ORIGINAL ARTICLE

Role of Sleep Questionnaires in Screening of Sleep Apnea among Chronic Kidney Disease patients

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ABSTRACT

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Background: Sleep apnea is prevalent and under estimated in renal disease patients. Chronic kidney disease (CKD) and sleep apnea share common comorbidities, so it is not surprising that both diseases commonly coexist. **Objectives**: This cross sectional study aimed to screen the prevalence of sleep apnea among CKD patients using sleep questionnaires. **Patients and Methods:** The study was carried out on one hundred patients with known CKD who attended Aswan University hospital during the period between May 2017 and March 2020. Patients were screened for sleep apnea using STOP-BANG and Berlin questionnaires and further confirmed the diagnosis of sleep apnea by in-laboratory polysomnography; the gold standard diagnostic test. **Results**: STOPBANG score revealed that 52% of CKD patients had high risk of sleep apnea, 39% had intermediate risk and 9% had low risk with a mean value of 4.66 ± 1.67. Berlin score was suggestive of high risk of sleep apnea in 70% of patients with a mean value of 2 ± 0.8. Polysomnographic results reported that 77% of CKD participants had sleep apnea. Moreover, we detected significant positive correlations between sleep apnea severity and both Berlin score (r-value= 0.535 and P-value= 0.001) and STOPBANG score (r value= 0.283 and P-value= 0.004). **Conclusion**: Sleep apnea is highly prevalent among CKD patients. Berlin and STOPBANG questionnaires can help in predicting and screening sleep apnea among chronic kidney disease patients.

INTRODUCTION:

It is well known that chronic kidney disease (CKD) severely affects patient's health and it is defined as abnormalities of kidney structure or function, present for >3 months, with implications for health [1]. Sleep disturbance are common and under estimated in renal disease patients with a prevalence of 44% [2]. Sleep apnea is presented by cessation of respiration during sleep and categorized as obstructive sleep apnea (OSA) and central sleep apnea. Sleep apnea severity is classified according to the apnea-hypopnea index (AHI) into mild, moderate and severs [3].

Several studies support the coexistence between CKD and sleep apnea. Given that CKD and OSA share common comorbidities, it is not strange that both diseases commonly coexist [4]. Sleep apnea in renal disease patients is caused by instability of central ventilatory regulator and upper airway narrowing during sleep. Hypoxemia that occurs during sleep in CKD patients leads to cardiovascular hazards and nocturnal elevation of the blood pressure [5]. We conducted this study to screen the prevalence of sleep apnea among CKD patients using sleep questionnaires.
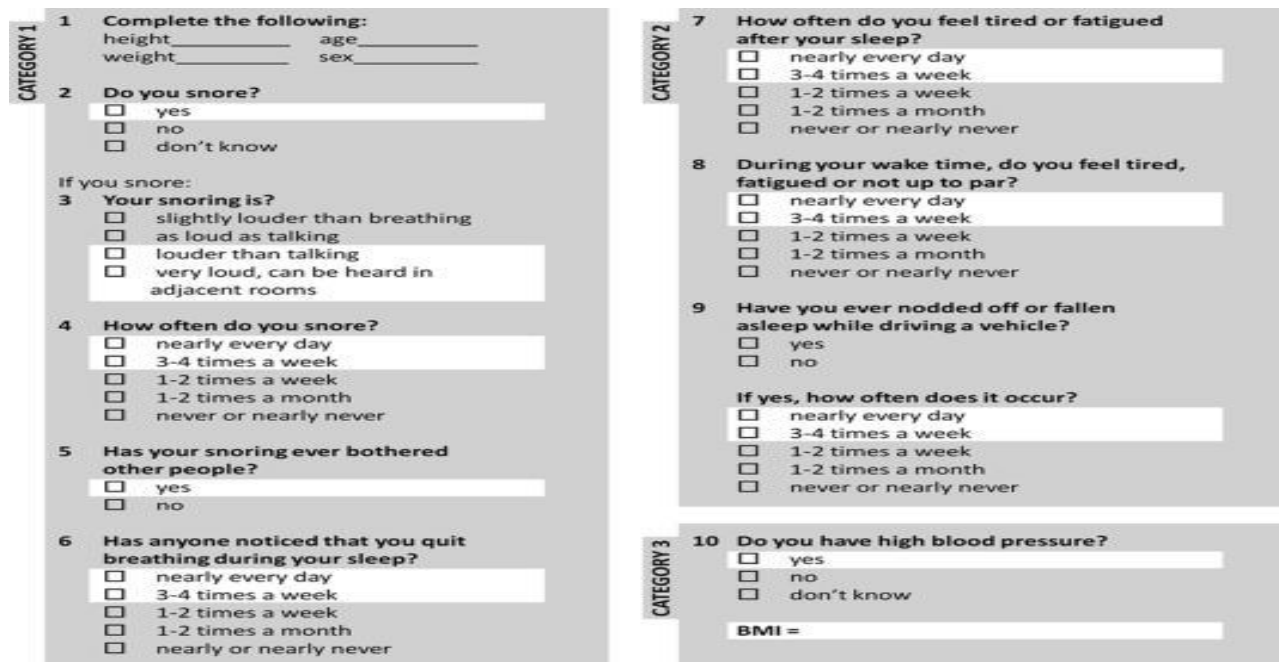
PATIENTS AND METHODS:

