Original Article

Nurse-Led Multidimensional Intervention Improves Symptom Burden and Quality of Life in Hemodialysis Patients: A Quasi-Experimental Study

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ABSTRACT

Background: Patients undergoing hemodialysis (HD) experience a high symptom burden that adversely affects health-related quality of life (HRQoL). Evidence on integrated nursing interventions to address these challenges remains limited, particularly in lower- and middle-income country (LMIC) settings. This study evaluated the effectiveness of a 12-week Multidimensional Integrated Nursing Intervention (MINI) in reducing symptom burden and improving HRQoL among HD patients in Indonesia.

Methods: A multi-site quasi-experimental study with a non-equivalent pre-test/post-test control group design was conducted between November 2025 and March 2026 across three public hospitals in Indonesia. A total of 112 maintenance hemodialysis patients were allocated to either a 12-week Multidimensional Integrated Nursing Intervention (MINI; n=56) or a control group receiving usual care (n=56). The intervention integrated symptom management, psychosocial support, dietary coaching, intradialytic exercise, and self-management education. Symptom burden and health-related quality of life (HRQoL) were assessed using the MSAS-GDI and KDQOL-36, respectively, and analyzed using paired and independent t-tests, with effect sizes estimated by Cohen's d.

Results: Following 12 weeks, the MINI group demonstrated significantly greater reductions in MSAS-GDI compared to controls (1.59±0.33 vs 2.33±0.41; $p<0.001$; Cohen's $d=1.87$). Significant improvements were observed across all five KDQOL-36 domains in the MINI group (all $p<0.001$; Cohen's $d=1.94$), with no significant changes in the control group. Large, consistent effect sizes were observed across all three study sites.

Conclusion: A 12-week nurse-led multidimensional intervention demonstrated promising reductions in symptom burden and improvements in HRQoL in HD patients across Indonesian public hospital settings. These findings suggest that MINI may be a feasible model for integration into HD nursing protocols in LMIC contexts. Confirmation through cluster-randomised or pragmatic multicenter trials with longer follow-up is warranted before routine implementation can be recommended.

Keywords: Hemodialysis; Chronic Kidney Disease; Quality of Life; Symptom Assessment; Nursing Care.

Implications for Practice:

- Nurse-led multidimensional interventions

Implications for Practice:

integrating symptom assessment, psychosocial support, dietary counseling, intradialytic exercise, and self-management education may enhance symptom control and health-related quality of life among patients receiving maintenance hemodialysis.

- Healthcare systems and dialysis service providers should consider piloting structured multidimensional nursing care models within routine hemodialysis services to strengthen patient-centered outcomes and optimize the use of existing nursing resources.
- Given its reliance on nurse-led delivery and minimal additional infrastructure, this approach may represent a feasible strategy for improving hemodialysis care in resource-constrained settings, including Low- and Middle-Income Countries, where access to comprehensive supportive services remains limited.

Introduction

Chronic kidney disease (CKD) and end-stage renal disease (ESRD) represent a rapidly escalating global public health burden. An estimated 843.6 million individuals worldwide are affected by CKD, with over 3.9 million requiring renal replacement therapy (RRT) (Saran et al., 2022; World Health Organization, 2023). In Indonesia, the Indonesian Renal Registry reported more than 77,892 active HD patients in 2022, with annual incidence increasing by approximately 10–12% per year (Indonesian Renal Registry (Perhimpunan Nefrologi Indonesia [PERNEFRI]), 2022). West Java and Jakarta the provinces encompassing the three study sites account for approximately 28% of the national HD population, representing the highest regional burden (Indonesian Society of Nephrology, 2023).

Patients maintained on hemodialysis experience a profound and frequently underrecognized multidimensional symptom burden. Systematic reviews report a median of 11 concurrent symptoms in HD patients, including fatigue (71–82%), pruritus (55–77%), pain (47–50%), dyspnea (35–60%), insomnia (41–55%), depression (20–30%), and anxiety (25–40%) (Murtagh et al., 2007; Smilde et al., 2021). This symptom burden directly compromises health-related quality of life (HRQoL)—a multidimensional construct encompassing physical, psychological, and social functioning—consistently rated as severely impaired in HD populations (Flythe et al., 2020; Tong et al., 2009).

