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Effectiveness of a Nurse-Led Clinical Intervention on Knowledge, Physiological and Psychological Outcomes, and Symptom Burden among Patients Undergoing Hemodialysis: A Quasi-Experimental Study from Mandya, India

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ABSTRACT

Patients receiving maintenance hemodialysis carry a heavy burden of symptoms, psychological stress and treatment demands, yet structured, nurse-delivered programmes remain scarce in India. This quasi-experimental, pre-test–post-test repeated-measures study with a control group evaluated a multicomponent nurse-led clinical intervention (NLCI) for hemodialysis patients in a tertiary-care dialysis unit in Mandya, Karnataka. A total of 120 patients (60 intervention, 60 control; no attrition) were allocated purposively by dialysis day. The intervention comprised a structured video teaching programme in Kannada (40 min), a supervised practice session of yoga and breathing meditation (20 min), individualised teaching and counselling, dietitian-led dietary counselling and weekly follow-up; controls received routine care. Knowledge, physiological indicators, perceived stress, coping, quality of life (KDQOL-SF) and symptom burden (Dialysis Symptom Index) were measured at baseline and at 6, 12 and 24 weeks. Groups were comparable at baseline except for occupation. Mean knowledge rose from 9.47 to 25.98 at 6 weeks and remained at 25.20 at 24 weeks in the intervention group, whereas the control group stayed near baseline (between-group $F = 1384.34$, $p = 0.001$). Symptom burden fell from 98.80 to 37.00 in the intervention group and was unchanged in controls (97.55 to 96.85; between-group $F = 3102.99$, $p = 0.001$). Stress decreased and coping increased significantly more in the intervention group, while quality of life did not differ between groups ($p = 0.77$). Physiological effects were mixed: between-group differences emerged for systolic and diastolic blood pressure, BMI, phosphorus and haemoglobin but not for sodium, potassium, calcium, urea clearance or dialysis adequacy. Because allocation was non-random, these findings should be treated as preliminary; they nevertheless support integrating structured, nurse-led education, relaxation and counselling into routine hemodialysis care and justify a randomised trial.

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1. Introduction

Chronic kidney disease (CKD) is a major and growing public health problem. The Global Burden of Disease Study 2017 estimated 697.5 million prevalent cases of CKD worldwide (a prevalence of 9.1%) and 1.2 million CKD deaths in that year, with the all-age CKD mortality rate rising by more than 40% between 1990 and 2017 (Bikbov et al., 2020). As kidney function declines, patients

accumulate a cluster of complications, including anaemia, mineral and bone disorder, hypertension, hyperkalaemia and cardiovascular disease (Thomas et al., 2008; Bello et al., 2017). Among patients receiving dialysis, cardiovascular disease is the leading cause of morbidity and mortality (Cozzolino et al., 2018).

Hemodialysis (HD) is the commonest form of kidney replacement therapy, but it demands strict adherence to treatment schedules, fluid and dietary restriction and regular medication. Patients commonly report a large number of physical and emotional symptoms, many of them under-recognised and under-treated (Weisbord et al., 2005), and higher symptom burden is independently associated with poorer health-related quality of life (Davison & Jhangri, 2010; Jablonski et al., 2007). Psychological stress and ineffective coping add to this burden (Soponaru et al., 2016).

Patient knowledge is one modifiable determinant of self-care. Studies from China and India describe substantial gaps in HD patients' knowledge of dietary and fluid management (Peng et al., 2024; Peter et al., 2021; Oddi et al., 2023), and non-adherence to diet and fluid restriction is linked to worse outcomes (Kugler et al., 2005; Kim et al., 2010). Nurses, who spend more time with HD patients than any other professional, are well placed to deliver education and counselling. A randomised comparison of comprehensive nursing care with routine care in 128 HD patients reported greater improvement in anxiety, depression, quality of life and renal function indices in the nursing group (Liao et al., 2020), and educational programmes have improved knowledge and some physiological outcomes in Indian HD units (Thomas et al., 2016; Rani et al., 2018).

Evidence nevertheless remains fragmented. Most studies test a single educational component and a single outcome domain, few follow patients beyond a few weeks, and little is known about a combined programme that joins education, relaxation-based practice and individual counselling and that tracks knowledge, physiological indicators, psychological outcomes and symptom burden together over six months. The present study addresses this gap. Its objectives were to (1) compare baseline knowledge, physiological and psychological outcomes and symptom burden in intervention and control groups; (2) examine change in these outcomes over 24 weeks within each group; (3) compare the two groups; and (4) explore correlations among outcomes and their associations with demographic variables.

