

A Comparative, Cross-Sectional Study On Prevalence Of Sleep Apnea In Chronic Kidney Disease And Heart Failure Patients

Bhavana.R¹, Dr. Pallavi Singh^{*2}

¹1-M.Pharm II YEAR, Department of Pharmacy Practice, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced studies, Chennai, Tamil Nadu, India - 600117.

^{*2}Assistant Professor, Department of Pharmacy Practice, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced studies, Chennai, Tamil Nadu, India – 600117

*Corresponding Author:

Dr. Pallavi Singh,

M.Pharm., Ph.D, Assistant Professor, Department of Pharmacy Practice, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies, Chennai, Tamil Nadu, India – 600117.

Email ID: pallavisingh090@gmail.com

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ABSTRACT

Background: Sleep Apnea is often ignored in patients with Chronic Kidney Disease (CKD) and Heart Failure (HF). The factors that cause sleep apnea in these two conditions are obesity, fluid retention, and hypertension. This study will compare the prevalence, risk factors, and effect of sleep apnea on quality of life in patients with CKD and HF.

Methods: A cross-sectional study was conducted with 132 subjects, comprised of 66 CKD and 66 HF patients, in a tertiary hospital. Collected were socio-demographic characteristics, clinical data, and lifestyle data. All patients underwent overnight polysomnography for apnea-hypopnea index (AHI) and sleep efficiency assessments. Quality of life (QoL) was assessed by the SF20 (Short Form-20) Health Survey. Data were analyzed using T-test and chi-square test with a significance level set at $p < 0.05$.

Results: Sleep apnea was prevalent in 69.70% of CKD and 75.76% of HF patients, with severe cases more frequent in HF (21.21%). Key risk factors included obesity, fluid retention, and male gender. Both groups experienced reduced quality of life, emphasizing the need for early detection and targeted interventions to improve outcomes.

Conclusion: In CKD and HF patients, sleep apnea is highly prevalent and severely affects the quality of life. Patients with HF showed a slightly higher degree of prevalence of sleep apnea. Routine screening and targeted interventions are necessary to prevent the occurrence of sleep apnea. Long-term effects and treatment-related responses need to be researched.

Keywords: Sleep Apnea, Chronic Kidney Disease, Heart Failure, Apnea-Hypopnea Index, Obesity, Fluid Retention, Quality of Life, Polysomnography, Risk Factors, CPAP Therapy.

1. INTRODUCTION

Sleep apnea is a sleep disorder that goes undiagnosed by a lot of the people. It occurs when people stop breathing many times at night. Sleep apnea can be classified as obstructive sleep apnea (OSA), where obstruction of the upper airway causes the breathing pauses, or central sleep apnea (CSA), where the brain does not properly signal the muscles to breathe. Sleep apnea also becomes a form of chronic disease with all major chronic diseases, especially those that have strong relationships with cardiovascular or renal disorders. Such diseases are CKD or HF since there are overlapping risk factors like fluid retention, obesity, and metabolic imbalances that increase the risk for patients with these conditions^[1]. This kind of population has a major sleep disturbance that creates challenges to the progress of the disease by exacerbating oxidative stress, systemic inflammation, and sympathetic nervous system activation. Sleep apnea, though clinically significant, is currently less diagnosed among patients with CKD and HF. Most importantly, it will necessitate routine screening and prompt management to ensure better outcomes and quality of life among patients.^[2]

CKD is a slow but progressive phenomenon which would take time to incapacitate the kidney. This has some complications like fluid gathering, metabolic problems, and effects on the cardiovascular system. Among the CKD patients, sleep apnea is

common due to various reasons like uremia, neuropathy, and abnormal system of breathing control.^[3] Due to the collection of fluid within the upper airway, obstructive sleep apnea is common in CKD patients. Moreover, CKD sometimes leads to metabolic disturbances like anemia and acidosis which affect the respiratory function thereby, predisposing the patient to central sleep apnea (CSA). In turn, this can induce hypertension variabilities, less supply of oxygen, and more endothelial dysfunction which deteriorates the kidney diseased person's progresses.^[4] Because of this, an understanding of the relation between sleep apnea and CKD becomes very necessary to properly formulate treatment strategies; treating sleep apnea in CKD patients may reduce the progression of the disease and risks of cardiovascular diseases. Research has been limited concerning the effects of sleep apnea in CKD, notwithstanding the growing acknowledgement that has occurred so far. Thus, extensive research is needed for effective management.^[5]

