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Evaluation of Sleep Disorders in Patients with Chronic Kidney Disease

Yasir Saadat, Muhammad Irshad Khan, Shoukat Ali, Abdul Hameed Jamali, Fahad Mushtaq, Aysha Jabeen

ABSTRACT

Objective: To assess the prevalence of sleep disorders in Patients with Chronic Kidney Disease

Study Design and Setting: This was a cross-sectional observational study conducted over six months (1st August 2024 to 31st January 2025) at the Pakistan Atomic Energy Commission (PAEC) General Hospital, Islamabad.

Methodology: A total of 200 adult patients with CKD (stages 3 to 5) were enrolled. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), daytime sleepiness with the Epworth Sleepiness Scale (ESS), and restless leg syndrome (RLS) using IRLSSG diagnostic criteria. Sociodemographic, clinical, and laboratory data were collected. Statistical analysis was performed using SPSS version 26, with t-tests and chi-square tests applied where appropriate. A p-value <0.05 was considered significant.

Results: Among the 200 participants, 84% had at least one sleep disorder. Poor sleep quality (PSQI > 5) was reported in 76%, excessive daytime sleepiness (ESS > 10) in 39%, and RLS in 32%. Sleep disorders were significantly associated with dialysis status (p=0.006), CKD stage 5 (p=0.009), lower hemoglobin levels (p=0.001), higher serum phosphate (p=0.001), and reduced serum calcium levels (p=0.001). Dialysis patients had significantly worse PSQI and ESS scores compared to non-dialysis patients.

Conclusion: Sleep disorders are highly prevalent in CKD, particularly in dialysis and advanced-stage patients. The regular assessment and proactive management of associated factors, such as anemia and mineral imbalances, are critical to optimizing patient care.

Keywords: Anemia, Quality of Life, Restless Legs Syndrome, Sleep Disorders, Uremia

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INTRODUCTION

There is currently 10-15 % of the global population with chronic kidney disease (CKD), leading to a progressive disease with varying quality of life for each patient.[1] Unfortunately, CKD is associated with extremely high morbidity and mortality. As renal function worsens, systemic complications arise, including cardiovascular disease, metabolic abnormalities, and, importantly, neurocognitive impairment.[2] One complication that continues to be increasingly recognized but remains poorly diagnosed is sleep disorders, as they not only affect the patient's quality of life but also have a wide-ranging implication for health outcomes overall, where the risk of hospitalization as well as death is increased. Sleep is critical for physiological recovery, immune modulation, and neurocognitive evaluation; however, in patients with CKD, sleep disturbance is always prevalent, with the literature suggesting that rates between 80%-90% of patients have sleep disturbance, depending on the stage of CKD and treatment modality.[3] Patients with CKD have a multi-domain range of sleep disturbances with sleep disorders in CKD, including insomnia, restless leg syndrome (RLS), periodic limb movement disorder (PLMD), sleep disordered breathing (SDB), and excessive daytime sleepiness.[4] The etiology of these sleep disorders is

multifactorial and likely includes biochemical, neurological, hormonal, and behavioral factors.[5]

Sleep disorders in CKD patients are often underdiagnosed due to overlapping symptoms with uremia, limited awareness among clinicians, and the lack of standardized screening in nephrology settings.[3] Despite their high prevalence and clinical significance, sleep disturbances are often overlooked in routine care, particularly in low-resource or high-burden settings. Early recognition is essential, as untreated sleep disorders can exacerbate comorbid conditions and impair treatment compliance, particularly in patients undergoing dialysis. Non-pharmacological interventions like cognitive behavioral therapy and structured sleep hygiene programs, along with correction of underlying metabolic derangements, have shown potential to improve sleep and overall outcomes.

Given the multifactorial etiology and significant consequences of sleep disorders in CKD, it is critical to assess their burden within specific populations and healthcare settings. Cultural norms, environmental conditions, and healthcare accessibility may influence both sleep quality and reporting patterns. Therefore, localized research is needed to accurately quantify the prevalence and identify key clinical correlates of sleep disorders among CKD patients.[3] This study was conducted to fill that gap by evaluating sleep quality and related disorders in a cohort of CKD patients, while also examining their association with biochemical and clinical parameters.