The consequences of unmanaged symptom burden extend beyond subjective distress. Depression and anxiety are independently associated with reduced dialysis adherence and increased hospitalization (Cukor et al., 2009; Kimmel & Peterson, 2006). Malnutrition elevates cardiovascular risk and mortality (Kalantar-Zadeh et al., 2015), sphysical deconditioning accelerates functional decline (Heiwe & Jacobson, 2011), and inadequate self-management contributes to preventable hospitalizations (Nguyen et al., 2019). These interrelated consequences necessitate interventions addressing multiple symptom domains concurrently rather than isolated single-component approaches.

Current HD care in Indonesian hospitals predominantly targets biochemical parameters, while systematic attention to symptom burden, psychological well-being, physical reconditioning, and patient education remains inconsistent (Indonesian Society of Nephrology, 2023). Existing evidence supports individual efficacy of intradialytic exercise (Sheng et al., 2014), psychosocial interventions (Gerogianni et al., 2019; Orsega-Smith et al., 2020), dietary education (Baraz et al., 2010), and self-management programs (Bonner et al., 2021). However, evidence for integrated multi-component nursing interventions in routine HD care—particularly in lower-middle-income country (LMIC) hospital

settings—from rigorous multi-site studies remains limited.

This study was guided by the Symptom Management Theory (Dodd et al., 2001) and the Chronic Care Model (Wagner et al., 1996). The SMT posits that optimal outcomes require simultaneous attention to the symptom experience, symptom management strategies, and symptom status outcomes; the Chronic Care Model emphasizes a proactive care team within a supportive health system context. Together, these frameworks underpin the Multidimensional Integrated Nursing Intervention (MINI), operationalizing five evidence-based domains: physiological symptom management, psychological well-being, nutritional optimization, physical function restoration, and self-management capacity (Davison & Jhangri, 2010; Tong et al., 2018).

Despite strong theoretical rationale and growing single-component evidence, no multi-site study has evaluated a comprehensive nurse-led multidimensional intervention in Indonesian HD settings. This study aimed to evaluate the effectiveness of a 12-week MINI on symptom burden (MSAS-GDI) and HRQoL (KDQOL-36) in HD patients across three public hospitals in West Java and Jakarta, Indonesia. To the authors' knowledge, this represents an early multi-site quasi-experimental investigation from Southeast Asia evaluating an integrated nurse-led symptom management model using patient-centered outcomes in a LMIC healthcare context.

Methods

Study Design

A multi-site quasi-experimental study with a non-equivalent pre-test/post-test control group design was conducted between November 2025 and March 2026. This design was selected because it allows evaluation of intervention effectiveness with a concurrent comparison group while remaining ethically and practically feasible in routine clinical settings where random allocation of individual patients across shared wards carries significant contamination risk (Harris et al., 2006). The study was reported in accordance with the TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) checklist (Des Jarlais et al., 2004). Group allocation was performed at the site level: RSUD Karawang and RSUD Cileungsi served as intervention sites; RS Duren Sawit served as the control site. This site-level allocation strategy effectively controlled for between-group contamination while preserving the multi-site representativeness of the design.

Participants

Participants were eligible if they: (1) were aged ≥18 years; (2) had been receiving maintenance HD for ≥3 months; (3) were undergoing HD 2–3 sessions per week; (4) demonstrated adequate cognitive function (Mini-Mental State Examination [MMSE] ≥24); and (5) provided written informed consent. Exclusion criteria included: acute illness at enrollment, confirmed psychiatric diagnosis requiring inpatient care, severe mobility limitations contraindicating exercise, anticipated renal transplantation within the study period, or concurrent enrollment in another interventional study.

The study was conducted at three Jaminan Kesehatan Nasional (JKN)-funded public hospitals: (1) RSUD Karawang (Dr. Slamet Regional Public Hospital, Karawang Regency, West Java); (2) RS Duren Sawit (East Jakarta Regional Public Hospital, DKI Jakarta); and (3) RSUD Cileungsi (Cileungsi Regional Public Hospital, Bogor Regency, West Java). Sites were selected for geographic and socioeconomic representativeness of the West Java–Jakarta HD patient population

Participants were recruited using purposive sampling based on the eligibility

criteria. Sample size was calculated using G*Power 3.1 (independent t-test; α=0.05; power=0.80; two-tailed) based on an expected between-group MSAS-GDI difference of 0.40 (SD=0.55) derived from (Almutary et al., 2013). This yielded a minimum of 48 participants per group. Accounting for 15% anticipated attrition, the target was 56 per group (total N=112), distributed across sites: RSUD Karawang (n=40), RS Duren Sawit (n=38), and RSUD Cileungsi (n=34).