2. Literature Review and Hypothesis Development

2.1 Education and counselling in hemodialysis care

Structured teaching programmes consistently raise knowledge among HD patients. Interventions delivered over several sessions on non-dialysis days have increased knowledge of diet, fluid control and access care (Rani et al., 2018; Thomas et al., 2016). Because poor knowledge is common at baseline (Peter et al., 2021; Oddi et al., 2023), and because adherence depends on understanding, education is a logical foundation for any nurse-led programme. Individualised counselling complements group teaching by addressing each patient's particular difficulties.

2.2 Mind–body practices, stress and coping

HD patients experience biopsychosocial stress related to treatment time, restrictions on fluid and activity, fatigue and cost (Soponaru et al., 2016; Nataatmadja et al., 2021). Mind–body approaches, including yoga and breathing-based relaxation, have been evaluated in dialysis populations as low-cost adjuncts (Chu et al., 2021; Yurtkuran et al., 2007). Combining such practices with education may influence both stress and coping, which in turn may affect how patients experience symptoms.

2.3 Symptom burden and quality of life

Symptom burden in HD patients is high and strongly related to quality of life (Davison & Jhangri, 2010; Weisbord et al., 2005). Interventions that reduce symptom distress therefore have intrinsic value, independent of changes in laboratory indicators, and symptom burden is a patient-centred outcome that nurses can influence directly.

2.4 Hypotheses

Based on this literature, four hypotheses were tested at the 0.05 level of significance:

H1. Knowledge, physiological and psychological outcome scores and symptom burden differ significantly between pre-test and post-tests across time among patients in the intervention group.

H2. The nurse-led clinical intervention is more effective than usual care in enhancing knowledge, improving physiological and psychological outcomes and reducing symptom burden.

H3. Pre-test knowledge, physiological and psychological outcome scores and symptom burden are significantly correlated.

H4. Pre-test knowledge, physiological and psychological outcome scores and symptom burden are significantly associated with selected demographic variables.

3. Research Design

3.1 Data and Sample

A quasi-experimental, pre-test–post-test repeated-measures design with a non-equivalent control group was used. Data were collected between May 2022 and June 2023 in the dialysis unit of Adhichunchanagiri Hospital and Research Center, B. G. Nagara,

Mandya district, Karnataka, India, a 1,250-bed teaching hospital whose unit runs 30 hemodialysis machines across three shifts. Eligible patients were aged 20–60 years, had undergone at least eight dialysis sessions through a catheter or shunt, scored none to moderate (0–6) on the Revised Piper Fatigue Scale, had fewer than three to four cardiovascular hospitalisations and consented to take part. Patients with a history of myocardial infarction, a renal transplant or irregular dialysis attendance were excluded.

The sample size was estimated from a pilot study (40 patients) using $N = (z\alpha + z\beta)^2 / (\delta/\sigma)^2$, with $\alpha = 0.05$, $\beta = 0.20$, mean difference $\delta = 3.17$ and $\sigma = 8.43$, giving about 56 per group; 60 patients per group were enrolled. Purposive sampling was used. Patients attending on Tuesdays and Thursdays formed the intervention group and those attending on Mondays and Wednesdays formed the control group; control data were collected first to limit contamination. All 120 patients (60 per group) completed every assessment, so there was no attrition.

3.2 Variables and Measures

The independent variable was the nurse-led clinical intervention (NLCI). Dependent variables were knowledge; physiological outcomes (systolic and diastolic blood pressure, weight, body mass index, serum sodium, potassium, calcium, phosphorus, post-dialysis blood urea nitrogen, haemoglobin, urea reduction ratio [URR] and dialysis adequacy [Kt/V]); psychological outcomes (stress, coping and quality of life); and symptom burden. Demographic variables were age, gender, religion, education, occupation, marital status, dialysis frequency and prior awareness programmes.