Uremia is a primary feature of ESKD (end-stage kidney disease) that produces a host of neurotoxic metabolites and disrupts the homeostasis of neurotransmitters and the sleep-wake cycle.[6] In addition to uremia, anemia, common in CKD, hyperphosphatemia, and secondary hyperparathyroidism, common in CKD, and disturbances in melatonin secretion are thought to contribute to sleep-related issues in CKD populations.[3, 7] Circadian rhythm disturbance, which is worsened (and often introduced) by nocturnal hemodialysis, contributes to insomnia and daytime sleepiness, restless leg syndrome, and PLMD are especially associated with iron deficiency and dopamine dysregulation, both seen in CKD populations.[3, 8]

Clinical outcomes stemming from sleep disorders in CKD are impactful. Poor sleep quality has been associated with hypertension, cognitive decline, depression, poorer treatment adherence, and increased risk of premature death, all common in CKD patients.[9] Obstructive sleep apnea (OSA), likely the most studied sleep disorder among CKD and ESKD in performed studies examining health outcomes, is independently associated with chronic fatigue, hypertension (HTN), left ventricular hypertrophy (LVH), and arrhythmias, all of which are more prevalent in CKD populations.[10, 11] Importantly, there is a bit of evidence that sleep disturbances in CKD contribute to the progression of kidney disease by inducing sympathetic activation, inflammation, and oxidative stress.[3]

Sleep disorders are now widely recognized as an important complication of CKD, but still warrant a systematic evaluation across several stages of CKD and clinical environments. Recent literature has highlighted the need for local, population-specific data to more effectively describe the burden and correlates of sleep disturbance in CKD. Additionally, the impact of cultural, environmental, and health care delivery factors on sleep quality in CKD patients has not been sufficiently explored. For these reasons, the present study aimed to evaluate the prevalence and types of sleep disorders in adults with chronic kidney disease, as well as clinical/biochemical correlates. The study also sought to highlight the need for a consolidated sleep assessment strategy as part of CKD management. An improved understanding of these associations will lead to earlier diagnosis, tailored care, and optimized long-term outcomes. The present study aimed to evaluate the prevalence and types of sleep disorders in patients with chronic kidney disease (CKD).

METHODOLOGY

This is an observational cross-sectional study conducted at the Pakistan Atomic Energy Commission (PAEC) General Hospital, Islamabad, for six months, between 1st August 2024 to 31st January 2025. The research was approved by the Ethical Review Committee (ERC) at Pakistan General Hospital Institute (PGHI) under reference number PGHI-IRB(DME)-RCD-06-086, dated 20th July 2024.

A non-probability consecutive sampling technique was used. Patients were selected from the nephrology and Dialysis Units at the time of their routine clinical visits. Patients were adults aged 18 years and older with a diagnosis of CKD stage 3, 4, or 5 (KDIGO 2021).[12] Inclusion criteria required that the patient had been diagnosed with CKD for at least 3 months and was on either conservative treatment or hemodialysis. Patients with a previous diagnosis of sleep disorders not related to CKD, sedative hypnotics, or antidepressants, adults diagnosed with cognitive disorders, or psychiatric illness, making communication impossible for clear understanding, those with terminal malignancy, advanced pulmonary disease, or neurologic disorders from the selection criteria due to the notion that these conditions may independently affect sleep were excluded from the study.

The sample size was calculated using the formula for estimating a proportion in a population:

$n = Z^2 \times p(1-p) / d^2$, where Z is the confidence level (1.96 for 95%), p is the expected prevalence of sleep disorders of 59% in CKD, and d is the margin of error (7%).[13] Substituting the values, the required sample size was determined to be 179 participants. To account for possible incomplete data or dropouts, the final sample included 200 patients.

Data collection was performed using a structured proforma, which included sociodemographic details, medical history,

CKD staging, dialysis status, laboratory parameters (hemoglobin, calcium, phosphate, urea, creatinine), and sleep assessment tools. Sleep quality and disorders were assessed using the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and the Restless Leg Syndrome Diagnostic Criteria (IRLSSG 2012).[14-16] These validated instruments have been widely used in previous nephrology-related sleep research and have demonstrated good reliability. Patients were recruited consecutively after obtaining written informed consent in both English and Urdu, explaining the purpose of the study, risks, and benefits. Participants were assured of the confidentiality and voluntary nature of their participation. All forms were anonymized and coded for data protection.