This cross sectional study was carried out on one hundred patients with known CKD who attended Aswan University hospital at the period between May 2017 and March 2020. The study included CKD patients of all stages with mean eGFR of 16.2 ± 15.77 ml/min/1.73m2 (ranging from 2.2- 90.5 ml/min/1.73m2). According to KDIGO clinical practice guidelines (2012), CKD is classified into 5 stages according to eGFR [1]. Patients with comorbidities like liver cell failure, chronic chest disease and diabetes were excluded by clinical history, examination, pulmonary function tests, laboratory and radiological investigations. Approval for this study was obtained from the Faculty of Medicine Ethics Committee, Aswan University hospital (IRB, 150/7/17). In addition, informed written consent was obtained from all patients. All patients were subjected to medical history, anthropometric assessment (weight, height, BMI) and renal function tests (serum creatinine and serum urea tests). We screened sleep apnea among CKD patients using STOP-BANG and Berlin questionnaires.

Table (1): STOP-BANG Questionnaire:

STOP		
Do you SNORE loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	No
Do you often feel TIRED, fatigued, or sleepy during daytime?	Yes	No
Has anyone OBSERVED you stop breathing during your sleep?	Yes	No
Do you have or are you being treated for high blood PRESSURE?	Yes	No
BANG		
BMI more than 35kg/m2?	Yes	No
AGE over 50 years old?	Yes	No
NECK circumference > 16 inches (40cm)?	Yes	No
GENDER: Male?	Yes	No

STOP-BANG questionnaire is used to classify patients as low risk and high risk OSA; STOP-BANG score of 5 – 8 is high risk of OSA, 3- 4 is intermediate risk and 0- 2 is low risk [6] (Table 1). The Berlin questionnaire involves 10 questions in addition to data about weight and height arranged in three categories: (category 1): snoring and cessation of respiration; (Category 2): symptoms of excessive daytime sleepiness, and (category 3); BMI and hypertension. Positive results in two or more categories propose that the subject has a high risk of obstructive sleep apnea [7] (Figure 1).   All participants underwent in-laboratory polysomnography (PSG); the gold standard diagnostic test for sleep apnea. PSG was carried out in the sleep unit of Chest Department of Aswan university hospital using Nihon Kohden's Polysmith Polysomnography with a full 10-20 montage, 8 bibolar inputs, 6 DC channels, bedside impedance checking, designated channels for Electro-oculogram (EOG), chin and 3 Electroencephalogram (EEG) channels with a dedicated reference. The PSG- 100 amplifier has a built-in transducer and SPO2. We scored the PSG manually guided by the American Academy of Sleep Medicine guidelines, 2017. The AHI is the most frequently used measurement for diagnosis and classification of severity of sleep apnea[3].

