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Demographics and Clinical Characteristics of Obstructive Sleep Apnea amongst Heart Failure Patients: A Cross-sectional Study from Ogun State, Nigeria

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Abstract

Objective: Obstructive sleep apnea (OSA) is a common disorder of breathing. It is characterised by recurrent episodes of total or partial obstruction of the upper airway during nighttime sleep. The study was aimed at evaluating the prevalence of OSA among heart failure patients and the association between echocardiogram parameters of heart failure and OSA.

Methods: This is a cross-sectional study among heart failure patients confirmed by echocardiogram. The sociodemographic, clinical, and echocardiographic variables were obtained. The questionnaire was administered by two trained independent investigators. The majority of the patients had overnight polysomnography. The data collected was analysed with SPSS version 22.

Result: 110 participants (70 males and 40 females) took part in the study; the male-to-female ratio of 1.75 to 1.53 (34 males and 19 females) performed the sleep study, giving a completion rate of 67.9%. The median age was 59.8 years. Mean BMI (SD) was 38.4(4.4) kg/m². 44 participants (40.0%) had a high risk of OSA using the STOP.BANG questionnaire, while 78 (70.9%) had no excessive daytime sleep. There was no statistical significance between gender and sleep parameters. Only 18 participants (34%) had significant OSA (AHI >5). There were significant associations between OSA severity and LVEF and STOP.BANG scores in both genders. (p<0.05)

Conclusion: This study showed a substantial rate of OSA (AHI>5) and daytime sleepiness among heart failure patients. The strong association seen between the LVEF on echocardiogram and AHI showed the need for improvement in the management strategy of heart failure patients.

Keywords: Obstructive sleep apnea, Apnea, Hypopnea, Apnea-hypopnea Index, STOB. BANG GO, Epworth Sleepiness scale

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Plain English Summary

Obstructive sleep apnea (OSA) involves recurrent upper airway obstruction during sleep, contributing to cardiovascular pathology. The study involved 110 heart failure patients from Nigeria, with a median age of approximately 60 years and a high prevalence of obesity. About 40% of participants had a high risk of OSA based on STOP-BANG screening, but only 34% showed significant OSA (AHI >5) on sleep studies. There was no significant gender difference in sleep parameters, despite a higher screening risk in males. The severity of OSA was significantly associated with reduced left ventricular ejection fraction, indicating worsened cardiac function. Most heart failure patients with OSA had systolic dysfunction, emphasising the bidirectional relationship between sleep apnea and heart failure. The study highlights the need for increased access to sleep diagnostics and integrated management approaches in low-resource settings

Introduction

The two major phenotypes of Sleep-disordered breathing (SDB) are obstructive sleep apnea (OSA) and central sleep apnea (CSA). In OSA (the most common form of SDB in the general population), there is collapse of the pharynx during sleep with consequent upper airway obstruction, often with snoring (1). Obstructive sleep apnea (OSA) is a common disorder of breathing in various communities worldwide (2). It is globally recognised as the most common form of sleep-disordered breathing in adults and is associated with poor outcomes, including the risk of death (3, 4). It is characterized by recurrent episodes of total (apnea) or partial (hypopnea) obstruction of the upper airway during night time sleep causing repeated arousal from sleep, intermittent hypoxemia, hypercapnia and daytime sleepiness consequently leading to various abnormalities in body function such as metabolic, cardiovascular, increased oxidative stress, inflammation and sleep fragmentation (5).

The American Academy of Sleep Medicine (AASM) recommends that hypopneas be identified using a definition that is based on a $\geq 30\%$ decrease in airflow associated with a $\geq 3\%$ reduction in the oxygen saturation or arousal for diagnosis of obstructive sleep apnea (OSA) in adults while apnea is defined as complete cessation of airflow for >10 s (6). The diagnosis of OSA is confirmed if the number of obstructive events (apneas, hypopneas with respiratory event-related arousals) on Polysomnography is more than 15 events in an hour or more than 5 events per hour in a patient who reports any of the following: daytime sleepiness and or un-refreshing sleep (6).

Multiple studies have shown that OSA is associated with the development of cardiovascular diseases (7), impaired glucose metabolism (8), hypertension (5), and coronary artery disease (9, 10). Documented risk factors for OSA include male gender, obesity, excessive alcohol intake, tobacco, upper airway obstruction, e.g., large tonsils, ethnicity, neck mass, e.g., large underactive thyroid

gland, abuse of sedatives and menopause in women (11).