Instruments were a researcher-developed demographic proforma and a 30-item knowledge questionnaire on renal care and hemodialysis (score 0–30); a physiological parameters checklist; the Perceived Stress Scale (Cohen et al., 1983); the Ways of Coping scale (Folkman & Lazarus, 1988); the Kidney Disease Quality of Life Short Form (KDQOL-SF™; Hays et al., 1997); and the Dialysis Symptom Index (DSI; Weisbord et al., 2004). Content validity was established by experts in nephrology, medicine and nursing, and tools were translated into Kannada and back-translated. Reliability coefficients were $r = 0.81$ (knowledge questionnaire), 0.96 (Perceived Stress Scale), 0.96 (Ways of Coping), 0.81 (KDQOL-SF) and 1.00 (DSI).

The intervention. Over the first four weeks, intervention patients received (a) a structured video teaching programme in Kannada (40 min) covering kidney disease, hemodialysis, fluid and dietary restriction, sleep, hygiene, exercise, yoga and Dan-jeon abdominal breathing meditation; (b) a supervised practice session of yoga postures and breathing (20 min), held on a Sunday when no dialysis was scheduled; (c) individualised teaching and counselling tailored to each patient's difficulties; (d) dietary counselling with a dietitian, including calorie calculation and food and fluid restrictions; (e) counselling on living with dialysis; and (f) weekly follow-up at the unit, alongside routine care. Control patients received routine care only and were offered the programme after data collection ended.

Outcomes were assessed at baseline (pre-test) and at 6 weeks (post-test 1), 12 weeks (post-test 2) and 24 weeks (post-test 3).

3.3 Empirical Models / Analytical Methods

Data were analysed with descriptive and inferential statistics. Baseline comparability was tested with chi-square and independent-samples t tests; normality was checked with the Kolmogorov–Smirnov and Shapiro–Wilk tests. Change over time within and between groups was examined with repeated-measures ANOVA, with Bonferroni-adjusted pairwise comparisons. Correlations among pre-test scores were assessed with Spearman's coefficient, and associations between outcomes and demographic variables with one-way ANOVA. Significance was set at $p < 0.05$.

4. Empirical Results

4.1 Descriptive Statistics

Table 1 describes the 120 participants. In both groups most patients were men (86.7%), the largest age band was 51–60 years, and about 90–95% were dialysed twice weekly. No participant had previously attended a renal-care awareness programme. The groups were comparable on all characteristics except occupation, where the intervention group had more unemployed patients (60.0% vs 35.0%; $p = 0.016$).

Table 1. Demographic characteristics of patients in the intervention and control groups (N = 120)

Characteristic	Intervention n (%)	Control n (%)	χ^2	p
Age (years)			**6.22**	**0.183**
21–30	6 (10.0)	8 (13.3)		
31–40	13 (21.7)	13 (21.7)		
41–50	14 (23.3)	9 (15.0)		
51–60	21 (35.0)	29 (48.3)		
Above 60	6 (10.0)	1 (1.7)		
Gender: male / female	52 (86.7) / 8 (13.3)	52 (86.7) / 8 (13.3)	0.001	1.000
Religion: Hindu / Muslim / Christian	32 (53.3) / 19 (31.7) / 9 (15.0)	33 (55.0) / 21 (35.0) / 6 (10.0)	4.08	0.130
Education: none / primary / high school	16 (26.7) / 21 (35.0) / 23 (38.3)	10 (16.7) / 32 (53.3) / 18 (30.0)	4.28	0.118
Occupation: employed / unemployed / self-employed	15 (25.0) / 36 (60.0) / 9 (15.0)	20 (33.3) / 21 (35.0) / 19 (31.7)	8.23	0.016*
Marital status: single / married / divorced or widowed	17 (28.3) / 35 (58.3) / 8 (13.3)	18 (30.0) / 39 (65.0) / 3 (5.0)	2.52	0.284
Dialysis frequency: once / twice weekly	3 (5.0) / 57 (95.0)	6 (10.0) / 54 (90.0)	1.08	0.298
Prior awareness programme: yes / no	0 / 60 (100)	0 / 60 (100)	–	–

Percentages are within group. * $p < 0.05$. Source: authors' data.

Baseline scores of the two groups did not differ significantly on any outcome (Table 2), indicating that the groups were comparable before the intervention.

