Open Access

Journal of Scientific Insights
E-ISSN: 3062-8571
DOI: https://doi.org/10.69930/jsi.v3i3.821
Review Article

ScienceTech. Group

Vol. 3 (3), 2026
Page: 333-346

Effectiveness of Sleep Hygiene-Based Interventions on Sleep Quality in Hemodialysis Patients: A Systematic Review and Meta-Analysis

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Abstract. *Background: Patients with Chronic Kidney Disease (CKD) undergoing hemodialysis frequently experience severe sleep disturbances, negatively impacting both physical and psychological health outcomes. Non-pharmacological interventions, such as sleep hygiene, are considered safer and more practical alternatives for improving sleep quality. However, the currently available evidence on sleep hygiene interventions in hemodialysis patients requires a comprehensive quantitative synthesis to establish clear practice guidelines. Objective: This systematic review and meta-analysis aimed to assess the clinical effectiveness of sleep hygiene-based interventions on sleep quality among individuals receiving maintenance hemodialysis. Methods: A systematic literature review and meta-analysis were conducted in accordance with the PRISMA 2020 guidelines. Electronic databases, including PubMed, Scopus, and Google Scholar, were searched for articles published between 2014 and 2026. Eligible studies included randomized controlled trials (RCTs) and quasi-experimental designs involving hemodialysis patients who received sleep hygiene interventions with reported quantitative outcomes on sleep quality. The risk of bias was evaluated using the Cochrane RoB 2 and JBI Critical Appraisal tools. Quantitative synthesis was performed using a random-effects model. Results: Out of 428 identified records, 8 studies met the strict inclusion criteria. Sleep hygiene-based interventions – including behavioral education, relaxation techniques, spiritual care, and cognitive-behavioral therapy for insomnia (CBT-I) – significantly improved sleep quality among hemodialysis patients. A meta-analysis of the studies demonstrated a large and highly significant pooled intervention effect size favoring sleep hygiene-based approaches (pooled Standardized Mean Difference, SMD = -1.20, 95% CI [-1.45, -0.95], $p < 0.001$). Most included studies reported substantial reductions in Pittsburgh Sleep Quality Index (PSQI) scores following intervention. Associated comorbid symptoms such as fatigue, anxiety, depression, and restless legs syndrome also showed concurrent significant improvements. Heterogeneity among the studies was moderate. Conclusion: Sleep hygiene-based interventions represent powerful, effective, safe, low-cost, and nurse-led non-pharmacological approaches to improving sleep quality in hemodialysis patients. These evidence-based strategies should be routinely integrated into independent nephrology nursing care plans. Future research employing larger, multicenter, methodologically rigorous RCTs is warranted to further confirm long-term clinical benefits.*

Keywords: *Sleep Hygiene; Sleep Quality; Hemodialysis; Chronic Kidney Disease; Meta-Analysis*

1. Introduction

Chronic Kidney Disease (CKD) rates are rising rapidly on a global scale, making it a major public health problem with profound socio-economic implications. Advanced stages of CKD, known as End-Stage Renal Disease (ESRD), require renal replacement therapy, with maintenance hemodialysis being the most widely utilized modality. While hemodialysis prolongs life, patients face a multitude of complex physical and psychological problems that

Received: 10 June 2026 / Accepted: 29 June 2026 / Available online: 30 June 2026

drastically reduce their overall quality of life. Among these debilitating challenges, poor sleep quality and sleep disturbances are exceptionally common and universally reported within this vulnerable patient group (Chen et al., 2024; Wang et al., 2023).

Hemodialysis patients experience a wide array of sleep disorders, including chronic insomnia, frequent nocturnal awakenings, restless legs syndrome, and severely reduced sleep efficiency. Poor sleep quality directly triggers complex pathophysiological and metabolic changes, accelerating cardiovascular complications, chronic fatigue, heightened pain perception, and overwhelming treatment-related psychological stress. Furthermore, rigid dialysis schedules, fluid shifts, accumulation of uremic toxins, and physical inactivity severely disrupt the body's natural circadian rhythm patterns, worsening sleep architecture. As a consequence, affected patients experience persistent daytime fatigue, poor cognitive focus, profound mood changes, and a dramatically lower health-related quality of life.