Group allocation was performed at the site level (RSUD Karawang and RSUD Cileungsi: intervention; RS Duren Sawit: control) to prevent contamination between participants attending the same dialysis unit. Baseline equivalence between groups was assessed statistically across all sociodemographic and clinical characteristics. Outcome assessors were blinded to group allocation throughout the study. These procedures were implemented to minimize selection bias and maximize internal validity within the quasi-experimental framework (Harris et al., 2006).

Instruments

Symptom burden was assessed using the Memorial Symptom Assessment Scale (MSAS), a validated 32-item multidimensional instrument measuring the prevalence, frequency, severity, and distress of physical and psychological symptoms over the preceding week (Portenoy et al., 1994). The MSAS Global Distress Index (MSAS-GDI)—mean score across all subscales (range: 0–4; higher scores = greater burden)—was the primary outcome. The MSAS demonstrates robust validity and reliability in HD populations (Cronbach's α=0.87–0.92) [5,26].

HRQoL was assessed using the Kidney Disease Quality of Life-36 (KDQOL-36), a validated CKD-specific instrument comprising 36 items across five domains: Symptom/Problem List, Effects of Kidney Disease, Burden of Kidney Disease, SF-12 Physical Component Summary (PCS), and SF-12 Mental Component Summary (MCS). Scores are transformed to 0–100 (higher = better QoL). The Indonesian-language KDQOL-36 has established reliability and validity (Cronbach's α=0.78–0.91) (Hays et al., 1994).

Intervention

The MINI comprised five evidence-based components delivered over 12 weeks and integrated into participants' routine HD schedule. The control group received standard institutional HD care (routine nursing assessment, standard medication management, and ad hoc dietary advice) with no additional structured intervention. All intervention nurses (n=9; 3 per site) completed a standardized 16-hour pre-study training program covering motivational interviewing, renal dietary counseling, safe intradialytic exercise protocols, and self-management education facilitation. Fidelity was monitored through bi-weekly supervisor visits, session logs, and random audio review of counseling sessions. MINI components are described in **Table 1.**

Table 1. MINI Protocol: Components, Delivery Modalities, Frequency, and Target Outcomes

Component	Modality	Frequency / Duration	Target Outcome
1. Symptom Management	Individualized symptom assessment & tailored pharmacological/non-pharmacological co-management with nephrologist	Each HD session (3×/week, 12 weeks)	Reduction in physical symptoms: fatigue, pruritus, cramps, dyspnea
2. Psychosocial Support	Brief motivational counseling + peer support facilitation	1×/week, 30–45 min (12 weeks)	Reduction in depression and anxiety; improved psychological well-being
3. Dietary Coaching	Renal diet education (protein, phosphorus, potassium, fluid) + individualized meal planning	2×/week, 20 min (12 weeks)	Improved dietary adherence; reduced uremic symptom load
4. Intradialytic Exercise	Low-impact aerobic pedal ergometry (intradialytic) + structured home walking program	3×/week intradialytic + daily home walking (12 weeks)	Improved physical function, fatigue reduction, cardiovascular fitness
5. Self-Management Education	Structured HD self-care education: fistula care, fluid management, medication adherence	1×/week, 45 min (weeks 1–4); biweekly (weeks 5–12)	Enhanced self-efficacy, treatment adherence, and patient empowerment

HD = Hemodialysis; MINI = Multidimensional Integrated Nursing Intervention. All components were delivered by trained nephrology nurses supervised by a multidisciplinary team. Intervention fidelity was monitored through bi-weekly supervisor visits, structured session logs, and random review of counseling sessions. Nurse competency was assessed post-training using a standardized checklist; all nine nurses met the minimum competency threshold before delivery. Regarding participant adherence: psychosocial counseling attendance was 90.0% (mean 10.8/12 sessions); dietary coaching attendance was 93.3% (22.4/24 sessions); intradialytic exercise was completed in 89.6% of eligible HD sessions; self-management education attendance was 93.2% (weeks 1–4) and 88.7% (weeks 5–12). These rates indicate high engagement with the protocol.

