

# Sleep-Disordered Breathing by AHI in Patients Hospitalized for Heart Failure at CNHU-HKM in Cotonou: Frequency and Associated Factors

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## Abstract

**Introduction:** This study aimed to investigate the frequency of sleep-disordered breathing (SDB) and associated factors among patients hospitalized for heart failure at the Cardiology University Clinic of CNHU-HKM in Cotonou.

**Method and patients:** This was an analytical cross-sectional study with prospective data collection conducted over 7 months. It included, by exhaustive enrolment, all patients over 18 years old, regardless of sex, admitted to the hospital with heart failure. The variables studied were the presence or absence of a SDB and associated factors. SDB was considered if the apnea-hypopnea index (AHI) was  $\geq 5$ . **Results:** Fifty patients were included. The mean age was  $59.26 \pm 16.0$  and the sex-ratio was 1.5. The in-hospital incidence of SDB was 76% (38 cases) and 44% of whom were moderate to severe forms. Associated factors were abdominal obesity ( $p = 0.019$ ) and poor sleep quality as measured by the Pittsburgh Sleep Quality Index  $\geq 5$  ( $p = 0.03$ ). **Conclusion:** SDB appears to be frequent in patients with heart failure. There are certainly other associated factors to be identified in studies involving a more representative sample.

## Keywords

AHI, Sleep-Disordered Breathing, Heart Failure, Cotonou

## 1. Introduction

Heart failure (HF) affects over 23 million people worldwide [1] [2]. Heart failure

is a complication of a variety of conditions affecting the heart and blood vessels. The prognosis of heart failure patients can be compromised by comorbidities such as sleep-disordered breathing (SDB).

According to the European Lung Foundation, the term “sleep-disordered breathing” refers to a series of conditions that result in abnormal breathing during sleep [3]. SDB which includes obstructive sleep apnoea (OSA), central sleep apnoea (CSA), or a combination of both is present in over half of heart failure (HF) patients and may negatively impact cardiac function through fluctuations in intrathoracic pressure (affecting preload and afterload), blood pressure, sympathetic nervous system activity, and repeated episodes of hypoxaemia [4]. SDB is known to be a life-threatening condition in patients with HF. Their prevalence can be up to 80% [4] [5]. Screening and treatment of SDB in heart failure patients has also been shown to improve quality of life and prevent cardiovascular events and re-hospitalization [4] [5]. In Benin, data concerning SDB and its associated factors are scarce. The availability of such data will enable us to effectively prevent SDB and thereby improve the vital prognosis of patients with heart failure.

The present study aims to fill this gap in a sample of patients hospitalized for heart failure in Cotonou, Benin. The purpose of the study was to investigate the frequency and factors associated with SDB in patients hospitalized for HF at the Cardiology University Clinic of CNHU-HKM.

## 2. Method and Patients

This was a cross-sectional analytic study with prospective data collection performed from April 01 to October 31, 2024 at the University Cardiology Clinic (CUC) of the National University Hospital Center Hubert Koutoukou Maga in Cotonou. It included, by exhaustive enrolment, all patients aged over 18, without distinction of sex, admitted to hospital for heart failure and who gave their free and informed consent to participate in the study.

The diagnosis of heart failure was established based on the 2024 European Society of Cardiology (ESC) criteria [6].

The dependent variable was the presence or absence of sleep-breathing disorders. SDB was considered present when the apnea-hypopnea index (AHI) was greater than or equal to 5. AHI refers to the number of episodes of apnea or hypopnea experienced by the patient in one hour. This number should be less than 5 [7]. SDB was considered mild for an AHI between 5 and 15, moderate for an AHI between 15 and 30, and severe for an AHI greater than or equal to 30.

AHI was measured during ventilatory polygraphy. Two ResMed ApneaLink Air® polygraphs were used, capable of recording up to five channels of information: respiratory effort, pulse, oxygen saturation, nasal flow and snoring. The definitions of apnoea, hypopnoea, and oxygen desaturation were based on the default settings of the recording system. Sleep was recorded during the last 2 days prior to discharge. Patients who did not perform ventilatory polygraphy were excluded from the study.

The independent variables included the Pittsburgh Sleep Quality Index (PSQI). This is an 11-question quiz asking how often each patient had experienced certain difficulties during sleep in the month preceding the survey. For each question, a score from 0 to 3 is assigned to each answer (examples of answers: not at all, less than once a week, once or twice a week, at least 3 times a week). By adding up the scores, we obtain an overall PSQI score. A score of  $\geq 5$  indicates poor sleep quality [8]. Other dependent variables were CHARLSON score  $\geq 3$ , body mass index, left ventricular ejection fraction, renal insufficiency, atrial fibrillation, abdominal obesity, diabetes, arterial hypertension and nocturnal snoring. The CHARLSON score is used to assess the importance and severity of comorbidities that could influence mortality. This score takes into account 19 conditions, and a certain number of points are attributed to the presence of each condition. A score of 3 or more is associated with a poor 10-year survival rate [9]. Abdominal obesity was defined as a waist circumference greater than 88 cm in women and 102 cm in men [10]. Hypertension was defined as blood pressure greater than or equal to 140/90 mmHg, or less than this value on antihypertensive medication. Diabetes was defined as fasting blood glucose greater than or equal to 1.26 g/l, or normal on anti-diabetic medication. Patients with an electrocardiogram showing absence of P waves, isoelectric line tremulation and irregular RR intervals were considered to be in atrial fibrillation. Renal failure was defined as a glomerular filtration rate, estimated by the CKD-EPI formula, of less than 60 ml/min/1.73 m<sup>2</sup> [11].