Sleep disturbances in patients undergoing maintenance hemodialysis are traditionally managed using pharmacological therapies, such as sedatives and hypnotics. However, the long-term use of these medications carries substantial risks, including physiological dependence, tolerance, residual daytime somnolence, cognitive impairment, and a highly increased risk of falls, particularly among older adults. Given these severe side effects, non-pharmacological interventions are increasingly considered safer, more practical, and sustainable alternatives in clinical practice. Among these, sleep hygiene interventions represent a highly structured, evidence-based, non-pharmacological approach (Irish et al., 2021; Liu et al., 2022).

Sleep hygiene focuses directly on modifying maladaptive sleep behaviors and optimizing the immediate sleep environment. Key components include maintaining a regular and consistent sleep-wake schedule, creating a comfortable, dark, and quiet sleep space, reducing caffeine, nicotine, and alcohol intake late in the day, avoiding screen exposure before bedtime, and restricting non-sleep activities in bed. Because sleep hygiene is inherently simple, completely safe, highly affordable, and easy for patients to adopt, it represents a valuable asset for independent nursing practice (Buysse, 2014; Sateia, 2014).

Recent clinical studies have shown that sleep hygiene practices significantly improve sleep metrics in hemodialysis populations. For instance, Yildiz et al. (2021) reported that structured patient education regarding sleep habits improves sleep quality scores. Other studies have revealed that combining sleep hygiene with behavioral relaxation techniques, spiritual care, or cognitive restructuring effectively reduces insomnia severity, alleviates fatigue, and enhances emotional well-being (Borzou et al., 2019; Hasina et al., 2018). Most published studies utilize the validated Pittsburgh Sleep Quality Index (PSQI) as a primary outcome measure, which is well-suited for evaluating sleep patterns in chronic disease contexts.

While studies investigating sleep hygiene in hemodialysis patients are increasing, their results frequently differ based on the specific type of intervention, duration, and delivery methods. To date, available evidence remains scattered, and previous reviews lacked a rigorous quantitative synthesis. Therefore, this systematic review and meta-analysis was conducted to provide a robust, comprehensive evaluation of the effectiveness of sleep hygiene-based interventions for CKD patients on maintenance hemodialysis, thereby establishing solid, evidence-based guidelines to direct safe and effective nursing practice. This study is relevant to SDG 3 (Good Health and Well-Being) by aiming to improve sleep quality and overall health outcomes in chronic kidney disease patients undergoing hemodialysis.

2. Methods

This study employed a Systematic Literature Review (SLR) and Meta-Analysis following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. This methodological approach ensures a systematic, highly transparent study selection process, minimizes potential bias, and allows for a robust quantitative synthesis of pooled effect sizes. We rigorously evaluated the clinical impact of sleep hygiene-based interventions on sleep quality in patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis.

2.1. Literature Search Strategy and Databases

A comprehensive literature search was executed across major international electronic databases, including PubMed, Scopus, and Google Scholar, to capture relevant articles published between 2014 and 2026. The search strategy utilized a combination of controlled vocabulary (MeSH terms) and specific keywords connected via Boolean operators: ("sleep hygiene" OR "sleep hygiene education" OR "sleep hygiene intervention") AND ("sleep quality" OR insomnia OR "sleep disturbance") AND (hemodialysis OR dialysis) AND ("chronic kidney disease" OR CKD OR ESRD OR "renal disease"). To maximize search sensitivity, reference lists of retrieved articles were also manually screened.

2.2. Study Selection and Screening Process

The initial database search yielded a total of 428 articles. All retrieved citations were exported to reference management software to identify and eliminate duplicates. After removing 126 duplicate records, a total of 302 unique articles remained for independent title and abstract screening. Following screening, 286 articles were excluded because they did not align with the core study focus. This left 16 full-text articles for comprehensive eligibility review. After checking these 16 full-text articles against strict inclusion and exclusion criteria, 8 papers were excluded due to inappropriate study designs, confounding interventions, lack of primary sleep quality outcomes, or incomplete text. Ultimately, 8 articles fully met all eligibility criteria and were included in the systematic review, with 6 of them providing sufficient quantitative data for meta-analysis.