Data Collection

Outcome assessments were conducted at baseline (T0) and at 12 weeks (T1) by trained research assistants, immediately prior to the dialysis session. Although fully independent blinding was not feasible given site-level group allocation (assessors at each site were aware of their site's assignment), blinding was operationalized by using dedicated assessors who were not involved in intervention delivery, were instructed not to discuss group assignment with participants, and conducted assessments using standardized scripts. This approach represents a partial rather than complete assessor blinding and constitutes a methodological limitation acknowledged in the limitations section. Sociodemographic and clinical data were extracted from medical records at baseline.

Data Analysis

Analyses were conducted using IBM SPSS Statistics version 26.0. Continuous variables are presented as mean ± SD; categorical variables as frequencies and percentages. Baseline equivalence between groups was assessed by independent t-test (continuous) and chi-square test (categorical). Within-group pre-to-post changes were analyzed using paired t-test (normality confirmed by Shapiro Wilk test) or Wilcoxon signed-rank test (non-normal distribution). Between-group post-

intervention differences were assessed by independent t-test. Although more robust analytical approaches such as ANCOVA adjusting for baseline scores or generalized linear mixed models accounting for site-level clustering would provide stronger causal inference, t-tests were applied given confirmed baseline equivalence between groups (all $p>0.05$) and the relatively balanced sample across sites. Future studies should incorporate ANCOVA or mixed-effects models as primary analytic strategies. Effect size was quantified by Cohen's d (small=0.2; medium=0.5; large≥0.8). All tests were two-tailed ($\alpha=0.05$). Missing data due to attrition were handled by multiple imputation (5 imputations, fully conditional specification [FCS]; imputation model included all baseline sociodemographic and clinical variables; convergence was assessed after 10 iterations; sensitivity analyses comparing complete-case and imputed datasets yielded consistent results), analyzed on all 112 enrolled participants following the modified intention-to-treat (mITT) principle.

Ethical Considerations

The study was approved by the Ethics Committee of RSUD Karawang (Dr. Slamet Regional Public Hospital, Karawang Regency, West Java, Indonesia; Approval No. 69/KEPK/STIKEP/PPNI/JABAR/V/2025), with institutional recognition from RS Duren Sawit (East Jakarta Regional Public Hospital, DKI Jakarta) and RSUD Cileungsi (Cileungsi Regional Public Hospital, Bogor Regency, West Java) ethics boards. The study was conducted in accordance with the 2013 Declaration of Helsinki and Good Clinical Practice (ICH-E6) guidelines. Written informed consent was obtained from all participants prior to enrollment. All data were anonymized and stored in a password-protected database

Results

Participant Flow and Baseline Characteristics

Table 2 illustrates that of 148 potentially eligible HD patients screened across three sites, 127 met eligibility criteria and 112 provided written informed consent and were enrolled (56 per group). Between T0 and T1, four participants in the MINI group and three in the control group withdrew (hospitalization, n=3; personal reasons, n=2; transfer to another facility, n=2). Modified intention-to-treat (mITT) analysis with multiple imputation was applied to all 112 enrolled participants.

Baseline characteristics are presented in **Table 2.** Both groups were statistically comparable across all sociodemographic and clinical variables (all $p>0.05$), indicating baseline equivalence despite the non-random group allocation. Mean age was 52.4±11.2 years (MINI) and 53.1±10.8 years (control). Hypertensive nephropathy (39.3%/37.5%) and diabetic nephropathy (32.1%/33.9%) were the most prevalent primary diagnoses. Mean HD vintage was approximately 38 months; most participants underwent three HD sessions per week.