HF is a chronic disease in which the heart is unable to pump blood adequately and causes fluid overload, congestion, and decreased oxygen delivery to the tissues. Out of this, sleep apnea is a major comorbidity in patients with HF; CSA rather impaired autonomic control of breathing is the common one. With the presence of sleep apnea in HF, cardiac dysfunction is further aggravated with nocturnal hypoxia, sympathetic overactivity, and hemodynamic instability. In addition, fluid shifts associated with HF lead to increased airway obstruction that contributes to mixed patterns of sleep apnea.^[6] When untreated, sleep apnea causes an increase in morbidity and mortality rates in HF patients through the induction of arrhythmias, aggravation of heart failure symptoms, and reduction of overall functional capacity. The management of sleep apnea in patients with HF using positive airway pressure therapy, fluid management, and individualized approaches to treatment should improve cardiovascular stability and quality of life. There is substantial overlap between sleep apnea, CKD and HF. Thus, this study will compare the prevalence and severity of sleep apnea between the two patient populations, identify important risk factors, and therefore call for integrated disease management that will optimize patient care.^[7]

AIM: To compare the prevalence and severity of sleep apnea in patients with Chronic Kidney Disease and Heart Failure.

OBJECTIVE:

- To assess the prevalence of sleep apnea in patients with Chronic Kidney Disease and Heart Failure
- To evaluate the severity of sleep apnea using the Apnea-Hypopnea Index (AHI).
- To assess the impact of sleep apnea on patients quality of life

2. METHODOLOGY

This was a comparative, cross-sectional study. Over the course of six months, 132 individuals (66 with CKD and 66 with HF) were recruited from a tertiary care hospital for this cross-sectional study. After giving their informed agreement, patients ≥ 18 years old with confirmed CKD (Stages 2–5) or HF (HFrEF or HFpEF) were added. A standardized form was used to gather baseline information on demographics, alcohol consumption, smoking history, BMI, and comorbidities (diabetes, hypertension). To assess oxygen saturation, sleep efficiency, and the AHI, all subjects underwent nocturnal polysomnography (PSG). Based on AHI levels, sleep apnea was categorized as normal, mild, moderate, or severe. The SF-20 Health Survey was used to measure QoL in the social, emotional, and physical domains. Risk factors like smoking, obesity, and fluid retention were assessed. Patients with CKD and HF were compared in terms of the prevalence and severity of sleep apnea, its effect on quality of life, and related risk factors.

Study Criteria

Inclusion Criteria:

Adults aged 18 years and older, Patients diagnosed with chronic kidney disease (CKD) and Heart Failure (HF), Willingness to provide informed consent.

Exclusion Criteria:

Patients with pre-existing severe respiratory conditions (e.g., COPD), Pregnant women and lactating women.

Statistical Analysis

Data were entered into Microsoft excel and statistical analysis was performed to assess the prevalence of sleep apnoea, QOL and risk factors.

3. RESULTS

1. Patient Characteristics

The below table demonstrates the demographic information of patients with CKD and HF. Among patients with CKD, there were higher numbers of males (26.52%) than females (23.48%); in HF males (29.55%) also outnumbered females (20.45%). In regard to age distribution, CKD patients were most prevalent in the 31-40 years age group (13.64%), while the HF patients were more prevalent in the 41-50 years age group (14.39%). In terms of BMI, 21.21% of CKD patients were having a normal

BMI, 16.67% were overweight, and 12.12% were obese, while in patients with HF, 21.97% of patients were having a normal BMI, 12.88% were overweight, and 15.15% were obese. Hypertension was more prevalent in HF (22.73%) compared to CKD patients (20.45%), whereas diabetes (24.24%) was more prevalent in CKD than in HF patients (19.50%). In smoking history ex-smokers were slightly higher in HF (17.42%) as compared to CKD (15.15%), while drinking patterns were similar in the two groups.