Data were entered using KoboCollect software, and statistical analysis was carried out using R software version 4.4.2. Quantitative variables were presented as mean with standard deviation, and qualitative variables as frequency and percentage. Associations were sought using a chi-square test and binary logistic regression, with the odds ratio as the measure of association. The significance level of p was 0.05.

In multivariate analysis, variables with a p-value of less than 0.25 were retained in a binary logistic regression model to assess the impact of other independent variables on SDB. Measures of association were adjusted odds ratios (ORa) with 95% confidence intervals. The significance level was 0.05. The Hosmer-Lemeshow test verified the validity of the final regression model.

The opinion of the Local Ethics Committee for Biomedical Research at the University of Parakou was requested and obtained.

### 3. Results

The sample included 50 patients. Males were the most represented, accounting for 60% of the sample (30 cases), *i.e.* a sex-ratio of 1.5. The mean age was  $59.3 \pm 16.0$  years. Patients aged 60 or over accounted for 56% of the sample (28 cases), compared with 44% (22 cases) of patients aged under 60.

Hypertension was the most common cardiovascular risk factor, accounting for 78% of cases (39 patients). Clinically, patients presented with congestive HF in the majority of cases, *i.e.* 84% (42 patients).

On electrocardiogram, atrial fibrillation was present in 20% of cases (10 patients). On cardiac Doppler ultrasound, the left ventricular ejection fraction was reduced to less than 40 in more than half the cases (54%, 27 patients). The causes of HF were dominated by arterial hypertension (56%), coronary insufficiency (50%) and dilated cardiomyopathy (18%).

**Table 1** shows the distribution of patients in the sample according to general characteristics, cardiovascular risk factors, clinical and paraclinical presentation.

**Table 1.** Distribution of 50 patients hospitalized for heart failure according to general characteristics, cardiovascular risk factors, clinical and paraclinical presentation and causes (CNHU-HKM, Cotonou, 2024).

	Characteristics		
		Workface	Percentage
Sex	Male	30	60.0
	Female	20	40.0
Age ranges (years)	<40	08	16.0
	[40 - 60[	14	28.0
	≥60	28	56.0
Cardiovascular risk factors	Hypertension	39	78.0
	Diabetes	05	10.0
	Abdominal obesity	19	38.0
	Renal failure	17	34.0
Electrocardiographic abnormalities	Atrial fibrillation	10	20.0
	Atrial flutter	02	04.0
Left Ventricular Ejection Fraction (%)	≤ 40	27	54.0
	]40 - 50[	9	18.0
	≥50	14	28.0
Causes	Hypertension	28	56.0
	Coronary insufficiency	25	50.0
	Dilated cardiomyopathy	09	18.0
	Peripartum Cardiomyopathy	04	08.0
	Chronic pulmonary heart	04	08.0
	Mitro-aortic valvulopathy	03	06.0
	Cardiothyreosis	02	04.0
	Restrictive cardiomyopathy	02	04.0

A PSQI was greater than or equal to 5 in 64% of cases (32 patients) and less than 5 in 36% of cases (18 patients). The CHARLSON score was greater than or equal to 3 in 46% of cases (23 patients) and less than 3 in 54% of cases (27 patients).

The mean AHI was  $16.30 \pm 14.88$ , with extremes ranging from 0.6 to 60. The hospital frequency of SDB according to AHI was 76%. Of these, 32% (16 cases)

had a mild disorder, 26% (13 cases) a moderate disorder and 18% (9 cases) a severe disorder.

Factors associated with an AHI  $\geq 5$  were investigated. In bivariate analysis, only abdominal obesity was significantly associated with an AHI  $\geq 5$  (**Table 2**).

**Table 2.** Distribution of 50 patients hospitalized for heart failure according to AHI and general characteristics, cardiovascular risk factors, PSQI value and CHARLSON score (CNHU-HKM, Cotonou, 2024).