Heart failure (HF) is rapidly becoming a global health burden. It affects approximately 23-26 million people worldwide (12), and 5.8 million in the United States (13). There is a paucity of comprehensive data on heart failure in Nigeria. However, population-based studies estimated that cardiovascular diseases accounted for 7-10% of all medical admissions to hospitals in Africa, and HF constitutes 3-7% of these admissions (14).

Sleep-disordered breathing (SDB), or sleep apnea, is common in patients with cardiovascular disease, and its presence is associated with a poorer prognosis and high healthcare costs. In recent years, studies have revealed that a significant number of heart failure patients have co-existing OSA. This sleep disorder was previously underestimated in heart failure patients (15). OSA is more common in NYHA functional classes I and II, while central sleep apnea is more common in NYHA functional classes III and IV (16, 17, 18). Both diseases are related in a bidirectional way; obstructive sleep apnea (OSA) often leads to the development of HF through multiple means. Apnea can cause an acute rise in cardiac afterload and subsequent hypertension, which may contribute to the development of myocardial hypertrophy and eventually HF. OSA also increases the risk of myocardial infarction and impaired recovery of cardiac function after the event. Impaired cardiac function, as seen in heart failure and myocardial infarction, may contribute to the development of OSA (19). This study was designed to provide insight into the associations, if any, between heart failure and OSA in Nigerians with heart failure. There are no local studies on the effects of OSA on heart failure among Nigerian and black Africans. Therefore, our study was designed to determine the prevalence of OSA among heart failure patients and to determine the association between heart failure severity and OSA in patients being managed at Babcock University Teaching Hospital, Sagamu, Ogun State, Nigeria.

Materials and Methods

Study area

We conducted a cross-sectional, observational study from July 2020 to June 2022 among heart failure patients in the Sleep Unit of the Interventional Cardiology Department of a tertiary hospital in Ogun State, Nigeria. The interventional Cardiology Department is a 70-bed centre with 12 beds in the Intensive Care Unit, managing between 400-500 heart failure patients yearly.

Subject population/subject selection

The study population consisted of 504 adult men and women aged 32-84 years who were being managed for heart failure at the cardiology clinic of the hospital. After patients who had non-cardiac life-threatening diseases such as cancers, stroke, chronic obstructive pulmonary disease, poorly controlled asthma and those with valvular heart disease requiring surgical treatment were excluded, a consecutive sampling method was employed among patients who fulfilled the inclusion criteria and gave written and verbal informed consent. These patients were assessed by echocardiography within 3 months of being enrolled on this study.

Inclusion criteria

The patient must be 18 years and above with no clinical history or evidence of any life-threatening diseases such as cancers, stroke, chronic obstructive pulmonary disease, poorly controlled asthma and those with valvular heart disease requiring surgical treatment. The patient must be clinically stable and have received optimal medical therapy for heart failure for at least 1 month.

Assessment tools

The sociodemographic, clinical, and echocardiographic variables were obtained as a baseline by trained interviewers. STOP-BANG and Epworth Sleepiness Scale (ESS) questionnaires were then administered by two trained investigators independently of each other to assess the risk of obstructive sleep apnea and daytime sleepiness in these patients. Subsequently, the majority of the patients had overnight polysomnography.

Definitions

An echocardiogram (trans-thoracic) was performed in the cardiac laboratory using an ultrasound machine with a 3.75-MHz sector probe by a single experienced cardiologist blinded to clinical information on patients at baseline. All images were obtained using standard techniques: M-

mode, two-dimensional, and Doppler measurements in line with the recommendations of the American Society of Echocardiography (ASE). Left ventricular systolic function was assessed by estimating the ejection fraction (EF) using the modified Simpson's method. LV systolic dysfunction was graded with left ventricular ejection fraction (LVEF) as mild (41-45%), moderate (36-40%), and severe (<35%) (20).