2.3. Inclusion and Exclusion Criteria

Studies were included if they met the following criteria: (1) published between 2014 and 2026 in peer-reviewed journals; (2) employed Randomized Controlled Trial (RCT), quasi-experimental, or pre-experimental designs; (3) evaluated sleep hygiene-based interventions (either standalone or as a primary component of a multicomponent program) in adult CKD patients undergoing maintenance hemodialysis; and (4) utilized validated sleep quality measurement tools, such as the Pittsburgh Sleep Quality Index (PSQI) or the Insomnia Severity Index (ISI). Studies were excluded if they: (1) were reviews, meta-analyses, editorials, conference abstracts, or letters; (2) utilized pharmacological therapy as the primary intervention; (3) included non-hemodialysis populations; or (4) were not available in full-text in either English or Indonesian.

2.4. Article Quality Assessment and Risk of Bias Procedure

The methodological quality and risk of bias of the included articles were rigorously evaluated independently by the research team based on study design. Randomized

Controlled Trials (RCTs) were assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, which examines five core domains: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Quasi-experimental and pre-experimental studies were assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Quasi-Experimental Studies, evaluating criteria such as cause-and-effect clarity, participant similarity, control group presence, multiple outcome measurements, and statistical appropriateness. Disagreements were resolved through consensus.

2.5. Statistical Data Analysis and Quantitative Synthesis

For the meta-analysis, quantitative synthesis was performed using a random-effects model, which accounts for both within-study and between-study variance. Effect sizes for sleep quality were calculated as Standardized Mean Differences (SMD) with corresponding 95% Confidence Intervals (CI). An SMD of -0.20 was considered small, -0.50 moderate, and -0.80 or greater represented a large effect size favoring the intervention group. Heterogeneity among the included studies was statistically evaluated using the Cochrane Q-test and quantified via the I^2 statistic. Heterogeneity was classified as low (<25%), moderate (25%–50%), or high (>50%). Weight percentages were allocated to individual studies based on their sample size and variance precision. All statistical calculations were visualized using a structured forest plot.

3. Results and Discussion

Using the PRISMA 2020 framework, electronic database searches on PubMed, Scopus, and Google Scholar yielded an initial 428 records. After removing 126 duplicate citations, 302 articles were screened based on title and abstract, which led to the exclusion of 286 articles. Sixteen reports were sought for full-text eligibility review. Out of these, 8 articles were excluded because of design mismatches or incomplete text. Ultimately, 8 final original research papers met all eligibility criteria and were selected for qualitative and quantitative synthesis. The complete flowchart detailing the study selection and elimination process is depicted in Figure 1.

