at night*	19 (6.3)	5 (25.0)	9.4	0.002
Non refreshing sleep*	107 (35.7)	12 (60.0)	4.8	0.03
Morning headache*	179 (59.7)	7 (35.0)	4.7	0.03
Memory loss (forgetfulness)*	36 (12.0)	9 (45.0)	16.9	0.001
Decreased libido*	20 (6.7)	7 (35.0)	19.5	0.001
Nocturia (frequent urination at night)*	269 (89.7)	11 (55.0)	20.6	0.001
Sleep fragmentation (excessive waking at night)	191 (63.7)	13 (65.0)	0.01	0.90
Awakening with a dry mouth or sore throat	84 (28)	6 (30)	0.04	0.85
Difficulty concentrating during the day*	18 (6)	5 (25.0)	10.1	0.001
Experiencing mood changes such as depression or irritability	40 (13.3)	5 (25.0)	2.1	0.34
Night time sweating	133 (44.3)	5 (25.0)	2.9	0.09

OSA: Obstructive sleep apnea, EDS: Excessive daytime sleepiness, [β]Int: intermediate; For Non-EDS group, ESS score is 1–9 and for EDS group, ESS score is≥10. χ^2 tested differences across the two groups. *Symptoms that show statistically significant differences between the two groups (*P*<0.05). *n:* Number of participants

Anti-hypertensive medications use and RH across risk groups

We performed a Chi-square test to examine the relationship between OSA risk groups and the number of antihypertensive medications used by the participants. The relationship between these variables was statistically significant, χ^2 (6, n = 320) = 14, P = 0.03. When Bonferroni was applied to adjust the *P*-value, the *P*-value still remained the same and the pairwise comparison showed that patients at high risk of OSA were more likely to be without antihypertensive medication compared to the intermediate-risk group. There was no statistically significant difference between the risk groups in terms of the number of antihypertensive medications used [Table 5]. Among the 95 participants with RH, 24.2%, 65.3%, and 10.5% were at low, intermediate, and high risk of OSA, respectively.

Table 5: Anti-hypertensive medication distribution among OSA risk groups.

Number of anti-hypertensive medications[β]	Low risk *n*=88 *n* (%)	*Int risk *n*=188 *n* (%)	High risk *n*=44 *n* (%)
None	4 (4.5)	5 (2.7)	6 (13.6)
One	10 (11.4)	16 (8.5)	3 (6.8)
Two	43 (48.8)	86 (45.7)	24 (54.5)
Three	31 (35.2)	81 (43.1)	11 (25.0)

(χ^2=14.0; *P*=0.03); [β]χ^2 test was applied across all four medication groups. *Int: Intermediate; OSA: Obstructive sleep apnea, *n*: Number of participants

DISCUSSION

Identification and subsequent treatment of OSA in hypertensive patients could lead to reversal of sleep-disordered breathing and modest BP reduction which are associated with significant improvements in cardiovascular events and mortality.[23] The main finding is that 13.8% of our study participants are at high risk of OSA with 18.2% experiencing EDS. In addition, more than a quarter of them had RH, and a significant proportion of those at high risk of OSA experienced snoring, nocturia, daytime tiredness, and sleep fragmentation.

The modest prevalence rate of high risk of OSA we found is similar to that of a nationwide population study in Korea[24] where 2855 out of 7650 participants had hypertension, out of whom 23.3% were at high risk of OSA. Another study that recruited 500 hypertensive patients with similar age and BMI as our study at a tertiary hospital in India found a prevalence of 23.8% using the Berlin questionnaire.[18] The prevalence studies of OSA among hypertensive patients attending outpatient clinics at tertiary hospitals in India, South-west, and South-south Nigeria found higher proportions of high risk of OSA (76.5%, 52%, and 64.1%, respectively).[8,16,25] A community-based study in a North central area of Nigeria also found a higher rate of 42% among their hypertensive sub-population.[26]

The higher prevalence rate in these studies could be attributed to differences in study design and study population characteristics. They used the Berlin questionnaire which has been shown to have less specificity compared to the STOP-BANG questionnaire at detecting high risk of OSA and yields more false-positive results.[27] The study in southwest Nigeria had a small population (n = 100) recruited from a cardiology specialist clinic, with probably a different set of unspecified

comorbidities. The hypertensive patients (n = 201) at the University of Uyo Teaching Hospital had diabetes mellitus, which is itself an independent risk factor for OSA, while the study in North-central Nigeria had a small sample size (n = 50) of participants who self-reported hypertension.