Diastolic function was assessed by pulse wave Doppler examination of the mitral inflow and Doppler imaging (TDI) of the medial mitral annulus. Diastolic dysfunction was graded on a four-point ordinal scale as (1) normal, (2) mild diastolic dysfunction= abnormal relaxation without increased LV end-diastolic filling pressure (decreased E/A ratio <0.75), (3) moderate diastolic dysfunction= abnormal relaxation with increased LV end-diastolic filling pressure (E/A 0.75 to 1.5, deceleration time >140ms, plus 2 other Doppler indices of elevated end-diastolic filling pressure), (4) or severe diastolic dysfunction= advanced reduction in compliance with restrictive filling (E/A ratio >1.5, deceleration time <140ms, and Doppler indices of elevated LV end-diastolic filling pressure. Participants with atrial fibrillation diastolic function were classified as indeterminate unless restrictive physiology (E/A>1.5, deceleration time <140ms) was present (21).

Sleep studies were performed overnight in the Cardiology ward of the hospital with the aid of a computerised system. Oro-nasal airflow was measured with a chest thermistor while chest and abdominal effort were measured by inductance plethysmography. A pulse oximeter was used to measure the peripheral oxygen saturation (SPO₂) at the same time. The other parameters recorded were oxygen desaturation index (ODI), snoring index, body position change index (arousal index), apnea index (AI), hypopnea index (HI), and apnea-hypopnea index (AHI). The apnea-hypopnea index (AHI) is the combined average number of apnea and hypopnea that occur per hour of sleep. According to AASM, it is classified into mild (5-15 events/ hour), moderate (15-30 events/ hour and severe (>30 events/ hour).

This study was carried out to assess the prevalence of obstructive sleep apnea among heart failure patients and to evaluate the association between echocardiogram parameters of heart failure and OSA.

Data analysis

The data collected in this study were analysed with SPSS (Statistical Program for Social Sciences) version 22. General characteristics of the patients,

including the socio-demographic data (age, gender and level of education), were subjected to univariate analyses. Continuous (such as weight, height, BMI, neck circumference, and sleep study values) and categorical variables were presented as frequency, mean, and standard deviation. Significant statistical differences were assessed with the chi-square [χ^2] test for categorical variables and Student's *t*-test or *F*-test for continuous variables. Associations between variables or predictive factors for disability were analyzed with Poisson regression analysis or predictive factors of disability. The level of statistical value was set at a *p*-value of 0.05.

Results

A total population of 504 heart failure patients (311 males and 193 females) attends the cardiology clinic of the hospital. However, 397 patients (218 males, 179 females) fulfilled the inclusion criteria. Out of this number, only 110 patients (70 males, 40 females) gave written and oral informed consent and were recruited into the study with a male: female ratio of 1.75:1. Of these, 78 subjects (56 males, 22 females) had intermediate and high risk of OSA using STOP.BANG score out of which 53 (34 males and 19 females), performed the sleep study, giving a completion rate of 67.9%. The process of enrolment is depicted in Figure 1.

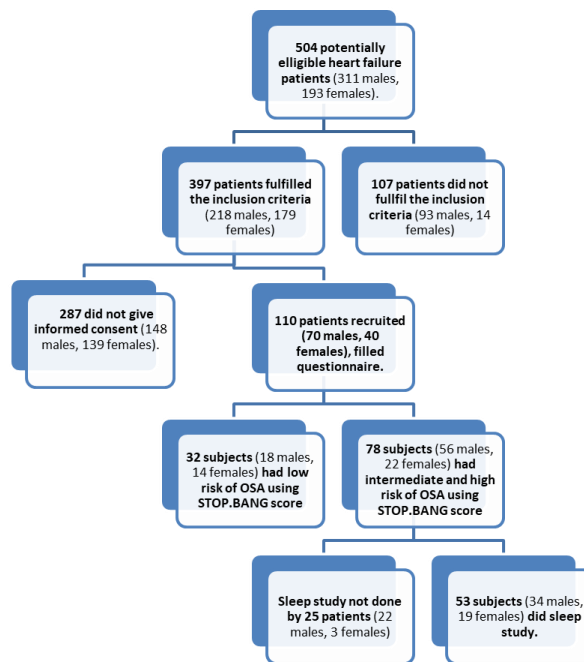


Figure 1: Screening and enrolment of study participants

Socio-demographic characteristics

The socio-demographic characteristics of the 110 study participants are shown in Table 1. The age range of the study participants was between 32 years to 84 years old; the median age was 59.8 years. The majority of them, 40 (36.4%), had normal body mass index (BMI), and 36 (32.7%) were obese; the mean BMI (SD) was 38.4(4.4) kg/m². Only 10 (9.1%) study participants are current cigarette smokers. A majority (n=70, 63.6%) had been diagnosed with heart failure for less than 5 years. With the use of sleep

assessment tools, the majority (n=78, 40.0%) had an intermediate and a high risk of sleep abnormalities using the STOP.BANG questionnaire, while more than two-thirds (n=72, 70.9%) had no excessive daytime sleep abnormalities using the Epworth sleepiness scale questionnaire. The majority of the study participants (n=72, 65.4%) had severe Left Ventricular Ejection Fraction (LVEF) dysfunction, while less than a third (n=32, 29.1%) had severe diastolic dysfunction on echocardiogram.