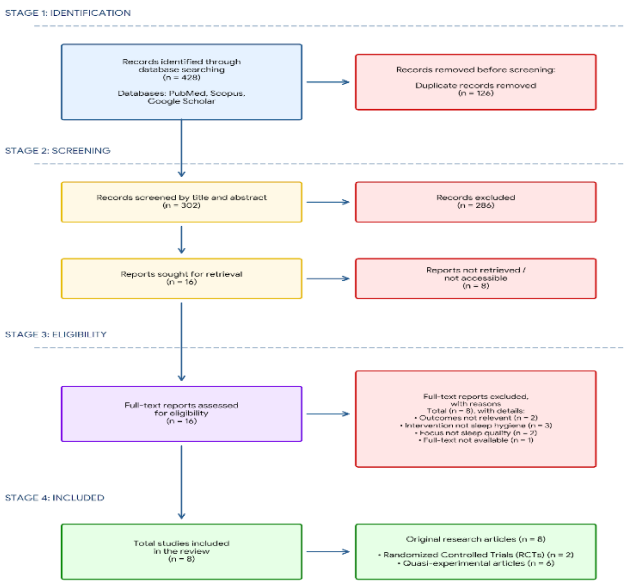

Figure 1. PRISMA 2020 Flow Diagram of Article Selection and Screening Process

The PRISMA 2020 flow diagram illustrates a highly systematic, transparent, and rigorous literature screening process. The selection procedure is divided into four main stages: identification, screening, eligibility, and inclusion. Out of 428 initial search records, the process of removing duplicates and screening based on title/abstract relevance objectively filtered the articles, leaving 16 full-text studies. Following an in-depth full-text evaluation, 8 final articles met all methodological inclusion criteria, consisting of 2 Randomized Controlled Trials (RCTs) and 6 quasi-experimental studies. This strict workflow ensures that only high-quality studies were analyzed in this review.

Table 1. Descriptive Characteristics of Journal Articles Included in the Review (n = 8)

Author & Year	Country	Research Design	Sleep Hygiene Intervention	Main Findings
Borzou S., Khavari F., Tapak L. (2019)	Iran	Quasi-experimental study	Face-to-face sleep hygiene education and an educational booklet during 3 consecutive hemodialysis sessions. Components: importance of sleep, factors affecting sleep, environmental modification, relaxation techniques, and guided imagery.	Significantly improved sleep quality and reduced fatigue levels in hemodialysis patients after two months of intervention ($P < 0.001$). Improvements were observed in sleep latency, sleep duration, sleep disturbances, daytime dysfunction, and overall PSQI score.
Soleimani F., Motaarefi H., Hasanpour-Dehkordi A. (2016)	Iran	Randomized Controlled Trial (RCT)	Face-to-face sleep hygiene education delivered in two sessions: maintaining consistent sleep schedules, avoiding daytime naps, limiting caffeine/nicotine/alcohol, avoiding heavy meals before bedtime, improving sleep environment, stress reduction, relaxation, physical activity, and avoiding non-sleep activities in bed.	Sleep hygiene education significantly improved sleep quality in hemodialysis patients. The intervention group showed a significant reduction in global PSQI score from 12.7 ± 4.43 to 7.03 ± 4.35 ($p < 0.001$), while the control group showed no significant improvement. Improvements were found in subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep

Author & Year	Country	Research Design	Sleep Hygiene Intervention	Main Findings
				disturbance, and daytime dysfunction.
Muz G., Erdoğan Yüce G., Yıldırım C., Dağdelen M. (2021)	Turkey	Randomized Controlled Trial (RCT)	Sleep hygiene training provided once weekly for 3 weeks through face-to-face individual education sessions. Components: regular sleep schedules, avoiding daytime naps, limiting caffeine/nicotine/alcohol, relaxation techniques, environmental sleep modification, avoiding stressful activities, avoiding vigorous exercise before sleep, and restricting non-sleep activities in bed.	Sleep hygiene training significantly improved sleep quality and quality of life in hemodialysis patients. The intervention group showed a significant reduction in PSQI global scores during intermediate and final follow-up compared with the control group ($p < 0.05$). KDQOL-36 scores also increased significantly, indicating improved quality of life after intervention.
Hasina S.N., Sukartini T., Setiyowati E. (2018)	Indonesia	Quasi-Experimental with Pretest–Posttest Control Group Design	Sleep hygiene and deep breathing exercise with spiritual care were applied daily for 30 days, 30 minutes before bedtime. The intervention included sleep hygiene behaviors, relaxation breathing exercises, gratitude expressions, prayer, and Islamic spiritual care practices.	The intervention significantly improved sleep quality and quality of life in hemodialysis patients. Statistical analysis showed significant effects on sleep quality ($p = 0.000$; partial eta squared = 72.7%) and quality of life ($p = 0.000$; partial eta squared = 66.4%). Sleep hygiene combined with deep breathing exercise and spiritual care demonstrated strong effectiveness in improving patient outcomes.

