RESEARCH PAPER

A Study of Sleep Quality and its association with Demographic and Dialysis-Related Factors in Patients Undergoing Maintenance Hemodialysis at a Tertiary Care Centre

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ABSTRACT

Background: Sleep disturbances are highly prevalent among maintenance hemodialysis (MHD) patients globally, yet data from South India remain sparse despite high end-stage renal disease burden.

Methods: In this cross-sectional study the sleep quality was assessed using Pittsburgh Sleep Quality Index (PSQI) in 75 adults (≥18 years) on MHD ≥3 months. Data collected via pre-tested proforma included sociodemographics (age, sex), clinical details (dialysis vintage, comorbidities), history/examination (CKD risk factors), and biochemistry (hemoglobin, urea, creatinine, eGFR). Associations analyzed via t-tests/chi-square ($p<0.05$) and Spearman's correlations.

Results: Poor sleep (PSQI ≥5) prevailed in 92% (69/75), with mean age 50.3±11.6 years (74.7% male). Longer hemodialysis duration significantly linked to poor sleep (median 36 vs. 6 months, $p=0.023$; rho=0.213), while age ($p=0.828$), sex ($p=1.000$), comorbidities (hypertension $p=1.000$), and biochemicals (hemoglobin $p=0.385$) showed no ties. Pulmonary edema paradoxically associated with good sleep ($p=0.001$), likely due to small n=18.

Conclusion: Near-universal poor sleep underscores dialysis vintage as key driver in MHD. Routine PSQI screening and targeted sleep hygiene for long-term patients warranted to enhance outcomes in resource-limited settings.

Keywords: Sleep quality, Pittsburgh Sleep Quality Index, hemodialysis, chronic kidney disease.

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INTRODUCTION

Chronic kidney disease (CKD) represents a major global health challenge, affecting an estimated 788 million individuals worldwide, with its progression to end-stage renal disease (ESRD) necessitating renal replacement therapies such as maintenance hemodialysis (MHD).[1,2]

For patients undergoing MHD, the life-sustaining necessity of thrice-weekly sessions is often shadowed by a profound physiological and psychological burden, most notably the disruption of sleep architecture. Sleep disorders, including insomnia, restless legs syndrome, and sleep apnea—are nearly ubiquitous in this population, with meta-analyses indicating that 64% to 80% of patients experience clinically significant impairment as measured by the Pittsburgh Sleep Quality Index (PSQI). These rates are five to ten times higher than those observed in age-matched general populations, driven by a complex interplay of uremic toxin accumulation, interdialytic pruritus, and the circadian rhythm disruptions inherent to dialysis-induced fluid shifts and inflammation.[3,4]

Furthermore, this disturbed nocturnal sleep results into severe clinical consequences, including accelerated cognitive decline, endothelial dysfunction, and a heightened risk of cardiovascular events. Ultimately, poor sleep quality serves as a potent independent predictor of mortality, with elevated PSQI scores correlating to a 20–30% increase in death risk, thereby underscoring the urgent need for integrated sleep management within renal care protocols.[5,6]

Given the rising global burden of end-stage renal disease, evaluating sleep pattern in patients on MHD is clinically essential, as sleep disturbances are potent but frequently skipped predictors of cardiovascular morbidity and diminished quality of life. This study seeks to address this gap by utilizing the Pittsburgh Sleep Quality Index (PSQI) to provide a standardized assessment of sleep quality within this high-risk population. By rigorously analyzing the interplay between poor sleep and a spectrum of demographic variables, dialysis-specific parameters, and biochemical markers, this study aims to identify modifiable risk factors.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in a tertiary care centre at Puducherry, among patients attending the dialysis unit after obtaining approval from the Institutional Ethics Committee.

Data collection utilized a pre-designed and pre-tested structured proforma to ensure consistency and reliability in capturing sociodemographic, clinical, and laboratory

variables. The study enrolled a fixed sample size of 75 patients undergoing maintenance hemodialysis (MHD), selected through convenience sampling.

Eligibility Criteria

Inclusion criteria comprised adult patients aged ≥18 years on MHD for ≥3 months, ensuring representation of stable chronic cases. Exclusion criteria included acute kidney injury or dialysis duration <3 months; known severe cognitive impairment, active psychosis, or inability to respond to questionnaires, thereby minimizing bias from acute or non-communicative states.

Data Collection

Following the informed consent, data were systematically collected using a structured proforma that captured a comprehensive range of sociodemographic and clinical parameters, including age, sex, and detailed hemodialysis history (duration, frequency, and timing). The protocol involved documenting primary renal etiologies, comorbidities—specifically diabetes and hypertension—and current pharmacological regimens, alongside established chronic kidney disease (CKD) risk factors such as smoking, dyslipidemia, and family history. Laboratory investigations, including hemoglobin, blood urea, serum creatinine, and estimated glomerular filtration rate (eGFR), were recorded to correlate clinical status with sleep outcomes.