Table 1: Socio-demographic characteristics of study participants

Characteristics	All participants N=110(%)	Males n=70(%)	Females n=40(%)
Median age in years	59.8(32.4)	60.7(34.0)	59.5(30.8)
Age groups			
< 50 years	23(23.6)	16(22.9)	10(25.0)
≥ 50 years	84(76.4)	54(77.1)	30(75.0)
Level of Education			
No formal education	23(21.0)	16(22.8)	7(17.5)
Primary	49(44.5)	32(45.7)	17(42.5)
Secondary	27(24.5)	14(20.0)	13(32.5)
Tertiary	11(10.0)	8(11.5)	3(7.5)
Mean±SD BMI in kg/m²	27.4±6.6	26.8±6.5	28.6±6.9
BMI categories in kg/m²			
Underweight (<18.5)	2(1.8)	2(2.9)	0(0.0)
Normal (18.5-24.9)	40(36.4)	26(37.1)	14(35.0)
Overweight (25-29.9)	32(29.1)	24(34.3)	8(20.0)
Obese (≥30)	36(32.7)	18(25.7)	18(45.0)
Smoking history			
Non smokers	84(76.4)	46(65.7)	38(95.0)
Ex-smokers	16(14.5)	14(20.0)	2(5.0)
Current smokers	10(9.1)	10(14.3)	0(0.0)
Mean±SD Neck Circumference (cm)	38.4±4.4	39.1±4.7	37.0±3.5
Neck Circumference			
<43 cm/17 inches	92(83.6)	54(77.1)	38(95.0)
≥43cm/17 inches	18(16.4)	16(22.9)	2(5.0)
STOP.BANG Score			
Low risk	32(29.1)	14(20.0)	18(45.0)
Intermediate risk	34(30.9)	20(28.6)	14(35.0)
High risk	44(40.0)	36(51.4)	8(20.0)
Epworth Sleepiness Scale			
Normal	78(70.9)	48(68.6)	30(75.0)
Mild sleepiness	20(18.2)	14(20.0)	6(15.0)
Moderate sleepiness	10(9.1)	6(8.5)	4(10.0)
Severe sleepiness	2(1.8)	2(2.9)	0(0.0)
Duration of heart failure diagnosis			
<5 years	70(63.6)	38(54.3)	28(70.0)
≥ 5 years	40(36.4)	32(45.7)	12(30.0)
Echocardiograph findings			
Left Ventricular Ejection Fraction (LVEF)			
Normal (EF>45%)	6(5.5)	4(5.7)	2(5.0)
Mild (EF=41-45%)	20(18.2)	10(14.3)	10(25.0)
Moderate (EF=36-40%)	12(10.9)	6(8.5)	6(15.0)
Severe (EF≤35%)	72(65.4)	50(71.5)	22(55.0)
Diastolic dysfunction			
Normal	12(10.9)	6(8.5)	6(15.0)
Mild	34(30.9)	24(34.3)	10(25.0)
Moderate	32(29.1)	16(22.9)	16(40.0)
Severe	32(29.1)	24(34.3)	8(20.0)

Sleep pattern and severity of Obstructive Sleep Apnea

Table 2 shows the mean (SD) values of sleep parameters in study participants (n=53) who did the sleep study. Mean SPO₂ (oxygen saturation) was

(92.6±8.8)%; ODI (25.8±40.1); Snoring Index (210.8±194.9) per hour; Body position change count (155.7±204.9); Hypopnea index (6.0±11.6) per hour; Apnea Index (33.8±45.7) per hour; and Apnea-hypopnea Index (9.6±15.1) per hour for the

53 participants with sleep study. We compared the mean values between male and female participants and observed no statistical

significance in the various values of the parameters of the sleep study. (p>0.05).