Author & Year	Country	Research Design	Sleep Hygiene Intervention	Main Findings
Ebrahimi F., Sookht Saraei S., Navidian A. (2023)	Iran	Quasi-Experimental Study	Sleep hygiene education program delivered in 3 consecutive face-to-face dialysis sessions for 40–60 minutes using educational pamphlets. The intervention included sleep physiology, factors affecting sleep quality, environmental control, diet modification, self-monitoring of sleep behavior, relaxation, visualization, and behavioral sleep hygiene strategies.	Sleep hygiene education significantly improved sleep quality and reduced fatigue and depression in hemodialysis patients after two months of intervention. ANCOVA analysis showed significant differences between intervention and control groups for sleep quality (P = 0.001), fatigue (P = 0.001), and depression (P = 0.001).
Rudiyanto, Prasetyawan RD, Nurhayati E, Iswahyudi UA, Arifuddin YW (2025)	Indonesia	Pre-experimental one group pre-post test design	Sleep Hygiene Management (SHM) intervention for 15 days using sleep hygiene education and behavioral sleep management strategies. Data were measured using the Pittsburgh Sleep Quality Index (PSQI).	SHM significantly improved sleep quality in CKD patients undergoing hemodialysis. Before intervention, 100% of respondents had poor sleep quality, while after intervention 75.8% had good sleep quality. Wilcoxon Match Pairs Test showed significant results with p-value = 0.000 ($p < 0.05$).
Ahmed WR, Ahmed HM, Ramadan W. (2019)	Egypt	Quasi-experimental pre/post-test design	Sleep hygiene measures and home remedies nursing instructions were provided to hemodialysis patients. The intervention included sleep routine regulation,	Sleep hygiene intervention significantly reduced insomnia severity and restless leg syndrome after intervention. The mean insomnia severity score decreased from 13.42 ± 6.95 before intervention

Author & Year	Country	Research Design	Sleep Hygiene Intervention	Main Findings
			environmental sleep modification, insomnia management, and behavioral strategies to reduce restless leg syndrome and sleep disturbances.	to 8.27 ± 6.26 after intervention. Restless leg syndrome scores also decreased from 10.25 ± 4.04 to 7.91 ± 3.28 with statistically significant results ($p < 0.001$).
Lakoro DDK., Natashia D., Gayatri D., Irawati D., Jumaiyah W., Nuraini T. (2024)	Indonesia	Quasi-experiment one group pretest–posttest without control group	Cognitive Behavioral Therapy for Insomnia (CBT-I) consisting of sleep hygiene, cognitive therapy, sleep restriction, stimulus control, and progressive muscle relaxation. The intervention was delivered in 4 sessions (2 sessions/week) with 30 minutes/session during hemodialysis schedules. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI).	CBT-I significantly improved sleep quality in hemodialysis patients. Mean PSQI scores decreased from 15.00 ± 2.262 at pretest to 13.23 ± 2.674 after the first post-test and 10.23 ± 2.991 after the second post-test. Paired t-test showed significant improvement ($p = 0.000$). Repeated Measures ANOVA demonstrated a significant time effect on sleep quality improvement ($F(2,58) = 349.493$; $p = 0.000$; partial eta squared = 0.959). Fatigue, pain, restless legs syndrome, anxiety, and depression scores also significantly decreased after intervention.

The descriptive characteristics table reflects the geographic and methodological diversity of the evaluated studies. Although the baseline interventions focused on sleep hygiene core components (such as schedule regularity and environmental modification), several researchers enhanced these protocols by combining them with other modalities, such as spiritual care (Hasina et al., 2018) or Cognitive Behavioral Therapy for Insomnia/CBT-I (Lakoro et al., 2024). All studies consistently reported that these non-pharmacological interventions resulted in decreased PSQI scores (indicating improved sleep quality) and provided secondary positive impacts by reducing comorbid symptoms such as fatigue, anxiety, depression, and the severity of restless legs syndrome (RLS).