Sleep quality was objectively quantified using the Pittsburgh Sleep Quality Index (PSQI), a validated 19-item instrument evaluating seven distinct domains of sleep over the preceding month. Global PSQI scores range from 0 to 21, with a threshold of ≥5 utilized to identify poor sleep quality. To ensure data integrity and accommodate participants with limited literacy, the proforma was administered by trained interviewers during active dialysis sessions, thereby enhancing both response accuracy and participant recruitment.

STATISTICAL ANALYSIS

Statistical analysis was conducted using SPSS software, employing descriptive statistics to summarize the study variables. Continuous data were reported as means pm standard deviation for normal distributions or medians with interquartile ranges (IQR) for skewed data, while categorical variables were expressed as frequencies and percentages. Comparative analysis between cohorts (good vs. poor sleep) was performed using independent t-tests or Mann-Whitney U tests for continuous measures, and chi-square or Fisher's exact tests for categorical data, as appropriate. Furthermore, Spearman's rho was utilized to evaluate correlations between variables. For all analyses, statistical significance was defined by a two-tailed p-value of <0.05.

RESULTS

Seventy-five adult patients (mean age 50.3 ± 11.6 years; 74.7% male) on maintenance hemodialysis for ≥3 months were included, with 84% rural residence and 56% illiterate. Common comorbidities included hypertension (92%), diabetes mellitus (57.3%), and heart failure (22.7%), reflecting typical end-stage renal disease profiles in this South Indian tertiary center.

Sleep Quality Distribution

The Pittsburgh Sleep Quality Index (PSQI) revealed poor sleep quality (global score ≥5) in 69 patients (92%), while only 6 (8%) had good sleep, confirming near-universal sleep impairment in this study population (Figure 1).

Figure 1: Distribution of Sleep Quality

Demographic Associations: No significant differences emerged by age (p=0.828), gender (p=1.000), or residence (p=0.074). Education trended toward significance (p=0.054). (***Table 1***)

Table 1: Demographic Factors and Sleep Quality

Characteristic	Good Sleep (n=6)	Poor Sleep (n=69)	Total (N=75)	p-value
Age, mean (SD)	49.3 (13.0)	50.4 (11.6)	50.3 (11.6)	0.828*
Gender				
Male	4 (7.1%)	52 (92.9%)	56 (74.7%)	1.000
Female	2 (10.5%)	17 (89.5%)	19 (25.3%)	
Education				
Graduate+	0 (0%)	2 (100%)	2 (2.7%)	0.054
Illiterate	1 (2.4%)	41 (97.6%)	42 (56.0%)	
Primary	2 (10.0%)	18 (90.0%)	20 (26.7%)	
Secondary	3 (27.3%)	8 (72.7%)	11 (14.6%)	
Residence				
Rural	3 (4.8%)	60 (95.2%)	63 (84.0%)	0.074
Urban	3 (25.0%)	9 (75.0%)	12 (16.0%)	
*Independent t test was applied Chi-square test was applied				

Dialysis-Related Factors

Hemodialysis duration showed significant association (good sleep median: 6.0 [6.0-10.5] vs. poor: 36.0 [36.0-48.0] months, p=0.023), with Spearman's rho=0.213 (p=0.066). CKD duration (p=0.129) and interdialytic weight gain (3.8 ± 0.9 vs. 4.0 ± 1.0 kg, p=0.733) lacked significance. (***Table 2***)

Table 2: Dialysis Parameters and Sleep Quality

Parameter	Good Sleep (n=6)	Poor Sleep (n=69)	p-value
CKD duration, median (IQR) months	30.0 (15.0-36.0)	48.0 (36.0-48.0)	0.129
HD duration, median (IQR) months	6.0 (6.0-10.5)	36.0 (36.0-48.0)	0.023
Interdialytic weight gain, mean (SD) kg	3.8 (0.9)	4.0 (1.0)	0.733*
*Independent t test was applied Mann-Whitney U test was applied			

Comorbidities and Clinical Features

No significant comorbidity links appeared (e.g., hypertension p=1.000, diabetes p=1.000), though pulmonary edema paradoxically associated with good sleep (33.3% vs. 66.7%, p=0.001), potentially due to small subgroup (n=18). Nocturnal cough (p=0.626) showed no difference.(***Table 3***)

Table 3: Comorbidities and Clinical Features

Condition	Good Sleep n (%)	Poor Sleep n (%)	Total n (%)	p-value
Hypertension	6 (8.7%)	63 (91.3%)	69 (92.0%)	1.000
Diabetes mellitus	3 (7.0%)	40 (93.0%)	43 (57.3%)	1.000
Heart failure	2 (11.8%)	15 (88.2%)	17 (22.7%)	0.887
Pulmonary edema (Yes)	6 (33.3%)	12 (66.7%)	18 (24.0%)	0.001
Nocturnal cough (Yes)	2 (11.1%)	16 (88.9%)	18 (24.0%)	0.626

Biochemical Parameters

No significant differences occurred across markers (e.g., hemoglobin 9.1 ± 1.5 vs. 8.6 ± 1.4 g/dL, p=0.385; serum creatinine 9.3 ± 3.5 vs. 13.9 ± 26.4 mg/dL, p=0.673). Correlations included interdialytic gain (rho=0.218, p=0.060). (***Table 4***)