Analysis of the data was done with SPSS version 26. For continuous data, descriptive statistics like means and standard deviations were computed, whereas for categorical variables, frequencies and percentages were employed. The independent t-test for continuous variables and the Chi-square test for categorical variables were used to examine the relationship between sleep disturbances and clinical data such as hemoglobin levels, CKD stage, dialysis status, and calcium-phosphate imbalance. P-values below 0.05 were regarded as statistically significant.

RESULTS

A total of 200 patients with chronic kidney disease (CKD) were enrolled in the study. The study population consisted predominantly of middle-aged individuals with a notable burden of comorbidities and advanced kidney dysfunction. A considerable proportion of patients were in stage 5 CKD, and more than half were undergoing dialysis, reflecting the inclusion of patients with advanced disease. The duration of CKD was prolonged in many cases, and a majority had coexisting hypertension and diabetes, consistent with common etiologies of renal impairment. Biochemical analysis indicated significant renal insufficiency, with elevated serum creatinine and urea levels, alongside evidence of anemia and mineral imbalance, including disrupted calcium and phosphate homeostasis. These clinical and laboratory characteristics highlight a patient group with complex and multifaceted health challenges, which may contribute to the high prevalence of sleep disturbances observed in this study. (Table 1) The assessment of sleep-related symptoms revealed a high burden of sleep disorders among patients with chronic kidney disease. Overall, 168 patients (84%) had at least one type of sleep disturbance, while only 32 patients (16%) reported no symptoms suggestive of any sleep disorder. The most frequently reported condition was poor sleep quality, as measured by the Pittsburgh Sleep Quality Index (PSQI > 5), which was observed in 152 participants (76%). Excessive daytime sleepiness, defined by an Epworth Sleepiness Scale (ESS > 10), was present in 78 patients (39%). Additionally, 64 patients (32%) met the diagnostic criteria for restless leg syndrome based on the IRLSSG 2012 guidelines. Importantly, a proportion of patients experienced more than one type of sleep disorder concurrently, indicating overlapping symptomatology and highlighting the complex sleep-related challenges faced by CKD patients. These findings underscore the need for comprehensive assessment and targeted management of multiple sleep disorders in this population. (Figure 1) The analysis revealed that sleep disorders in CKD patients were significantly associated with several clinical and biochemical parameters. Patients with sleep disturbances were more likely to be on dialysis and in stage 5 of CKD, suggesting a correlation between disease severity and sleep impairment. Hematological and biochemical markers indicated that those with sleep disorders had more pronounced anemia, higher phosphate levels, and lower serum calcium compared to patients without sleep complaints. Although differences in age and gender were observed between the groups, they did not reach statistical significance. These findings suggest that advanced renal dysfunction and related metabolic imbalances may play a critical role in the development of sleep disorders in this population. (Table 2). Patients undergoing dialysis reported significantly poorer sleep outcomes compared to those not on dialysis. This was reflected in higher scores on both the

Table 1: Sociodemographic and Clinical Characteristics of Study Participants (n = 200)

Variable	Frequency (%) / Mean ± SD
Age (years)	52.6 ± 13.2
Gender	
Male	114 (57%)
Female	86 (43%)
Marital Status	
Married	182 (91%)
Unmarried	18 (9%)
CKD Stage	
Stage 3	42 (21%)
Stage 4	76 (38%)
Stage 5	82 (41%)
Dialysis Status	
On Dialysis	110 (55%)
Not on Dialysis:	90 (45%)
Duration of CKD (months)	28.4 ± 10.7
Comorbidities	
Hypertension	160 (80%)
Diabetes	122 (61%)
CVD	52 (26%)
Hemoglobin (12 – 16g/dL)	9.8 ± 1.4
Serum Calcium (8.5 – 10.5mg/dL)	8.2 ± 0.6
Serum Phosphate (Normal: 2.5 – 4.5mg/dL)	5.3 ± 1.2
Serum Creatinine (Normal: 0.6 – 1.2mg/dL)	6.1 ± 2.5
Blood Urea (Normal: 7-20 mg/dL)	78.2 ± 24.3