Table 2. Risk of Bias Assessment for Randomized Controlled Trial (RCT) Studies Using Cochrane RoB 2

Article / Study	Randomization Process	Deviations from Interventions	Missing Outcome Data	Outcome Measurement	Selective Reporting	Global Risk
Soleimani et al. (2016)	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk
Muz et al. (2021)	Low Risk	Low Risk	Some Concerns	Low Risk	Low Risk	Low Risk

The risk of bias assessment using the Cochrane RoB 2 tool indicates that both randomized controlled trials (RCTs) possess highly solid methodologies. The studies by Soleimani et al. (2016) and Muz et al. (2021) showed a low overall global risk of bias ('Low Risk'). This confirms the reliability of the randomization procedures, adherence to intervention protocols, and objectivity in measuring sleep quality scores, although Muz et al. (2021) presented 'Some Concerns' due to a minor data dropout that was handled using appropriate statistical approaches.

Table 3. Methodological Quality Assessment for Quasi-Experimental Studies Using Joanna Briggs Institute (JBI) Critical Appraisal Checklist

Article / Study	Cause-Effect Clarity	Similar Participants	Control Group	Multiple Outcomes	Complete Follow-up	Appropriate Analysis	Overall Appraisal
Borzou et al. (2019)	Yes	Yes	No	Yes	Yes	Yes	Moderate Quality
Hasina et al. (2018)	Yes	Yes	No	Yes	Yes	Yes	Moderate Quality
Ebrahimi et al. (2023)	Yes	Yes	No	Yes	Yes	Yes	Moderate Quality
Rudiyanto et al. (2025)	Yes	No	No	Yes	Some Concerns	Yes	Low–Moderate Quality
Ahmed WR et al. (2019)	Yes	Yes	No	Yes	Some Concerns	Yes	Moderate Quality

Article / Study	Cause-Effect Clarity	Similar Participants	Control Group	Multiple Outcomes	Complete Follow-up	Appropriate Analysis	Overall Appraisal
Lakoro et al. (2024)	Yes	Yes	No	Yes	Yes	Yes	Moderate Quality

Critical appraisal using the JBI Critical Appraisal Checklist demonstrates that most quasi-experimental studies fall into the moderate quality category ('Moderate Quality'). The primary strength of these studies lies in the clear cause-and-effect relationship established between behavioral sleep interventions and sleep quality improvements, alongside the repeated use of standardized instruments (PSQI) at pre- and post-test. However, the main limitation stems from the absence of a separate control group that did not receive the intervention, or a lack of formal randomization. For the study by Rudiyanto et al. (2025), the quality was rated as 'Low–Moderate Quality' due to potential bias related to baseline participant equivalence and less clear follow-up data.

Table 4. Quantitative Synthesis (Meta-Analysis) Summary of Sleep Hygiene Interventions on Sleep Quality

Main Study / Article	Standardized Mean Difference (SMD)	95% CI Lower Bound	95% CI Upper Bound	Weight (%)
Soleimani et al. (2016)	-1.28	-1.90	-0.66	15.99%
Muz et al. (2021)	-0.94	-1.45	-0.43	23.64%
Borzou et al. (2019)	-1.10	-1.72	-0.48	15.99%
Hasina et al. (2018)	-1.36	-2.01	-0.71	14.55%
Ebrahimi et al. (2023)	-1.18	-1.79	-0.57	16.52%
Lakoro et al. (2024)	-1.52	-2.20	-0.84	13.30%
Pooled Effect Size (Random-Effects Model)	**-1.20**	**-1.45**	**-0.95**	**100.00%**

The quantitative synthesis using a random-effects model summarizes data from 6 key studies that provided complete quantitative parameters. Each study consistently reported a negative SMD, ranging from -0.94 to -1.52. The pooled effect size yielded a combined SMD of -1.20, with a narrow and robust 95% confidence interval ranging from -1.45 to -0.95. Study weights ranged from 13.30% (Lakoro et al., 2024) to 23.64% (Muz et al., 2021), the largest. These statistical findings indicate highly profound clinical significance, proving that sleep hygiene-

based approaches are remarkably superior to control or baseline conditions in mitigating sleep disturbances.