Table 2: Mean sleep study values in 53 participants

Variable	Mean(SD)						
	SPO ₂ (%)	OD index	Snoring Index (per hour)	Body position change count	Apnea Index (per hour)	Hypopnea Index (per hour)	Apnea-Hypopnea Index (AHI) (per hour)
Males, n=34	91.5(8.9)	20.9(30.1)	175.7(182.5)	179.9(240.0)	31.3(40.0)	4.6(7.1)	10.3(14.1)
Females, n=19	94.7(8.5)	34.7(53.4)	273.4(205.3)	112.3(110.7)	38.3(55.3)	8.1(17.0)	8.5(17.1)
All participants, n=53	92.6(8.8)	25.8(40.1)	210.8(194.9)	155.7(204.9)	33.8(45.7)	6.0(11.6)	9.6(15.1)
F test	1.576	1.457	3.185	1.342	0.276	1.014	0.162
p-value	0.219	0.228	0.082	0.253	0.595	0.316	0.685

Grading of OSA severity with AHI

Based on AASM consensus criteria, using the Apnea-Hypopnea Index (AHI), sleep pattern was normal in 35 participants (66.0%), 14 (13.2%)

participants had mild OSA, 8 (15.1%) participants had moderate OSA and only 3 (5.7%) had severe OSA (Figure 2).

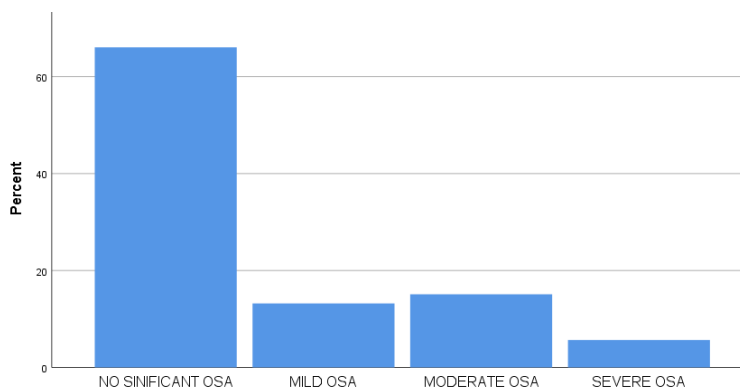


Figure 2: The classification of Obstructive sleep apnea severity by AHI in heart failure patients using the AASM criteria

Relationship between obstructive sleep apnea severity and echocardiography features of heart failure in the study participants

Our study demonstrated significant associations between obstructive sleep apnea severity and Left Ventricular Ejection fraction (p=0.016 and p=0.042)

among male and female study participants, respectively. However, there was no significant association between obstructive sleep apnea severity and diastolic dysfunction among all study participants, irrespective of gender (p>0.05) (Table 3).

Table 3: Relationship between obstructive sleep apnea severity and echocardiography features of heart failure in study participants

Gender	OSA classification	Left Ventricular Ejection Fraction (LVEF) n=53(%)				*p-value	Diastolic dysfunction n=53(%)				*p-value
		Normal	Mild	Mod	Severe		Normal	Mild	Mod	Severe	
Male	No significant OSA	2(3.8)	5(9.4)	1(1.9)	12(22.6)	0.016	3(5.7)	5(9.4)	5(9.4)	7(13.2)	0.544
	Mild OSA	0(0.0)	1(1.9)	0	4(7.5)		1(1.9)	1(1.9)	2(3.8)	2(3.8)	

Female	Moderate OSA	0(0.0)	1(1.9)	2(3.8)	5(9.4)		0(0.0)	3(5.7)	2(3.8)	1(1.9)	
	Severe OSA	0(0.0)	0(0.0)	0(0.0)	1(1.9)		0(0.0)	0(0.0)	1(1.9)	1(1.9)	
	No significant OSA	1(1.9)	1(1.9)	2(3.8)	11(20.8)	0.042	1(1.9)	7(13.2)	4(7.5)	3(5.7)	0.244
	Mild OSA	0(0.0)	0(0.0)	0(0.0)	2(3.8)		0(0.0)	0(0.0)	0(0.0)	1(1.9)	
	Moderate OSA	0(0.0)	0(0.0)	0(0.0)	0(0.0)		1(1.9)	0(0.0)	1(1.9)	1(1.9)	
All participants	Severe OSA	0(0.0)	0(0.0)	1(1.9)	1(1.9)		0(0.0)	0(0.0)	0(0.0)	0(0.0)	
	No significant OSA	3(5.7)	6(11.3)	3(5.7)	23(43.4)	0.732	4(7.5)	12(22.6)	9(17.0)	10(18.9)	0.821
	Mild OSA	0(0.0)	1(1.9)	0(0.0)	6(11.3)		1(1.9)	1(1.9)	2(3.8)	3(5.7)	
	Moderate OSA	0(0.0)	1(1.9)	2(3.8)	5(9.4)		1(1.9)	3(5.7)	3(5.7)	1(1.9)	
	Severe OSA	0(0.0)	0(0.0)	1(1.9)	2(3.8)		0(0.0)	0(0.0)	1(1.9)	2(3.8)	