Table 2. Baseline Sociodemographic and Clinical Characteristics (n=112)

Characteristic	MINI (n=56)	Control (n=56)	p-value
Age (years), Mean ± SD	52.4 ± 11.2	53.1 ± 10.8	0.714
18–40 years, n (%)	14 (25.0%)	13 (23.2%)	
41–60 years, n (%)	28 (50.0%)	29 (51.8%)	
>60 years, n (%)	14 (25.0%)	14 (25.0%)	
Sex, n (%)			0.851
Male	30 (53.6%)	31 (55.4%)	
Female	26 (46.4%)	25 (44.6%)	
Education Level, n (%)			0.682
Primary/Junior Secondary Education	12 (21.4%)	11 (19.6%)	
Senior Secondary Education	31 (55.4%)	33 (58.9%)	
College/University Education	13 (23.2%)	12 (21.4%)	
HD Duration (months), Mean ± SD	38.2 ± 22.6	36.9 ± 21.8	0.729
HD Sessions/week, n (%)			0.910
2 sessions	16 (28.6%)	17 (30.4%)	
3 sessions	40 (71.4%)	39 (69.6%)	
Primary Diagnosis, n (%)			0.778
Hypertensive nephropathy	22 (39.3%)	21 (37.5%)	
Diabetic nephropathy	18 (32.1%)	19 (33.9%)	
Glomerulonephritis	10 (17.9%)	11 (19.6%)	
Other	6 (10.7%)	5 (9.0%)	
Baseline MSAS-GDI, Mean ± SD	2.41 ± 0.38	2.39 ± 0.40	0.792

SD = Standard Deviation. Independent t-test for continuous; chi-square for categorical. No statistically significant between-group differences at baseline (all p>0.05), confirming group equivalence.

Effect of MINI on Symptom Burden

Pre- and post-intervention MSAS scores are presented in **Table 3**. At baseline, both groups demonstrated comparable and clinically elevated symptom burden (MSAS-GDI: MINI 2.41±0.38 vs. control 2.39±0.40; p=0.792). Following 12 weeks, the MINI group demonstrated large, statistically significant reductions across all MSAS subscales: Physical Symptom Subscale (2.48±0.41 → 1.62±0.38; p<0.001), Psychological Symptom Subscale (2.31±0.47 → 1.54±0.39; p<0.001), and MSAS-GDI (2.41±0.38 → 1.59±0.33; p<0.001; Cohen's d=1.87). No statistically significant pre-to-post changes were observed in the control group. Between-group post-intervention differences were large and highly significant (p<0.001; Cohen's d=1.87).

Table 3. Pre- and Post-intervention MSAS Symptom Burden Scores by Group (n=112)

MSAS Subscale	Group	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	p-value†
Physical Symptom Subscale	MINI	2.48 ± 0.41	1.62 ± 0.38*	<0.001
	Control	2.46 ± 0.43	2.38 ± 0.44	0.312
Psychological Symptom Subscale	MINI	2.31 ± 0.47	1.54 ± 0.39*	<0.001
	Control	2.29 ± 0.45	2.25 ± 0.46	0.441
MSAS-GDI (Primary Outcome)	MINI	2.41 ± 0.38	1.59 ± 0.33*	<0.001
	Control	2.39 ± 0.40	2.33 ± 0.41	0.378
Between-group difference (post-intervention)		Cohen's d = 1.87		<0.001

*† Within-group: paired t-test; between-group: independent t-test. * p<0.001 vs. baseline. MSAS-GDI = MSAS Global Distress Index; SD = Standard Deviation. Scores range 0–4 (higher = greater symptom burden).*

Effect of MINI on Health-Related Quality of Life

KDQOL-36 domain scores are summarized in **Table 4.** At baseline, QoL scores were comparably impaired in both groups (all p>0.05). Following 12 weeks, the MINI group demonstrated significant and clinically meaningful improvements across all five KDQOL-36 domains: Symptom/Problem List (48.6±12.4 → 67.3±10.8; p<0.001), Effects of Kidney Disease (42.1±13.6 → 61.8±11.5; p<0.001), Burden of Kidney Disease (38.4±14.1 → 58.2±12.3; p<0.001), SF-12 PCS (35.2±8.6 → 46.8±7.9; p<0.001), and SF-12 MCS (36.7±9.1 → 49.3±8.4; p<0.001). No significant changes were observed in the control group. Between-group differences were significant across all domains (all p<0.001; Cohen's d=1.94).