PATIENT CHARACTERISTICS		CKD		HF	
		NO. OF PATIENTS	PERCENTAGE (%)	NO. OF PATIENTS	PERCENTAGE (%)
Gender	Female	31	23.48%	27	20.45%
	Male	35	26.52%	39	29.55%
Age (In Years)	31 To 40 Years	18	13.64%	13	9.85%
	41 To 50 Years	12	9.09%	19	14.39%
	51 To 60 Years	12	9.09%	10	7.58%
	61 To 70 Years	13	9.85%	9	6.82%
	>= 71 Years	11	8.33%	15	11.36%
BMI Category	Normal	28	21.21%	29	21.97%
	Overweight	22	16.67%	17	12.88%
	Obesity	16	12.12%	20	15.15%
Comorbidities	Hypertension	27	20.45%	30	22.73%
	Diabetes Mellitus	32	24.24%	26	19.50%
Smoking History	Ex-Smoker	20	15.15%	23	17.42%
	No	25	18.94%	19	14.39%
	Yes	21	15.91%	24	18.18%
Alcohol Consumption	Former	23	17.42%	20	15.15%
	No	24	18.18%	25	18.94%
	Yes	19	14.39%	21	15.91%

2. Disease Related Information

The below table on disease-related information presents the duration and severity of CKD and HF. Most patients with CKD (60.61%) had the disease for more than 10 years, while patients with HF showed a lower percentage of patients (45.45%) who fall in the same 10-year range. HF patients also had disease for less than five years (30.30%) than CKD patients (22.73%). Staging of CKD revealed that 45.45% of the patients were in stage 2, while 54.55% were in stage 3, with no patients in stages 1 or 4. In HF, most patients were in stage 2 (51.52%), followed by stage 4 (21.21%) and stage 1 (18.18%).

Disease Related Information		CKD		HF	
		NO. OF PATIENTS	PERCENTAGE (%)	NO. OF PATIENTS	PERCENTAGE (%)
Duration	< 5 Years	15	22.73%	20	30.30%

	6 To 10 Years	11	16.67%	16	24.24%
	> 10 Years	40	60.61%	30	45.45%
Stages	1	0	0	12	18.18%
	2	30	45.45%	34	51.52%
	3	36	54.55%	6	9.09%
	4	0	0	14	21.21%

3. Severity of Sleep Apnea

According to the AHI table, severe sleep apnea was observed in 18.94% of patients suffering from CKD, while a slightly higher number, 21.21%, was recorded in patients with HF. Moderate sleep apnea was observed in 6.06% in CKD patients and 7.58% in HF patients, while mild sleep apnea affected 9.85% of the patients with CKD compared with 9.09% of patients with HF. On the other hand, normal AHI levels were recorded in 15.15% of patients with CKD and in 12.12% of patients with HF. The results thus indicate that sleep apnea is severe in HF patients when compared with CKD patients.

SEVERITY OF SLEEP APNEA BASED ON AHI	CKD		HF	
	NO. OF PATIENTS	PERCENTAGE (%)	NO. OF PATIENTS	PERCENTAGE (%)
Normal	20	15.15%	16	12.12%
Mild	13	9.85%	12	9.09%
Moderate	8	6.06%	10	7.58%
Severe	25	18.94%	28	21.21%

4. Prevalence of Sleep Apnea

In this study, the prevalence of sleep apnea (with an AHI of 5 or greater.) was high in patients with HF (75.75%) followed by CKD patients with sleep apnea (66.69%).

PREVALENCE OF SLEEP APNEA	CKD	HF
SLEEP APNEA (Apnea-Hypopnea Index (AHI $\geq$ 5).	46	50
PREVALENCE (%)	66.69%	75.75%

5. Prevalence of Sleep Apnea based on gender and age

In the below table, Males showed a bit higher prevalence than females in both CKD (26.04%) and HF (29.17%) as against the female gender (21.88% in CKD and 22.90% in HF). Age-wise, the maximum prevalence was noticed at a high rate in CKD patients aged 31-40 years (12.50%) and 41-50 years (13.54%) in patients with HF. Subjects aged 71 years and older recorded the observed prevalence of sleep apnea in CKD (9.38%) and HF (11.46%). Age thus plays a major role in the development of the condition.