*Fischer's exact test

Relationship between obstructive sleep severity and the results of OSA assessment tools of heart failure in the study participants

Table 4 shows significant associations between obstructive sleep apnea severity and STOP.BANG risk groups (p=0.000 and p=0.014) among male

and female study participants, respectively. However, there was no significant association between Obstructive sleep apnea severity and Excessive daytime sleepiness evaluated with the Epworth Sleepiness Scale (ESC) among all study participants irrespective of gender (p>0.05).

Table 4: Relationship between obstructive sleep severity and OSA assessment tools of heart failure in study participants

GENDER	OSA CLASSIFICATION	STOP. BANG RISK STRATIFICATION			p-value	EPWORTH SLEEPINESS SCALE				P-value
		Low	Intermediate	High		Normal	Mild	Moderate	Severe	
Male	No significant OSA	6(10.9)	8(14.4)	7(12.6)	0.000	19(34.5)	3(5.5)	2(3.6)	1(1.8)	0.659
	Mild OSA	2(3.6)	2(3.6)	2(3.6)		4(7.3)	1(1.8)	0(0.0)	0(0.0)	
	Moderate OSA	3(5.5)	0(0.0)	3(5.5)		2(3.6)	1(1.8)	0(0.0)	0(0.0)	
	Severe OSA	0(0.0)	0(0.0)	1(1.8)		0(0.0)	0(0.0)	0(0.0)	0(0.0)	
Female	No significant OSA	4(7.3)	5(9.1)	5(9.1)	0.014	8(14.4)	2(3.6)	1(1.8)	0(0.0)	0.609
	Mild OSA	0(0.0)	0(0.0)	1(1.8)		2(3.6)	2(3.6)	1(1.8)	0(0.0)	
	Moderate OSA	0(0.0)	1(1.8)	1(1.8)		1(1.8)	1(1.8)	1(1.8)	0(0.0)	
	Severe OSA	0(0.0)	0(0.0)	2(3.6)		0(0.0)	0(0.0)	0(0.0)	0(0.0)	

All participant	No significant OSA	10(18.2)	13(23.6)	12(21.8)	0.298	27(49.1)	5(9.1)	3(5.5)	1(1.8)	0.119
	Mild OSA	2(3.6)	2(3.6)	3(5.5)		6(10.9)	3(5.5)	1(1.8)	0(0.0)	
	Moderate OSA	3(5.5)	1(1.8)	4(7.3)		3(5.5)	2(3.6)	1(1.8)	0(0.0)	
	Severe OSA	0(0.0)	0(0.0)	3(5.5)		1(1.8)	0(0.0)	0(0.0)	0(0.0)	

*Fischer's exact test

Discussion

In sub-Saharan Africa (SSA), there is a growing interest in sleep disorders in Africans due to increasing recognition of the increasing burden of both central and obstructive sleep apneas (11). Previous studies have focused on sleep abnormalities in hospitalised patients irrespective of the indications for admission, and vulnerable groups such as patients with heart failure, who might face other health conditions, have not been explored in Sub-Saharan Africa (SSA) and indeed globally (2, 4, 5, 9, 10).

One of the most important findings in this study was the low but significant prevalence of OSA, as the majority of participants (n=35, 66.0%) had no evidence of OSA as shown by the AHI, among heart failure patients. This is supported by the result of the Epworth sleepiness scale, in which a majority of participants (n=78, 70.9%) also had no evidence of daytime sleepiness. However, the STOP.BANG evaluation result stands in contrast to these findings, with the risk of OSA almost evenly distributed and the highest risk seen in 44 (40.0%) participants. This study did not show any significant association between the participants who were assessed to be at risk of OSA using the EPS questionnaire and those diagnosed with OSA using the sleep test. However, there were significant associations between study participants diagnosed with OSA using the sleep test and the STOP.BANG risk classes in both male and female participants.