Interestingly, an alternative high prevalence of high risk of OSA which we obtained when we applied STOPBANG cutoff of ≥3 is comparable to an Indian study that assessed 179 outpatient hypertensives using the same cutoff. However, we note that more recent studies have favored the cutoff of ≥5[22,24,28,29] as it has high sensitivity and moderate specificity in identifying patients with moderate to severe OSA (apnea-hypopnea index ≥15).

Our finding that higher BMI, older age, greater neck circumference, and male gender are associated with a high risk of OSA is consistent with the previous studies.[30-32] The predominance of females in and the mean age of our study population is similar to the work of Umoh *et al*. (54.1% females)[16] and Akintunde *et al*. (60% females).[8] This may reflect the better health-seeking behavior of women compared to men in Nigeria,[33] or indicate that women aged ≥60 years tend to have greater incidence and prevalence of hypertension,[34] a phenomenon found in postmenopausal women and linked to estrogen deficiency and weight gain.[34-37]

Participants with intermediate and high risk of OSA constituted the majority of those with RH, supporting the association between OSA and resistant or poorly controlled hypertension and other cardiac diseases.[20,38]

Dyspepsia was the most common comorbid condition among the study participants. Although dyspepsia in OSA patients may indicate the presence of either GERD or PUD, it is neither sensitive nor specific for the diagnosis of these conditions.[39] A recent study demonstrated that OSA is causally associated with GERD (odds ratio: 1.30; 95% CI: 1.14–1.48, P = 0.001).[40] OSA patients also experience intermittent hypoxia, systemic inflammation, and sympathetic activation which contribute to both the initiation and progression of peptic ulcers.[41]

Our finding of the high frequency of snoring and nocturia among the high-risk OSA group was similar to a study by Romero *et al*.[42] who found a high prevalence of snoring and nocturia among 797 adults (out of 1007) polysomnographically diagnosed with OSA. The comparable sensitivities for snoring and nocturia (82.6% and 84.8%) in that study gave ground for their recommendation that nocturia should be considered as a screening symptom of OSA. Nocturia in OSA is said to result from increased intra-abdominal pressure, higher secretion of atrial natriuretic peptide, arousals, and bladder overactivity.[43]

Finally, considering the use of both the STOP-BANG questionnaire and ESS in assessing the risk of OSA; in our study, it is notable that the disparity in their detection rate reflects the marked difference in their predictive accuracy (sensitivity of 87% for STOPBANG and 39% for ESS).[44] In addition to the poor sensitivity of ESS, the cutoff of ESS >10 for identifying EDS is not clinically reproducible as demonstrated by Campbell *et al*. given that not all patients with OSA develop EDS irrespective of OSA severity.[45] The implication is that ESS is not recommended to be used to determine eligibility for a sleep study, unlike STOPBANG.[21]

Strengths and weaknesses

To the best of our knowledge, this study represents the only one evaluating the burden of high risk OSA in hypertensive patients in Nigeria within the past 10 years, and the only one conducted in the southeastern part of the country. However, being a tertiary care hospital-based study, which may recruit sicker patients, the prevalence rate found may be greater than the actual burden of high risk of OSA among hypertensive individuals in the communities.

Detection bias might have occurred in documentation of memory loss and dyspepsia among the participants, as they were self-reported. Memory loss was not evaluated with any formal neurological tool.

Measurement bias might have occurred in relation to the application of the term "resistant hypertension", as we did not confirm that participants receiving three antihypertensive medications with BP still uncontrolled (i.e., BP ≥140/90 mmHg) actually received maximum doses or maximum tolerated daily doses of each of the medications. This might have resulted in a slight overestimation of RH burden in our study population.

CONCLUSION

The proportion of the high risk of OSA among hypertensive patients presenting at tertiary hospitals in southeast Nigeria is modest, and over a quarter have RH. Snoring and nocturia are their most common presenting symptoms. We recommend screening hypertensive patients for OSA at outpatient clinics of hospitals so as to detect those at high risk. We suggest that this will improve referral for sleep studies to confirm OSA and reduce missed opportunities to treat the condition.

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Ethical approval

The author(s) declare that they have taken the ethical approval from IRB/IEC.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author(s) confirms that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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