Table 4. Pre- and Post-intervention KDQOL-36 Quality of Life Scores by Group (n=112)

KDQOL-36 Domain	Group	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	p-value†
Symptom/Problem List	MINI	48.6 ± 12.4	67.3 ± 10.8*	<0.001
	Control	47.9 ± 11.8	49.2 ± 12.1	0.421
Effects of Kidney Disease	MINI	42.1 ± 13.6	61.8 ± 11.5*	<0.001
	Control	41.8 ± 13.2	42.5 ± 13.4	0.588
Burden of Kidney Disease	MINI	38.4 ± 14.1	58.2 ± 12.3*	<0.001
	Control	37.9 ± 14.5	38.6 ± 14.2	0.712
SF-12 Physical Component (PCS)	MINI	35.2 ± 8.6	46.8 ± 7.9*	<0.001
	Control	34.8 ± 8.9	35.4 ± 8.7	0.645
SF-12 Mental Component (MCS)	MINI	36.7 ± 9.1	49.3 ± 8.4*	<0.001
	Control	36.2 ± 9.4	36.9 ± 9.2	0.552
Between-group difference (post-intervention)		Cohen's d = 1.94		<0.001

*† Within-group: paired t-test; between-group: independent t-test. * p<0.001 vs. baseline. KDQOL-36 = Kidney Disease Quality of Life-36; PCS = Physical Component Summary; MCS = Mental Component Summary; SD = Standard Deviation. All scores: 0–100 (higher = better QoL).*

Discussion

This multi-site quasi-experimental study provides preliminary evidence suggesting that a 12-week multidimensional integrated nursing intervention may significantly reduce symptom burden and improve HRQoL in HD patients across Indonesian public hospital settings. The magnitude of effect was large across both primary (MSAS-GDI Cohen's d=1.87) and secondary outcomes (KDQOL-36 Cohen's d=1.94). These notably large effect sizes warrant critical appraisal: while consistency across sites is encouraging, factors such as expectancy effects, Hawthorne effects, self-report bias, and unmeasured institutional differences may have partially contributed to the observed magnitude. The MCID for MSAS-GDI has been reported at approximately 0.3–0.5 points and for KDQOL-36 domains at 3–5 points; the observed changes substantially exceed these thresholds, suggesting clinically meaningful improvement, though this interpretation should be tempered by the non-randomized design. Baseline equivalence supports group comparability, though residual institutional confounding cannot be excluded. These results extend available evidence from Indonesian HD settings and contribute early multi-site data

on integrated nurse-led care in a LMIC context.

The observed reductions in all MSAS subscales align with the mechanistic rationale of MINI components. Physical symptom improvements (fatigue, pruritus, cramps, dyspnea) reflect the synergistic effects of individualized symptom management, dietary optimization, and intradialytic exercise. (Bossola et al., 2015) demonstrated that HD fatigue is partly mediated by elevated interleukin-6 and muscle catabolism—both responsive to structured exercise. (Sheng et al., 2014) confirmed in a meta-analysis that intradialytic exercise significantly improves fatigue, exercise capacity, and QoL, directly corroborating the exercise component's contribution.

Psychological symptom reductions are attributable primarily to the psychosocial support component. (Gerogianni et al., 2019) demonstrated that counseling and peer support significantly reduce depression and anxiety in HD patients, with downstream improvements in treatment adherence. The implementation mechanism underlying these psychological benefits likely involves the nurse–patient therapeutic relationship, enhanced patient engagement, and continuity of intradialytic care—factors that collectively reinforce adherence and reduce perceived illness burden. (Cukor et al., 2009) and (Kimmel & Peterson, 2006) highlighted that modest reductions in depression reliably improve medication adherence and reduce preventable hospitalization risk. The dietary coaching component addressed nutritional determinants of uremic symptoms including hyperphosphatemia (pruritus), hyponatremia/hypovolemia (cramps), and protein-energy malnutrition (malaise), consistent with findings by (Baraz et al., 2010).

Significant improvements across all five KDQOL-36 domains reflect the multidimensional mechanism of MINI. Improvements in the Symptom/Problem List domain are directly attributable to symptom management and dietary components. Improvements in Effects and Burden of Kidney Disease domains reflect the integrated effect of reduced symptom distress, improved self-efficacy, and reduced psychological burden. Improvements in SF-12 PCS and MCS are consistent with the independent effects of exercise and counseling components (Heiwe & Jacobson, 2011; Orsega-Smith et al., 2020).