Figure (1): Berlin questionnaire:

Statistical analysis:

Data were analyzed using SPSS version 25 (IBM Inc., Armonk, New York, USA). Descriptive statistics: Means, standard deviations, medians, ranges, and percentages were calculated. The correlations between different parameters were done using Pearson correlation analysis. P-value < 0.05 was considered significant.

Ethical considerations: Approval for this study was obtained from the Faculty of Medicine Ethics Committee, Aswan University hospital (IRB, 150/7/17). In addition, an informed written consent was obtained from patients.

RESULTS:

This study was conducted on one hundred CKD patients; 42.0% males and 58.0% females with a mean age of 53.9 ± 16.97 years. The rest of the demographic data was illustrated in table (2)

Table (2): Demographic data of the study population

Demographic data	Chronic kidney disease patients (no= 100)
Sex:	
Male	42 (42%)
Female	58 (58%)
Age:	
Mean ± SD	53.9 ± 16.97
Range	19 – 90
Smoking:	
Non-smoker	82 (82%)
Current smoker	9 (9%)
Ex-smoker	9 (9%)
Hypertension	64 (64%)
Ischemic heart disease	11 (11.0%)
CVS	4 (4.0%)
Renal Functions	Urea: • Mean ± SD 116.44 ± 49.55 • Range 21.5-244.0
	Creatinine: • Mean ± SD 5.92 ± 3.51 • Range 1.4-17.0
	Glomerular filtration rate (GFR): • Mean ± SD 16.2 ± 15.77 • Range 2.2- 90.5

STOP-BANG Questionnaire revealed that 52% of patients had high risk of obstructive sleep apnea (score= 5-8), 39% had intermediate risk (score= 3-4) and 9% had low risk (score= 1-2); with a mean value of 4.66 ± 1.67 (Table 3). Also, Berlin score revealed that 70% of our CKD patients had high risk of obstructive sleep apnea (score ≥2) with a mean value of 2± 0.8 (Table 3).

Table (3): STOPBANG and Berlin Questionnaires among CKD patients

Sleep Questionnaires	CKD patients (no= 100)	
Berlin score:	Mean ± SD	2 ± 0.79
	Median	2.0
	(Range)	(1.0-3.0)
	Score ≥ 2	70 (70%)
STOPBANG score:	Mean ± SD	4.66 ± 1.67
	Median	5.0
	(Range)	(1.0-8.0)
	Score = 1-2	9 (9%)
	Score = 3-4	39 (39%)
	Score = 5-8	52 (52%)

The Polysomnographic results confirm the presence of sleep apnea with AHI ≥ 5/hr in 77% of patients (Table 4). Moreover, we detected significant positive correlations between sleep apnea severity; marked by AHI and STOPBANG score (r-value= 0.283, and P-value= 0.004) (Fig. 2).

Table (4): Apnea Hypopnea Index (AHI) among CKD patients included in the study

AHI	CKD patients
Negative for sleep apnea (AHI <5/hr)	23 (23.0%)
Positive for sleep apnea (AHI ≥ 5/hr)	**77 (77%)**