Table 2: Association of Sleep Disorders with Selected Clinical Variables

Variable	Sleep Disorder Present (n = 168)	No Sleep Disorder (n = 32)	p-value
Mean Age (years)	53.7 ± 12.8	47.6 ± 13.7	0.261
Female Gender	76 (45.2%)	10 (31.2%)	0.204
On Dialysis	100 (59.5%)	10 (31.2%)	0.006*
CKD Stage 5	76 (45.2%)	6 (18.7%)	0.009*
Hemoglobin (g/dL)	9.5 ± 1.3	10.9 ± 1.1	0.001*
Serum Phosphate (mg/dL)	5.6 ± 1.3	4.4 ± 1.0	0.001*
Serum Calcium (mg/dL)	8.1 ± 0.6	8.5 ± 0.5	0.001*

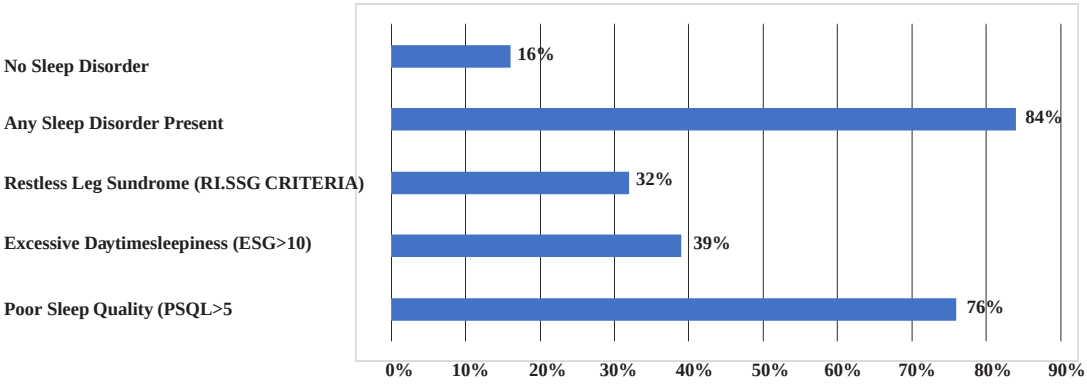
An Independent t-test and the Chi-square test was used.
**Statistically significant (p= 0.05)*

Table 3: Sleep Quality Scores Based on PSQI and ESS by Dialysis Status

Sleep Parameter	On Dialysis (n = 110)	Not on Dialysis (n = 90)	p-value
Mean PSQI Score	9.3 ± 2.1	7.5 ± 1.7	0.001*
Mean ESS Score	10.4 ± 2.6	8.1 ± 2.4	0.001*
Poor Sleep Quality (%)	92 (83.6%)	60 (66.7%)	0.009*
RLS Prevalence (%)	44 (40%)	20 (22.2%)	0.011*

'An independent t-test was used for PSQI and ESS'
'Chi-square test was used for Poor sleep quality and RLS prevalence'
**Statistically significant (p = 0.05)*

Figure 1: A Bar Graph Showing the Prevalence of Sleep Disorders Among CKD Patients



PSQI and ESS, indicating worse overall sleep quality and increased daytime sleepiness. Additionally, the proportion of dialysis patients reporting poor sleep and symptoms of restless leg syndrome (RLS) was markedly higher than in the non-dialysis group. These findings suggest that dialysis is an important contributing factor to both nocturnal sleep disturbances and daytime fatigue in CKD patients, emphasizing the need for targeted sleep assessment and management strategies within this subgroup. (Table 3)

DISCUSSION

Our study found that 84% of CKD patients experienced at least one sleep disorder, with 76% reporting poor sleep quality (PSQI >5), 39% exhibiting excessive daytime sleepiness (ESS >10), and 32% meeting criteria for restless leg syndrome (RLS). These prevalence figures are notably higher than those reported in pre-dialysis CKD populations, yet comparable with hemodialysis cohorts, underscoring the substantial burden of sleep disturbances in advanced CKD.