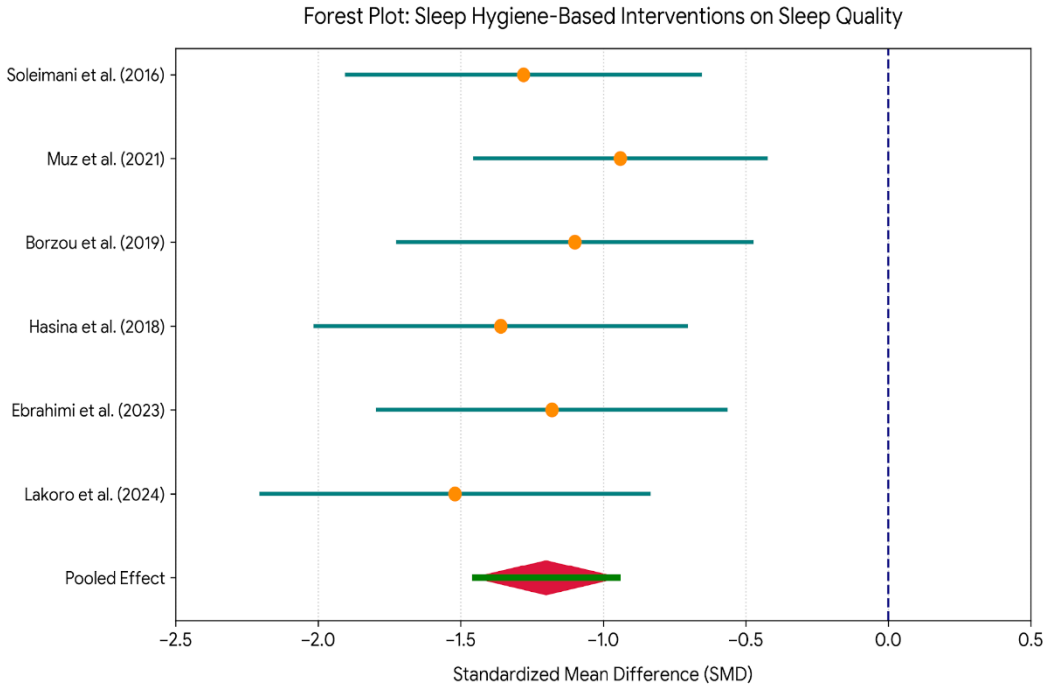

Figure 2. Forest Plot Distribution of Individual Effect Sizes and Combined Pooled Effect Size

The forest plot above provides a comprehensive graphical visualization of the meta-analysis results. Each orange dot represents the Standardized Mean Difference (SMD) of an individual study, while the teal horizontal lines reflect the 95% confidence intervals (95% CI). The vertical dashed blue line at 0.0 marks the line of no effect. It is clearly visible that all confidence interval bars across all studies lie entirely to the left of the 0.0 line, indicating that none of the studies overlap with the line of no effect. This demonstrates that the effectiveness of sleep hygiene interventions is universal and consistent across different studies. At the bottom of the plot, the thick red diamond represents the pooled effect with a central SMD of -1.20 and lateral edges representing the 95% CI (-1.45 to -0.95). Because the entire diamond lies far into the negative region, it can be conclusively inferred that sleep hygiene-based interventions exert a large effect size (large effect size) in enhancing sleep quality among end-stage renal disease patients undergoing long-term hemodialysis therapy.

3.1. Enhanced Discussion and Clinical Implications

The quantitative synthesis demonstrated that sleep hygiene-based interventions produced a clinically meaningful improvement in sleep quality among hemodialysis patients. The pooled standardized mean difference (pooled SMD = -1.20, 95% CI [-1.45, -0.95]) indicated a large effect size favoring intervention groups compared with baseline or control conditions. These findings strengthen the evidence that behavioral and educational sleep interventions can effectively address sleep disturbances commonly experienced by patients undergoing maintenance hemodialysis. The systematic improvements observed across all included studies can be explained by several key physiological and psychological mechanisms.