Figure (2): Correlation between AHI and STOPBANG score among CKD patients
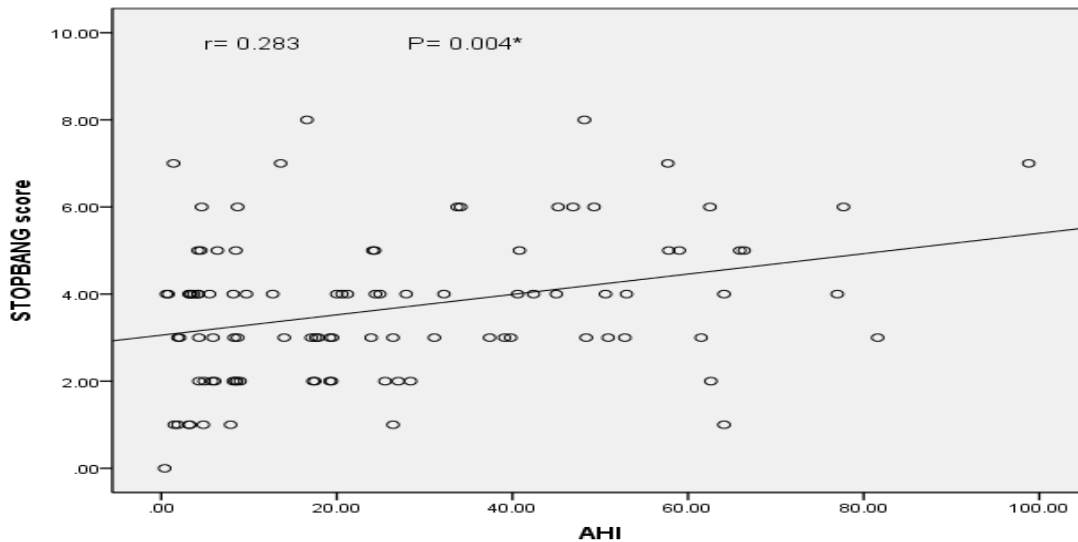
Also, there was significant positive correlations between AHI and Berlin score (r-value= 0.535 and P-value= 0.001) (Fig. 3).

There was no statistically significant difference in the mean of both STOPBANG and Berlin Scores between the hypertensive and normotensive CKD patients (Table 5).

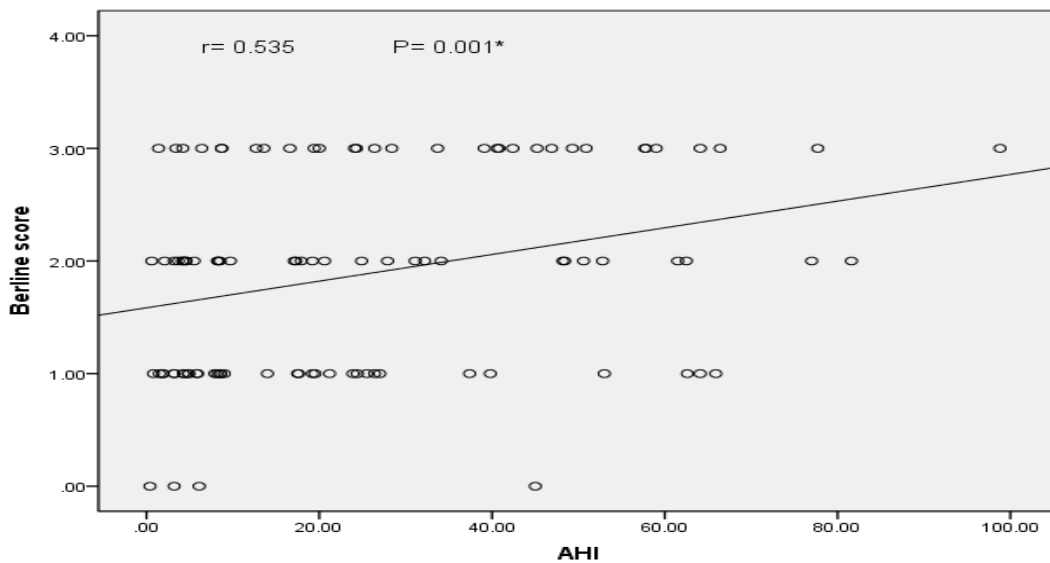**Figure (3):** Correlation between AHI and Berlin score among CKD patients

Table (5): Sleep Questionnaires in hypertensive and normotensive CKD patients

Sleep Questionnaire	Hypertensive CKD (n= 64)	Normotensive CKD (n= 36)	P-value
STOP-BANG score Mean (±SD)	5.06 ± 1.679	4.35± 1.577	0.093
Berlin Score Mean (±SD)	2.11± 0.8002	1.919 ± 0.768	0.126

DISCUSSION:

Sleep apnea is common and under-estimated in renal disease patients [2]. Sleep apnea is presented by cessation of respiration during sleep and categorized as obstructive sleep apnea (OSA) and central sleep apnea [3]. We screened sleep apnea among CKD patients using STOPBANG questionnaire and found that 52% of patients had high risk of OSA (score= 5-8), 39% had intermediate risk (score= 3-4) and 9% had low risk (score= 1-2); with a mean value of 4.66 ± 1.67. The Polysomnographic results of our study population confirmed the presence of sleep apnea (with AHI ≥ 5/hr) in 77 % of CKD patients. Moreover, we detected a significant positive correlation between AHI and STOPBANG score with r-value of 0.283 and P-value of 0.004. Our results agreed with Nicholl *et al.* who studied 172 patients who underwent overnight cardiopulmonary monitoring and STOPBANG to diagnose OSA. They found that obstructive sleep apnea was present in 51% of the ESRD patients and 38% of the CKD patients. analyses of component of the STOP-BANG score discovered that end stage renal disease patients with OSA were more likely to complain of witnessed apneas, loud snoring, their BMI > 35 kg/m2, and circumferences of the neck more than 40 cm. So, this resulted in higher STOP-BANG total scores and a greater proportion of end stage renal disease patients with OSA being diagnosed as high risk [4]. Also, Patakaa *et al.* evaluated the clinical usefulness of different sleep scores (Berlin, Stop-Bang and Epworth Sleepiness Scale) and home oximetry and in-laboratory polysomnography were performed. They found that STOP-BANG questionnaire had the highest sensitivity (98%) but the lowest specificity (11%) [8]. Also, Corso *et al.* reported that STOP-BANG questionnaire has been shown to identify patients at risk with moderate-to-severe OSA, with reasonable confidence and can be simply applied in the clinical setting [9]. Farney *et al.* who

assessed the STOP-BANG questionnaire among patients who underwent polysomnography found that STOP-BANG score increased the probability of having more severe OSA [10].

Similarly, the results of Berlin questionnaire among our CKD patients were suggestive of high risk of sleep apnea (Score≥ 2) in 70% of patients with mean Berlin score of 2± 0.8. We found significant positive correlation between AHI and Berlin score (r-value= 0.535 and P-value= 0.001). These results are consistent with Susanna *et al.* who studied 316 patients with newly suspected sleep apnea to complete Berlin questionnaire. Patients were randomized to group A; underwent home-based sleep test and group B; underwent hospital-based PSG. Their study revealed that the prevalence of severe to moderate OSAS was 54% and the Berlin questionnaire identified 69.7% of patients as high risk in group A and 77.5% in group B [11]. Also, Roumelioti *et al.* who studied CKD patients using Berlin questionnaire to evaluate the prevalence of OSA in CKD patients, detected a high incidence of OSA among CKD patients and demonstrated that it was 28%. The incidence of OSA after sleep study in screened population was 88% [12].

In contrast to our study, Hsin-Chia Huang *et al.* studied patients with glomerular filtration rate≤ 30 mL/min/1.73 m2, whether were receiving haemodialysis or not. The subjects completed symptom questionnaires and a multi-channel polysomnography recording; they demonstrated that the overall symptom scores were not associated with sleep apnea severity [13]. Possible explanation for the differences in results is that determining of the manifestations of sleep apnea is challenging in patients with severe renal failure as some accepted symptoms such as restless unrefreshing sleep and fatigue are often reported by patients with severe CKD, even without significant sleep apnea [14]. Other symptoms such as nocturia usually absent in anuric patients on dialysis or may be exist but unrelated to severe sleep apnea. These factors make symptom based screening scores less discriminatory among chronic kidney disease patients [15].

Study Limitations:

- Collection of data from multiple departments other than chest department.
- Some patients were so tired after or before dialysis sessions to give clear history.

CONCLUSION:

Sleep apnea is highly prevalent among CKD patients. Berlin and STOPBANG questionnaires can help for the prediction and screening of sleep apnea among CKD patients.

Abbreviations:

AHI: Apnea-Hypopnea Index

BMI: Body Mass Index

CKD: Chronic kidney disease

EEG: Electroencephalogram

EOG: Electro-oculogram

ESRD: End Stage Renal Disease

OSA: Obstructive Sleep Apnea

Disclosure and Potential of Interest:

All authors declare that there exist no commercial or financial relationships that could lead to a potential conflict of interest.

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