In pre-dialysis CKD patients in Turkey, Yazýcý and Güney reported a poor sleep quality rate of approximately 42.5%, significantly lower than our overall rate, likely due to lower dialysis exposure and differences in population characteristics.[17, 18] Similarly, a cross-sectional study in Nigeria showed CKD study documented a poor sleep prevalence of around 50.2%, again much lower than ours,

reflecting the progressive sleep burden as CKD advances.[19] Our findings align more closely with those in maintenance hemodialysis populations: in Palestine, the HD cohort showed poor sleep quality in 76.6%, with ESS >10 in 28.7% which are similar to our PSQI and ESS findings.[20]

A large multi-center study with 338 HD patients found PSQI >5 in 41.4%, much lower than our 76%, and ESS >10 in only 6.5% possibly due to differences in dialysis protocols, socioeconomic status, and clinical settings.[21] A Nigerian study comparing pre-dialysis patients and HD recipients noted poor sleep quality escalating from 43.6% to 59.5% with dialysis use, echoing our observation that dialysis patients had worse sleep outcomes.[19]

Consistent with prior literature, our multivariable analyses showed that dialysis status, CKD stage 5, anemia, higher serum phosphate, and lower serum calcium were significantly associated with sleep disorders. The Nigerian study also linked anemia and advanced CKD stage with worse sleep quality. In contrast, Yazýcý's study identified anemia, elevated phosphorus, and low hemoglobin as correlated with poor sleep in pre-dialysis patients.[18] These associations reinforce the multifactorial pathophysiology involving metabolic derangements, CKD-mineral bone disorder, and renal replacement therapy.

In terms of gender and age, our study found no statistically significant associations. Yazýcý et al. also reported no gender difference in poor sleepers among pre-dialysis CKD.[18] However, other studies conducted in Pakistan on HD patients did find female gender and increasing age to be significant predictors of poor sleep quality.[22, 23] This discrepancy may reflect population heterogeneity or different sociocultural factors influencing sleep in Pakistan compared to other settings.

Regarding the magnitude of sleep impairment in dialysis patients, our results are consistent with the Palestinian study, where 84.8% of HD patients were classified as poor sleepers (PSQI >5) and 63.6% had ESS >10.[24] This again mirrors our high PSQI and ESS values in the dialysis subgroup. The Chinese ESRD cohort also demonstrated strong correlations between eGFR reduction and worsening sleep scores, similar to our findings that CKD stage and lab markers correlate with poor sleep.[25]

Restless leg syndrome prevalence in our dialysis group (40%) exceeded most other reports. A study conducted in Upper Egypt HD patients found RLS at 42%, with significant correlations to anemia and hyperphosphatemia.[26] This mirrors our findings that low hemoglobin and high phosphate levels were strongly associated with RLS and sleep complaints. Taken together, our results broadly confirm that sleep disturbances are highly prevalent in CKD, particularly in stage 5 and dialysis patients, and are strongly associated with anemia, mineral imbalance, and dialysis exposure. While our rates exceed some pre-dialysis cohorts, they are consistent with studies of HD populations across differing regions.

Strengths of our study include robust sample size, use of validated standardized sleep tools (PSQI, ESS, IRLSSG), and comprehensive biochemical correlations. Future longitudinal studies incorporating objective sleep assessments, such as polysomnography, actigraphy, or wearable sleep tracking technologies, are essential to better understand the temporal and causal relationships between sleep disturbances and the clinical progression of chronic kidney disease. Such studies could help determine whether correcting specific modifiable factors like anemia, hyperphosphatemia, and secondary hyperparathyroidism can lead to measurable improvements in sleep quality and, in turn, enhance overall patient outcomes, including cardiovascular health, treatment adherence, and quality of life.

In addition, interventional trials that focus on optimizing dialysis schedules, nutritional management, and the use of sleep-focused pharmacologic or behavioral therapies are warranted. These could offer evidence-based strategies to reduce the high burden of sleep-related symptoms in this population. The integration of routine sleep screening using brief, validated tools such as the PSQI and ESS in nephrology clinics, particularly for high-risk groups like dialysis patients, may facilitate early detection and timely intervention. Our findings, in line with those of multiple international studies, reinforce the clinical importance of addressing sleep health as a core component of comprehensive CKD care. A multidisciplinary approach involving nephrologists, sleep specialists, dietitians, and mental health professionals could significantly improve both renal and non-renal outcomes in this vulnerable patient population.