Table 2. Baseline (pre-test) scores of the intervention and control groups (mean ± SD)

Outcome	Intervention (n = 60)	Control (n = 60)	t	p
Knowledge (0–30)	9.47 ± 3.72	9.88 ± 3.43	0.64	0.524
Systolic BP (mmHg)	142.40 ± 5.28	144.80 ± 5.43	1.93	0.056
Diastolic BP (mmHg)	94.60 ± 4.78	94.10 ± 3.46	0.66	0.513
Haemoglobin (g/dL)	9.14 ± 0.66	9.16 ± 0.61	0.17	0.864
Dialysis adequacy (Kt/V)	1.24 ± 0.06	1.29 ± 0.08	1.88	0.063
Perceived stress	19.28 ± 1.47	19.10 ± 1.46	0.69	0.495
Coping	35.60 ± 3.41	35.60 ± 3.41	0.00	1.000
Quality of life (KDQOL-SF)	233.30 ± 3.06	234.65 ± 1.25	1.95	0.053
Symptom burden (DSI)	99.00 ± 5.02	97.55 ± 6.20	1.20	0.233

Independent-samples t tests. Remaining physiological indicators (weight, BMI, sodium, potassium, calcium, phosphorus, BUN, URR) likewise did not differ at baseline (all $p > 0.05$).

4.2 Main Results

Knowledge. Knowledge scores in the intervention group rose from 9.47 ± 3.72 at baseline to 25.98 ± 1.85 at 6 weeks, 25.63 ± 1.48 at 12 weeks and 25.20 ± 1.90 at 24 weeks (Table 3, Figure 1a). Bonferroni comparisons showed that every post-test differed from the pre-test (mean differences −16.51, −16.16 and −15.73; all $p < 0.001$), whereas the 6- and 12-week scores did not differ from each other ($p = 0.146$). Control-group knowledge remained close to baseline (9.88 → 9.05). The group-by-time difference was highly significant (between-group $F = 1384.34$, $p = 0.001$). H1 and H2 are therefore supported for knowledge.

Symptom burden. DSI scores in the intervention group fell progressively, from 98.80 ± 5.30 to 77.05 ± 3.44, 46.60 ± 4.63 and 37.00 ± 2.32 at 6, 12 and 24 weeks, whereas control scores stayed at 96.85–98.00 throughout (Table 3, Figure 1b; between-group $F = 3102.99$, $p = 0.001$). All pairwise differences in the intervention group were significant ($p < 0.001$), including the further decline between 12 and 24 weeks (mean difference 9.60, 95% CI 8.56–10.63).

Table 3. Knowledge and symptom burden across time points (mean ± SD)

Outcome / group	Pre-test	6 weeks	12 weeks	24 weeks	Within-group F (p)	Between-group F (p)
Knowledge (0–30)						
Intervention	9.47 ± 3.72	25.98 ± 1.85	25.63 ± 1.48	25.20 ± 1.90	759.53 (0.001)	1384.34 (0.001)
Control	9.88 ± 3.43	10.37 ± 2.02	9.33 ± 2.29	9.05 ± 2.31	6.56 (0.001)	
Symptom burden (DSI, 0–270)						
Intervention	98.80 ± 5.30	77.05 ± 3.44	46.60 ± 4.63	37.00 ± 2.32	8597.57 (0.001)	3102.99 (0.001)
Control	97.55 ± 6.09	97.00 ± 6.27	98.00 ± 5.67	96.85 ± 5.22	0.61 (0.605)	

Repeated-measures ANOVA. Higher knowledge scores and lower DSI scores indicate better outcomes. Source: authors' data.

Psychological outcomes. Repeated-measures ANOVA showed that perceived stress fell and coping scores rose significantly in the intervention group (stress $F = 162.02$, $p = 0.001$; coping $F = 988.71$, $p = 0.001$), while stress was unchanged in controls ($F = 1.22$, $p = 0.301$). Between-group differences were significant for stress ($F = 421.37$, $p = 0.01$) and coping ($F = 7337.49$, $p = 0.001$). Quality-of-life scores changed significantly within both groups (intervention $F = 28.19$; control $F = 102.99$; both $p = 0.001$), but the two groups did not differ from each other ($F = 0.08$, $p = 0.77$). The intervention was therefore effective for stress and coping, but we found no evidence of a differential effect on quality of life.

Physiological outcomes. Results were mixed (Table 4). In the intervention group, systolic and diastolic blood pressure, sodium, potassium, calcium, phosphorus and haemoglobin changed significantly over time. Between-group differences were significant for systolic blood pressure, diastolic blood pressure, BMI, phosphorus and haemoglobin, but not for weight, sodium, potassium, calcium, BUN, URR or Kt/V. Control patients also showed a significant fall in systolic pressure and a change in weight over time, so improvements in blood pressure cannot be attributed to the intervention alone. H2 is therefore supported for knowledge, stress, coping and symptom burden, partly supported for physiological indicators, and not supported for quality of life.