The STOP.BANG questionnaire finding of high risk of OSA (n=44, 40.0%) in this study is similar to what was reported by Ozoh OB et al (24) in which the risk of OSA (based on the STOP-BANG questionnaire) was low in 701 (63.7%) and high in only 399 (36.3%) of the participants. This is also similar to the findings by Obaseki et al (25), and Worku A et al (26), among patients with Type 2 Diabetes Mellitus. Obaseki et al discovered that only 27% of the study respondents had a high risk for OSA, and only 22% had excessive daytime sleepiness (25).

The reason for the differences in the findings of the risk of OSA found in the EPS and STOP.BANG

questionnaires in this study may be due to the level of understanding of the questions posed in the questionnaires, as the majority of respondents had a primary level of education or no formal education. Worku et al also discovered that the overall prevalence of a high risk of obstructive sleep apnea among the study participants was low (31.97%) (26). Similar findings were observed in studies done by Awopeju OF et al (27), and Tete B et al (28), in an adult population in Ile-Ife, Nigeria, and Kinshasa, Democratic Republic of Congo, respectively, among patients attending outpatient clinics. This suggests that other factors, such as socio-economic, environmental, and comorbidity, which are pervasive in many heart failure patients, may play a role in the evolution and presentation of Obstructive sleep apnea.

The prevalence of significant OSA using AASM criteria as indicated by AHI value > 5 per hour in this present study (n=25, 22.7%) is similar to that reported among the general population by Young et al (29), in which the estimated prevalence of sleep-disordered breathing, defined as AHI >5 or higher was 9% for women and 24% for men. AHI score >5 in many heart failure patients often portends increased morbidity and mortality and therefore calls for improved heart failure care and care of possible fatal comorbidities.

Despite the association between OSA severity and LVEF in this study, no heart failure patients who participated in this study had had a sleep test before their inclusion in this study. Also, the inability of a large cohort of study participants to do the sleep test was a major limitation of this study, as the majority were solely responsible for their healthcare cost which in this part of the world had to come out of the pockets of individual heart failure patient, as a result of non-availability of effective and durable health insurance coverage. This exposes the limitations in our healthcare delivery system in Nigeria and Sub-Saharan Africa.

The presence of an association between OSA and systolic cardiac dysfunctions among heart failure patients in this study showcases the need to include sleep tests as a priority service in the

development of treatment interventions in patients with cardiovascular diseases to improve the health service delivery to heart failure patients and other patients with chronic diseases in Nigeria, Africa, and all over the world.

Conclusion

We have reported a substantial rate of risk of OSA using the STOP.BANG questionnaire and prevalence of OSA (AHI>5) using the AASM criteria among heart failure patients in this study, which is similar to findings in other diseases, such as patients with type 2 DM. However, the strong association seen between the LVEF on echocardiogram and AHI showed the need for improvement in the management strategy of heart failure patients and enhancement of access to sleep tests to aid prompt diagnosis of OSA among heart failure patients.

List of Abbreviations

OSA: Obstructive Sleep Apnea
LVEF: Left Ventricular Ejection Fraction
AHI: Apnea-Hypopnea Index
STOP-BANG: Snoring, Tiredness, Observed apneas, high blood Pressure, BMI, Age, Neck circumference, Gender (screening tool)
BMI: Body Mass Index
BP: Blood Pressure
HF: Heart Failure

Declarations

Ethical approval and consent to participate

Ethical clearance to carry out this research was sought and obtained from the Department of Health, Planning, Research and Statistics, Ogun State Ministry of Health, Abeokuta, Ogun State, Nigeria (HPRS/381/384). Confidentiality and privacy of respondents were duly respected during and after the period of collecting and collating data. Serial numbers rather than names were used to ensure confidentiality.

Consent for publication

All the authors gave consent for the publication of the work under the Creative Commons Attribution-Non-Commercial 4.0 license.

Availability of Data

Data for this work are available from the authors and may be provided upon reasonable request.

Conflict of interest

The authors have declared no conflict of interest

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Authors' contributions

All authors participated in the conceptualisation, design, definition of intellectual content, literature search, clinical studies, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, and manuscript review. All authors read and approved the final version of the manuscript.

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