PREVALENCE		CKD		HF	
		NO. OF PATIENTS	PERCENTAGE (%)	NO. OF PATIENTS	PERCENTAGE (%)
Gender	MALE	25	26.04%	28	29.17%
	FEMALE	21	21.88%	22	22.90%
Age	31 to 40 years	12	12.50%	12	12.50%
	41 to 50 years	7	7.29%	13	13.54%
	51 to 60 years	10	10.42%	7	7.29%
	61 to 70 years	8	8.33%	7	7.29%
	>= 71 years	9	9.38%	11	11.46%

6. Mean Quality Of Life Scores By Disease (SF-20 Health Survey)

The QoL scores based on SF-20 survey table presents the mean QoL scores for CKD and HF patients. The average QOL score for patients of CKD was determined to be 49.75, with a standard deviation of 5.46 whereas, the patients of HF exhibited a slightly higher average of 51.02 along with 6.30 as the standard deviation. The T-test value was found to be 1.2376, and the p-value was determined to be 0.2181, indicating that there was no statistically significant difference between the QoL scores of CKD and HF patients. Therefore, both conditions had an equivalent effect on the overall QoL of patients.

Quality Of Life Scores	CKD	HF
Mean	49.75	51.02
Std. Dev	5.46	6.30
T Test Value	1.2376	
P Value	0.2181	

7. Risk Factors For Sleep Apnea By Disease

The below table evaluates risk factors such as obesity, fluid retention, older age, male gender, hypertension, diabetes, smoking, and alcohol use. None showed a statistically significant difference between CKD and HF ($p > 0.05$). This suggests that these risk factors contribute equally to sleep apnea in CKD and HF patients.

Risk Factor For Sleep Apnea		CKD	HF	P VALUE
Obesity (Bmi > 30 Kg/M ²)	Yes (29)	13	16	0.8602
	No (67)	33	34	
Fluid Retention	Yes (51)	24	27	0.7623
	No (45)	22	23	
Older Age (> 60 Years)	Yes (35)	17	18	0.9225
	No (61)	29	32	
Male Gender	Yes (53)	25	28	0.8708
	No (43)	21	22	

Hypertension	Yes (40)	20	20	0.8901
	No (56)	26	30	
Diabetes	Yes (39)	22	17	0.2420
	No (57)	24	33	
Smoking Use (Current + Previous)	Yes (65)	29	36	0.4721
	No (31)	17	14	
Alcohol Consumption (Occasional + Normal)	Yes (57)	27	30	0.8680
	No (39)	19	20	

4. DISCUSSION

Sleep apnea is a critical concern in patients with CKD and HF, as its prevalence has been observed to be significantly higher in these populations. Our study aimed to explore this relationship and its implications for disease progression and quality of life. A study by Pisano et al. similarly highlighted the increased prevalence of sleep apnea among CKD and end-stage kidney disease patients, emphasizing metabolic and structural changes as contributing factors.^[1] Their findings support our results, which demonstrate that CKD patients experience progressive respiratory instability as the disease advances, increasing their susceptibility to sleep apnea.

The duration of CKD played a crucial role in the severity of sleep apnea, with a gradual decline in respiratory stability seen in patients over time. Previous study by Polecka et al. have demonstrated that fluid retention in HF patients exacerbates sleep apnea severity. Our findings align with this, showing that HF patients exhibit a more severe form of sleep apnea due to altered chemoreceptor sensitivity and fluid shifts, which contribute to breathing instability.^[4]

Quality of life (QoL) assessments using the SF-20 survey showed no statistically significant difference between CKD and HF patients ($p > 0.05$). Similar observations were made in the study by Burkhalter et al. which found that common risk factors such as obesity, male gender, hypertension, diabetes, smoking, and alcohol use equally impact sleep apnea severity across both conditions.^[3] This further supports the notion that despite differing pathophysiological mechanisms, the overall burden on patients' quality of life remains comparable.

Thus, these findings strengthen the rationale for routine screening and management of sleep apnea in CKD and HF patients. Early diagnosis of sleep apnea with subsequent intervention, that is, positive airway pressure therapy, fluid management intervention, and lifestyle modification, may render some improvement in sleep quality, cardiovascular outcomes, and overall disease prognosis for these groups of patients. Future studies to target therapies based on specific pathophysiological mechanisms mediating sleep apnea occurring in CKD and HF patients are warranted.

5. CONCLUSION

This study shows that both CKD and HF patients had a high prevalence of sleep apnea, with HF patients having more severe cases. Common risk factors such as obesity, male gender, and fluid retention contribute to sleep apnea, though the underlying mechanisms differ between the two conditions. If untreated, sleep apnea can aggravate the course of the disease and have a substantial negative impact on quality of life. It is crucial to screen early and manage the condition appropriately, which includes changing one's lifestyle and taking medication. Patient outcomes, complications, and general quality of life can all be improved by including sleep apnea evaluation and treatment into standard CKD and HF therapy.

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