Table 4. Repeated-measures ANOVA of physiological and psychological outcomes: F (p)

Outcome	Intervention (within)	Control (within)	Between groups
Systolic BP	52.79 (0.001)	112.83 (0.001)	6.36 (0.01)
Diastolic BP	34.65 (0.001)	59.15 (0.10)	191.95 (0.001)
Weight	0.58 (0.62)	22.40 (0.001)	0.19 (0.661)
Body mass index	0.003 (0.94)	–	5.80 (0.01)
Sodium	27.56 (0.001)	–	0.63 (0.42)
Potassium	5.13 (0.002)	–	0.37 (0.54)
Calcium	3.10 (0.02)	–	3.10 (0.08)
Phosphorus	32.55 (0.001)	–	12.50 (0.001)
Blood urea nitrogen	0.14 (0.70)	–	1.69 (0.19)
Haemoglobin	48.50 (0.001)	–	3.86 (0.04)
Urea reduction ratio	1.89 (0.13)	–	0.11 (0.73)
Dialysis adequacy (Kt/V)	–	–	1.69 (0.19)
Perceived stress	162.02 (0.001)	1.22 (0.301)	421.37 (0.01)
Coping	988.71 (0.001)	226.79 (0.001)	7337.49 (0.001)
Quality of life	28.19 (0.001)	102.99 (0.001)	0.08 (0.77)

– = not reported. Values are as reported in the study dataset; control-group within-group values for several physiological indicators were not computed.

4.3 Additional Analyses

Correlations (H3). Among pooled pre-test scores ($N = 120$), significant correlations were largely confined to pairs of physiological indicators, for example BUN and URR ($r = 0.92$) and systolic pressure and sodium ($r = -0.35$). Knowledge and the psychological scores showed essentially no significant correlation with the physiological variables or with one another. Symptom burden correlated weakly to moderately with potassium ($r = 0.30$), URR ($r = 0.34$), phosphorus ($r = -0.24$), BUN ($r = -0.27$) and haemoglobin ($r = -0.27$). H3 was therefore not supported for most variable pairs.

Associations with demographic variables (H4). In the intervention group, knowledge was associated with gender ($p = 0.01$) and dialysis frequency ($p = 0.006$), and haemoglobin with dialysis frequency ($F = 7.60$, $p = 0.001$); in the control group, knowledge was associated with religion ($F = 30.63$, $p = 0.001$). No other outcome was significantly associated with age, education, occupation or marital status, so H4 was largely not supported.

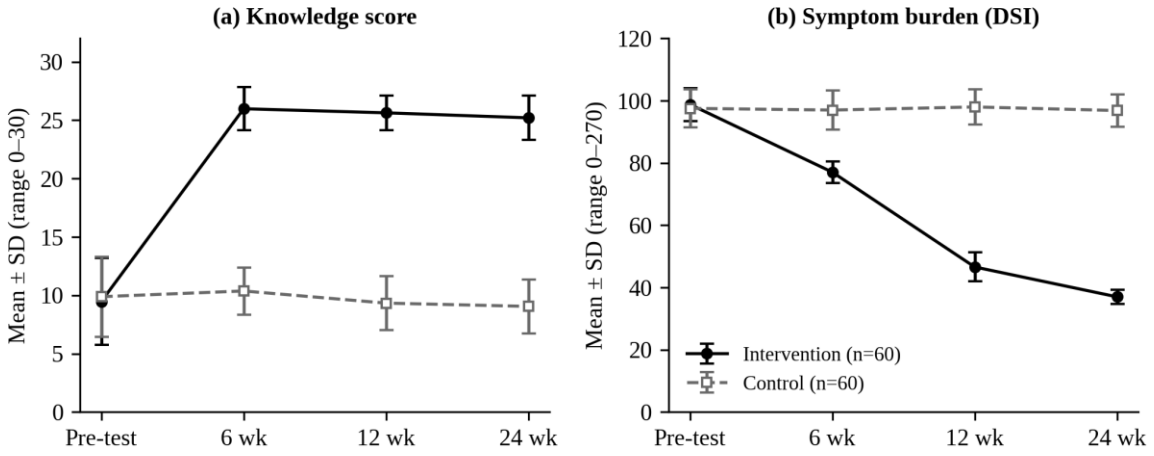


Figure 1. Mean (a) knowledge and (b) symptom burden scores of the intervention and control groups at baseline and 6, 12 and 24 weeks

Error bars show ± 1 SD. Knowledge range 0–30 (higher is better); Dialysis Symptom Index range 0–270 (lower is better). Source: authors' data.