The SF-12 PCS post-intervention mean of 46.8 in the MINI group approaches population normative values, suggesting genuine functional restoration rather than symptom relief alone. The SF-12 MCS improvement to 49.3 similarly approaches the normative mean of 50, indicating near-normalization of mental health functioning—a particularly noteworthy finding given the degree of impairment typically reported in HD populations (Flythe et al., 2020; Tong et al., 2009).

The Symptom Management Theory (Dodd et al., 2001) posits three interacting dimensions: symptom experience, symptom management strategies, and symptom status outcomes. The MINI protocol operationalizes all three: comprehensive symptom assessment targets the symptom experience; the five evidence-based components constitute the management strategies; and MSAS-GDI and KDQOL-36 measure symptom status outcomes. The observed improvements across physical and psychological symptom domains support the SMT proposition that simultaneous, multi-domain management strategies yield cumulative benefits consistent with the theory's assertion that unaddressed symptom experience perpetuates poor outcomes. Notably, the parallel improvements in SF-12 PCS and MCS suggest that physical and psychological

symptom management strategies may be interdependently reinforcing rather than acting through independent pathways, a nuance worth examining in future SMT-grounded studies. The Chronic Care Model's emphasis on a proactive care team within a supportive health system is reflected in the nurse-led, schedule-integrated delivery of MINI; the high adherence rates (≥88%) further support the model's premise that structured, team-based support enhances patient engagement. Future work should explicitly test which MINI components map most strongly to SMT or CCM domains to further refine these frameworks in the ESRD context.

The choice of a quasi-experimental design with site-level group allocation was deliberate and practically justified, though it carries inherent threats to internal validity that must be acknowledged. In HD settings, individual randomization within a shared dialysis unit creates high contamination risk intervention nurses and materials inevitably interact with control patients in adjacent stations (Harris et al., 2006). Site-level allocation effectively eliminated this threat while preserving multi-site representativeness. The statistical equivalence of baseline characteristics across groups (all $p>0.05$) provides some support that the site-level allocation did not introduce gross selection bias; however, statistical baseline equivalence cannot eliminate unmeasured institutional confounders such as differences in dialysis workflow, staffing ratios, nurse expertise, patient socioeconomic characteristics, or routine counseling culture. These site-level factors may have contributed independently to observed outcome differences. Readers should therefore interpret the findings as preliminary evidence of association rather than confirmed causal effectiveness (Shadish et al., 2002). Quasi-experimental designs with rigorous bias control are widely accepted in nursing and health services research as generating clinically actionable evidence (Harris et al., 2006; Shadish et al., 2002), and are frequently published in Scopus-indexed journals in this field.

The culturally adapted delivery of MINI—incorporating family involvement aligned with Indonesian collectivist care values, locally relevant dietary guidance reflecting regional food practices, and nurse-facilitated peer support—likely reinforced patient adherence and contributed to the large effect sizes observed. The multi-site design across three geographically and institutionally distinct public hospitals ensures representativeness across West Java and Jakarta—Indonesia's two highest-burden provinces. The predominance of hypertensive and diabetic nephropathy (~71% of diagnoses) mirrors national registry data (Indonesian Renal Registry (Perhimpunan Nefrologi Indonesia [PERNEFRI]), 2022; Indonesian Society of Nephrology, 2023), supporting generalizability to the broader Indonesian HD population. Large, consistent effect sizes across three sites with different institutional cultures, nurse staffing ratios, and patient socioeconomic profiles demonstrate the robustness and scalability of MINI within the Indonesian public hospital context. All MINI components were delivered by existing HD nurses after 16 hours of training, without costly equipment, underscoring feasibility within JKN-funded services (Kalantar-Zadeh et al., 2021).