The results of this study highlight the importance of frequent screening and early detection of sleep disturbances in individuals with chronic renal disease, especially those in stage 5 or receiving dialysis. It was discovered that restless legs syndrome, excessive daytime sleepiness, and poor sleep quality were all quite common and strongly correlated with clinical characteristics that could be changed, like anemia and calcium-phosphate imbalance. Addressing these issues through targeted interventions, such as anemia management, optimization of dialysis schedules, correction of mineral imbalances, and non-pharmacological sleep therapies, may improve not only sleep quality but also the overall quality of life and potentially slow CKD progression. Incorporating standardized sleep assessment tools like PSQI and ESS into nephrology practice could help in timely diagnosis and intervention.

The findings of this study highlight the need for integrating sleep health into routine clinical evaluation of patients with chronic kidney disease, particularly those at advanced stages or receiving dialysis. Sleep disorders such as poor sleep quality, excessive daytime sleepiness, and restless leg

syndrome are not only common but are also associated with modifiable clinical parameters like anemia, phosphate imbalance, and dialysis exposure. Early detection and management of these sleep disturbances can potentially improve quality of life, enhance treatment adherence, and reduce the burden of CKD-related complications. Routine use of simple, validated tools such as the PSQI and ESS in nephrology clinics could serve as an effective strategy to identify at-risk patients and initiate timely interventions.

A key strength of this study is its use of well-established, standardized sleep assessment tools that are widely validated in CKD populations. The inclusion of both dialysis and non-dialysis patients allowed for meaningful comparisons across disease stages, providing a more comprehensive understanding of sleep disturbances throughout the CKD spectrum. The relatively large sample size and the prospective, structured data collection enhanced the reliability of findings. Additionally, the study's focus on biochemical and clinical correlates offers valuable insight into potential underlying mechanisms and intervention targets for sleep-related issues in this vulnerable population.

CONCLUSION

The research shows that individuals with chronic renal disease, especially those on dialysis and those in advanced stages of the disease, have a significant burden of sleep disturbances, including restless legs syndrome and poor sleep quality. Significant correlations between anemia, elevated serum phosphate, and low calcium indicate that these clinically modifiable traits may contribute to the onset or exacerbation of sleep disorders. Given that sleep appears to be a major factor in CKD patients' overall well-being, our findings provide more support for the inclusion of a sleep history in the treatment of comprehensive CKD therapy. To establish causality and evaluate the impact of sleep therapies on renal and health outcomes, longitudinal and interventional studies are necessary.

LIMITATIONS

It is important to recognize the limitations of this study. First, the cross-sectional design restricts the ability to draw causal inferences between clinical factors and the presence of sleep disorders. While associations were identified, it remains unclear whether these clinical parameters contribute to the development of sleep disturbances or are consequences of poor sleep. Longitudinal studies would be necessary to establish temporal relationships and causality. Second, sleep disturbances were assessed using self-reported questionnaires, including the PSQI, ESS, and IRLSSG criteria, rather than objective diagnostic tools such as polysomnography or actigraphy. Although these validated instruments are widely used in clinical research, they are inherently subjective and may lead to under- or over-reporting due to recall bias or personal interpretation of symptoms. This reliance on self-reported data may limit the precision in identifying the true prevalence and severity of sleep disorders.

Third, the study was conducted at a single tertiary care hospital, which may not fully represent the broader CKD population, particularly those managed in rural or under-resourced settings. Factors such as healthcare access, socioeconomic status, and cultural perceptions of sleep may vary across regions and could influence the generalizability of the findings. Lastly, psychological variables such as anxiety, depression, and stress, which are known to be significant contributors to sleep disturbances, were not evaluated in this study. The omission of these variables limits the comprehensiveness of the analysis and may have excluded key confounders that influence both sleep quality and disease progression in CKD patients. Future studies should incorporate mental health assessments to provide a more holistic understanding of the factors influencing sleep in this population.

Authors Contribution:
Yasir Saadat: Responsible for data collection and entry
Muhammad Irshad Khan: Responsible for data collection and entry
Shoukat Ali: Contributed to the conception, study design, and supervision of the project
Abdul Hameed Jamali: Performed statistical analysis and interpretation of results.
Fahad Mushtaq: Conducted the literature review and drafted the initial manuscript
Aysha Jabeen: Conducted the literature review and drafted the initial manuscript

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