5. Discussion

This study examined whether a multicomponent nurse-led programme improved outcomes for patients on maintenance hemodialysis. The clearest and most consistent effects were on knowledge, symptom burden, stress and coping. Knowledge almost tripled after the programme and was largely retained at six months, in line with Indian and international studies in which structured teaching raised HD patients' knowledge (Rani et al., 2018; Thomas et al., 2016). Baseline knowledge in both groups was low (about 9 of 30), echoing reports of inadequate dietary and self-care knowledge among HD patients in India and China (Peter et al., 2021; Oddi et al., 2023; Peng et al., 2024) and underscoring that patients seldom receive systematic education.

The large and progressive fall in symptom burden is notable, particularly because it continued between 12 and 24 weeks while knowledge plateaued. This pattern may reflect cumulative benefit as patients practised yoga, breathing exercises and dietary and fluid control with weekly reinforcement. Because symptom burden is closely tied to quality of life (Davison & Jhangri, 2010; Jablonski et al., 2007), a sustained reduction is clinically meaningful. The reductions in stress and gains in coping are consistent with the proposed stress-reducing role of mind–body practices and counselling (Chu et al., 2021; Liao et al., 2020). We caution, however, that the very large F statistics for some outcomes reflect small within-group variances and an unusually uniform response, and that self-reported outcomes could be inflated in an unblinded study.

Physiological findings were less consistent. Haemoglobin, phosphorus and blood pressure differed between groups, but electrolytes, URR, Kt/V and BUN did not, and control patients' blood pressure also fell. These indicators depend heavily on dialysis prescription, medication and diet, and a six-month educational programme may have limited leverage over them. The absence of a between-group difference in quality of life despite large symptom reductions also deserves attention: the KDQOL-SF contains many domains (e.g., effects of kidney disease, work status, social support) that education and counselling may not change quickly, and quality-of-life scores moved within the control group as well. Correlations among outcomes were sparse and associations with demographic variables were largely absent, suggesting that the programme's benefit did not depend on age, education or marital status, although the study was not powered to detect such interactions.

Implications. The programme drew only on resources available in a typical dialysis unit (a nurse, a video, a dietitian and weekly contact) and was delivered without lengthening dialysis sessions. For clinical practice, nephrology nurses can incorporate structured education, simple yoga and breathing practice and individual counselling into routine care. For nursing education and administration, the findings support training nephrology nurses in these skills and creating nurse-led counselling clinics within dialysis units.

Limitations. First, allocation was non-random and based on dialysis day, so unmeasured differences between groups (baseline occupation differed) and day-of-week effects cannot be excluded. Second, control data were collected before intervention data to prevent contamination, which confounds group with calendar time. Third, the sample was limited to one tertiary-care unit, and purposive sampling restricts generalisability. Fourth, outcomes were collected by the researcher, which may introduce information and observer bias, particularly for non-literate patients. Fifth, several physiological indicators changed little between follow-up points, and the multicomponent design cannot separate the contribution of education, yoga, meditation and counselling. Finally, follow-up ended at 24 weeks, so longer-term effects are unknown.

6. Conclusion

A nurse-led programme combining video-based teaching, yoga and breathing practice, individual and dietary counselling and weekly follow-up produced large and sustained improvements in knowledge, stress, coping and symptom burden among patients on

hemodialysis over 24 weeks, with mixed effects on physiological indicators and no differential effect on quality of life. Because the design was quasi-experimental, the results are preliminary. A randomised, multicentre trial with blinded outcome assessment, an attention-control arm, component analysis and longer follow-up should now test whether these gains hold and which components drive them.

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Conflicts of Interest

Authors declare that there is no conflict of interest

Ethics Statement

The study was conducted after permission from the Institutional Ethics Committee and the hospital administration All participants received an explanation of the study and gave informed consent before data collection. Control participants received the programme after the study ended.

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