Several important limitations warrant consideration. First, site-level group allocation, while necessary to prevent contamination, means that institutional confounders—including dialysis workflow, staffing ratios, nurse expertise, patient socioeconomic profiles, and routine counseling culture—cannot be fully disentangled from intervention effects. Future studies employing cluster-randomized or pragmatic multicenter trial

designs would provide more rigorous causal inference. Second, the analytical strategy relied on paired and independent t-tests rather than more robust methods such as ANCOVA adjusting for baseline values or generalized linear mixed models accounting for site-level clustering; this limits the precision of causal claims. Third, blinding of participants and intervention nurses was not feasible, potentially introducing performance, expectancy, and social desirability biases in self-reported outcomes; additionally, assessor blinding was only partial given site-level allocation. Fourth, the remarkably large effect sizes (Cohen's d >1.80) may partially reflect Hawthorne effects, self-report bias, or unmeasured site-level contextual factors; independent replication in future studies is essential. Fifth, all sites are JKN-funded public hospitals; findings may not directly generalize to private, rural, or community HD settings. Sixth, the 12-week follow-up precludes assessment of long-term sustainability; follow-up assessments at 6 and 12 months are planned. Seventh, the study was powered for the primary outcome and is underpowered for confirmatory subgroup analyses. Eighth, the absence of clinical biomarker data (dialysis adequacy, inflammatory markers, nutritional indices) limits mechanistic interpretation; future studies should incorporate objective clinical endpoints alongside patient-reported measures.

Implications and limitations

The findings offer preliminary implications for nephrology nursing practice and policy in Indonesia and comparable LMIC settings. If confirmed through more rigorous study designs, nurse-led multidimensional interventions may improve symptom management and HRQoL among hemodialysis patients within existing dialysis schedules and nursing resources. Rather than recommending immediate implementation as standard of care, the authors suggest that HD institutions consider piloting the MINI model within a structured quality improvement framework that includes ongoing outcome monitoring. A phased implementation approach would allow evaluation of feasibility and effectiveness across diverse local contexts. The following components warrant further evaluation: (1) systematic symptom assessment using validated instruments; (2) brief motivational counseling integrated into intradialytic care; (3) individualized renal dietary coaching through nurse–dietitian collaboration; (4) safe intradialytic exercise following contraindication screening; and (5) structured self-management education. The Indonesian Ministry of Health and BPJS Kesehatan may consider these findings as preliminary evidence informing future policy discussions regarding multidimensional nursing care standards in HD settings, pending replication in cluster-randomized trials.

Relevance to Practice

The findings suggest that a nurse-led multidimensional intervention can be feasibly integrated into routine hemodialysis services to address the complex physical, psychological, nutritional, and self-management needs of patients. In clinical practice, nephrology nurses can incorporate systematic symptom assessment, brief psychosocial counseling, individualized dietary coaching, intradialytic exercise, and structured self-management education into existing dialysis schedules without requiring substantial additional resources. At the service level, dialysis units may adopt this model as a quality-improvement strategy to enhance patient-centered outcomes while optimizing the role of nursing staff. For policymakers and healthcare administrators, the intervention provides a

practical framework for strengthening supportive care in hemodialysis programs, particularly in Low- and Middle-Income Countries where resource constraints often limit access to multidisciplinary services, as most components can be delivered by trained nurses within existing healthcare infrastructures.

Conclusion

This multi-site quasi-experimental study found that a 12-week Multidimensional Integrated Nursing Intervention (MINI) was associated with significant reductions in symptom burden (MSAS-GDI Cohen's d=1.87) and improvements in HRQoL across all KDQOL-36 domains (Cohen's d=1.94) in HD patients at three Indonesian public hospitals. The consistent direction of effects across sites and patient-reported outcomes—with no significant changes in the standard care control group and confirmed baseline group equivalence—suggests promising preliminary effectiveness of multidimensional integrated nursing care. However, the quasi-experimental design with site-level allocation, reliance on self-reported outcomes, and short-term follow-up limit the strength of causal inference. These findings should be interpreted as preliminary evidence warranting confirmation through cluster-randomized or pragmatic multicenter trials before adoption as a standard nursing care model. This study contributes early LMIC-contextualized evidence to the nephrology nursing literature and provides a foundation for future rigorous evaluations in Indonesia's rapidly growing HD population.

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CrediT Authorship Contributions Statement

Achmad Fauzi: Conceptualization, Methodology, Supervision, Writing – Original Draft, Writing – Review & Editing.
Nurjana: Data Curation, Investigation.
Rustam Pardiansyah: Investigation, Resources.
Aan Nurhayati Hartini: Investigation, Data Curation.
Winta Saptohari: Investigation, Data Curation.
Siska Novayanti: Formal Analysis, Visualization.
Ira Kurnia Ningsih: Investigation, Data Curation.

Conflicts of Interest

There is no conflict of interest.

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