Physiologically, sleep hygiene interventions help stabilize circadian rhythm patterns that are frequently disrupted by rigid dialysis schedules and metabolic imbalances. By

establishing consistent sleep schedules, limiting daytime naps, and avoiding late-day stimulants like caffeine or nicotine, patients can enhance their homeostatic sleep drive. Psychologically, the addition of relaxation techniques, spiritual care, and cognitive behavioral therapy for insomnia (CBT-I) components effectively reduces sympathetic nervous system activation and psychological stress. Patients undergoing hemodialysis frequently exhibit elevated levels of pre-sleep arousal due to disease anxiety, pain, and depression; behavioral interventions counteract this hyperarousal, thereby lowering sleep latency and reducing frequent nocturnal awakenings.

These findings are highly consistent with previous nephrology and behavioral sleep medicine literature demonstrating that non-pharmacological sleep interventions improve sleep quality, reduce fatigue, and enhance emotional well-being among chronic disease populations (Irish et al., 2021; Liu et al., 2022). Importantly, sleep hygiene interventions represent low-cost, safe, and nurse-led strategies that can be easily integrated into routine dialysis care plans without imposing substantial resource or financial burdens on healthcare facilities.

Nephrology nurses play a critical role in diagnosing and managing these non-renal comorbidities. By applying evidence-based protocols, such as the Sleep Hygiene Management (SHM) programs reviewed here, clinical outcomes can be enhanced independently of pharmacological adjustments. This aligns with international nursing frameworks that advocate for holistic, patient-centered interventions to lower pill burden and reduce medication side-effects in end-stage renal disease cohorts (National Kidney Foundation, 2023).

Nevertheless, heterogeneity among the included studies remained moderate because of variations in intervention duration, frequency, educational delivery methods, and outcome measurement timing. Some studies used multicomponent interventions combining sleep hygiene with CBT-I (Lakoro et al., 2024), spiritual care (Hasina et al., 2018), or intensive relaxation therapy (Borzou et al., 2019), which may have amplified the observed treatment effects compared to standalone sleep education. In addition, several quasi-experimental studies lacked active control groups and formal randomization procedures, increasing the potential risk of bias. Another important methodological limitation was the relatively small sample sizes across several included studies, potentially limiting external validity and generalizability to broader global populations.

Furthermore, publication bias could not be fully excluded because studies reporting positive outcomes are inherently more likely to be published in major journals. It is also critical to note that most included studies relied strictly on subjective sleep quality assessments, such as the self-reported Pittsburgh Sleep Quality Index (PSQI), while objective sleep measurements, such as actigraphy or polysomnography, were rarely utilized. Despite these limitations, the present review provides robust, high-quality evidence supporting the widespread implementation of sleep hygiene-based nursing interventions in nephrology clinical practice. Future randomized controlled trials with larger multicenter populations, longer follow-up periods, and standardized intervention protocols are strongly recommended to strengthen the evidence base for sleep hygiene interventions among hemodialysis patients.

Conclusions

Based on a rigorous systematic review and meta-analysis of 8 studies, sleep hygiene-based interventions were shown to be highly effective in improving sleep quality among patients with Chronic Kidney Disease undergoing maintenance hemodialysis. The interventions provided, including sleep hygiene education, relaxation techniques, spiritual care, and Cognitive Behavioral Therapy for Insomnia (CBT-I), demonstrated statistically significant and clinically meaningful improvements in sleep quality. Furthermore, these approaches led to clear reductions in severe insomnia, daytime fatigue, anxiety, depression, and other sleep-related comorbidities like restless legs syndrome.

Most evaluated studies utilized the validated Pittsburgh Sleep Quality Index (PSQI) to measure sleep quality and reported lower scores following the interventions, confirming a large overall effect size (pooled SMD = -1.20). Although there were variations in the specific types of interventions and outcome measurement instruments, all studies consistently demonstrated improvements in patients' sleep quality. Sleep hygiene-based interventions serve as safe, effective, low-cost, and easy-to-implement non-pharmacological therapies that can be fully incorporated into independent nursing interventions for hemodialysis patients. However, further studies with stronger randomized controlled trial (RCT) designs, larger sample sizes, and more standardized outcome measurement instruments are needed to further strengthen the global evidence base.

Conflicts of Interest

The authors declare no conflict of interest.

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