Table 4: Biochemical Parameters and Sleep Quality

Parameter	Good Sleep mean (SD)	Poor Sleep mean (SD)	Total mean (SD)	p-value
Hemoglobin (g/dL)	9.1 (1.5)	8.6 (1.4)	8.6 (1.4)	0.385
Blood urea (mg/dL)	120.7 (14.3)	104.8 (27.9)	106.1 (27.3)	0.174
Serum creatinine (mg/dL)	9.3 (3.5)	13.9 (26.4)	13.5 (25.4)	0.673
eGFR (mL/min/1.73m²)	6.1 (3.3)	7.1 (3.0)	7.1 (3.0)	0.446
Serum sodium (mEq/L)	138.8 (2.6)	129.0 (27.8)	129.8 (26.8)	0.391
Independent-t test was applied				

DISCUSSION

Poor sleep quality affected 92% of maintenance

hemodialysis (MHD) patients in this South Indian cohort, representing one of the highest prevalence rates documented and underscoring sleep disturbance as a near-universal yet underaddressed comorbidity in end-stage renal disease (ESRD).

This study's 92% poor sleep prevalence (PSQI ≥5) substantially exceeds the 70.5% pooled estimate from a meta-analysis by Shi G et al,[3] where heterogeneity arose from variable PSQI cutoffs and dialysis modalities. Similar findings were documented by the Parmaksiz E et al,[7] reported 88.7% via PSQI, while Alsadat M et al[8] found 81.2%, both attributing excess to uremic pruritus and interdialytic cramps absent in higher-income peritoneal dialysis users. Conversely, lower rates in Western population as documented by Tan L et al[9] and Masoumi M et al,[10] reflect better anemia control and shorter duration of dialysis, highlighting South Asia's socioeconomic-dialysis nexus amplifying vulnerability beyond uremia alone.

The strong link between longer hemodialysis vintage and poor sleep (median 36 vs. 6 months, p=0.023; rho=0.213, p=0.066) aligns with the findings of Velu S et al,[11] driven by cumulative endothelial inflammation and vascular access pain, while Firoz M et al[12] and Akgul A et al[13] documented poor sleep linked to inflammation/anemia; vintage not primary but HD duration factored in regression. Unlike CKD duration (p=0.129 here), this dialysis-specific trajectory aligns with circadian desynchrony from thrice-weekly shifts, absent in pre-dialysis CKD, echoing the findings of Akmutary H et al.[14] Interdialytic weight gain's near-significance (rho=0.218, p=0.060) parallels the findings of Harmon R et al[15] and Jalazadeh M et al[16] documenting >4kg gains is associated with the to nocturnal dyspnea.

The lack of relationships between age, sex, and place of residence is consistent with MHD-specific results from a multicenter trial by Alshammari B et al.[17], who identified no demographic gradients and attributed uniformity to shared uremic burden overriding baseline risks.

Patients with non-communicable diseases (NCDs) were more likely to have poor sleep quality (PSQI ≥5), although this clinical tendency was statistically non-significant ($p > 0.05$). In subgroups with hypertension, diabetes, and ischemic heart disease, prevalence rates of sleep disruption varied from 88.2% to 100%, however in other research, it was found to be 64.2% (hypertension 70-90%, diabetes 30-50%, ischemic heart disease 20-35%).Non-significant comorbidity linkages support meta-regression findings that, following dialysis adequacy adjustment, diabetes only slightly increased PSQI (β=0.4), indicating that metabolic correction offsets direct effects.[3]

This study offers robust insights into the sleep quality of an understudied South Indian maintenance hemodialysis population using the PSQI. A key strength lies in its comprehensive data capture, including clinical, biochemical, and demographic variables, among a predominantly rural and illiterate population that reflects India's real-world ESRD demographics. However, the study's cross-sectional design precludes causal inferences, and the reliance on self-reported data introduces potential recall bias. Furthermore, the single-center convenience sampling limit the broader generalizability and statistical power for stratified analyses. Future research incorporating objective measures like actigraphy and adjustments for unmeasured confounders, such as dialysis adequacy (Kt/V), is warranted to strengthen these findings.

CONCLUSION

Poor sleep quality affects 92% of maintenance hemodialysis patients at this South Indian tertiary center, with longer dialysis vintage as the primary significant correlate and a notable descriptive burden among those with NCDs like hypertension (91.3% poor sleep) and diabetes (93.0% poor sleep). These findings affirm sleep disturbance as a near-universal, multifactorial issue exacerbated by dialysis-related factors alongside high NCD comorbidity prevalent in study populaton. Routine PSQI screening during dialysis sessions is recommended, with targeted interventions like sleep hygiene education prioritized for long-vintage patients and those with heavy NCD burden. Future multi-center prospective studies should validate these associations, quantify NCD contributions in larger samples, and test non-pharmacological strategies to mitigate this modifiable risk factor, ultimately improving quality of life and survival in India's growing ESRD population.

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