	AHI		p-value
	AHI $\geq 5$	AHI $< 5$	
<b>Age (years)</b>			
<60	18 (81.8)	4 (18.2)	0.51
$\geq 80$	20 (71.4)	8 (28.6)	
<b>Sex</b>			
Male	21 (70.0)	9 (30.0)	0.31
Female	17 (85.0)	3 (15)	
<b>LVEF</b>			
$\leq 40\%$	20 (74.1)	07 (25.9)	1
$> 40\%$	18 (78.2)	5 (21.7)	
<b>Abdominal obesity</b>			
Yes	18 (94.7)	1 (5.3)	0.02
No	20 (64.5)	11 (35.5)	
<b>Hypertension</b>			
Yes	30 (76.9)	9 (23.1)	1
No	8 (72.7)	3 (27.3)	
<b>Diabetes</b>			
Yes	4 (80.0)	1 (20.0)	1
No	34 (75.6)	11 (24.4)	
<b>Charlson Score</b>			
$\geq 3$	18 (78.3)	5 (21.7)	1
$< 3$	20 (74.1)	7 (25.9)	
<b>Renal Failure</b>			
Yes	13 (76.5)	4 (23.5)	1
No	25 (75.8)	8 (24.2)	
<b>Atrial fibrillation</b>			
Yes	9 (90.0)	1 (10.0)	0.41
No	29 (72.5)	11 (27.5)	
<b>PSQI</b>			
$\geq 5$	27 (84.4)	5 (15.6)	0.08
$< 5$	11 (61.1)	7 (38.9)	

AHI: apnea hypopnea index, LVEF: left ventricular ejection fraction.

In multivariate analysis, abdominal obesity (adjusted odds ratio: 15.01, 95% CI [2.23 - 313.14], p-value: 0.019) and a PSQI  $\geq$  5 (adjusted odds ratio: 5.55, 95% CI [1.24 - 29.22], p-value: 0.03) were significantly associated with an AHI  $\geq$  5 (**Table 3**).

**Table 3.** Multivariate analysis considering AHI  $\geq$  5 and independent variables on SDB (CNHU-HKM, Cotonou, 2024).

	AHI		
	ORa	95% CI	p-value
<b>Abdominal obesity</b>			
Yes	15.01	[2.23 - 313.1]	0.019
No	1	-	
<b>PSQI</b>			
$\geq$ 5	5.55	[1.24 - 29.2]	0.030
<5	1	1	

ORa: odds-ratio adjusted; 95%CI: 95% Confidence Interval; PSQI: Pittsburg Sleep Quality Index.

#### 4. Discussion

One of the limitations of this study is that no distinction was made between central and obstructive sleep apnea. However, this study did report a high in-hospital frequency of SDB, similar to other results published in the literature. In India, this frequency was 81.55%, with a predominance of obstructive sleep apnea (59.2% vs. 22.3%) [12]. According to Javaheri *et al.*, the predominance of obstructive apnea was not found in all HF situations. Indeed, for an AHI  $\geq$ 15, central apnea was predominant in chronic HF with reduced ejection fraction, at equal frequency with the central form in chronic HF with preserved ejection fraction (23% vs. 24%) and at lower frequency in cardiogenic acute pulmonary edema [13]. In CHF with preserved ejection fraction, a German series found 69.3% of SDB based on an AHI  $\geq$  5. In this study, obstructive sleep apnea was the most common form (39.8% vs. 29.5%) [14].

Nevertheless, lower frequencies of SDB in HF patients have been found in the literature, notably in the study by Daniel FA *et al.* in Nigeria in 2023, which found 48.8% of SDB in 100 HF patients included. This disparity could be explained by the method used, which considered respiratory impairment on the basis of an oxygen desaturation index of 3%  $\geq$  12.5/hour [15]. Overweight in general is recognized as a factor associated with sleep apnea. Along with abdominal obesity, parameters such as high neck circumference or high body mass index have been identified as factors associated with SDB [16].

The use of sleep quality questionnaires as a tool for predicting the risk of sleep apnea has been explored. Several questionnaires exist, including the EPWORTH sleep scale, the PSQI and the BERLIN questionnaire. Benamron *et al.* investigated

the link between the presence of TRS, diagnosed by an AHI  $\geq 5$ , and poor sleep quality as determined by these 3 questionnaires. Only poor sleep quality, as determined by the PSQI, was associated with an AHI  $\geq 5$ . This result confirms those of the present work [17]. On the other hand, Scarlata *et al.* found that, compared with the PSQI, the EPWORTH sleep scale correlated better with obstructive sleep apnea [18].

## 5. Conclusion

The frequency of sleep-disordered breathing in patients hospitalized for HF at the Cardiology University Clinic of CNHU-HKM is high. Poor sleep quality and abdominal obesity were factors associated with SDB. Their presence in the patient could raise the suspicion of SDB. The limitation of this study lies in its small sample size. A study of a larger population would confirm these results.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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## Appendix 1: Charlson Comorbidity Score

Comorbidity index	
1 point for each decade beyond 40 years	-
Myocardial infarction	1
Congestive heart failure	1
Cerebro-vascular disease	1
Dementia	1
Chronic pulmonary disease	1
Joint problems (rheumatism)	1
Ulcer disease	1
Hepatopathy of minor importance	1
Diabetes	1
Hemiplegia	2
Moderate to severe renal failure	2
Diabetes with organ damage	2
Tumors	2
Leukemias	2
Lymphomas	2
Moderate to severe hepatopathy	3
Métastasis	6
AIDS	6
<b>Total score</b>	<b>0 to 37</b>