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Original Research Article

Clinical Outcomes and Quality of Life in Patients Undergoing Maintenance Hemodialysis: A Prospective Observational Study

Himadri Shankar

Assistant Professor, Department of Nephrology, JLNMCH, Bhagalpur, Bihar, India

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Corresponding Author: Dr. Himadri Shankar
Conflict of interest: Nil

Abstract:

Background: End-stage kidney disease (ESKD) often requires long-term kidney replacement therapy and can substantially affect health-related quality of life (HRQoL). Assessing clinical measures alongside patient-reported outcomes provides a broader view of health in people receiving maintenance hemodialysis.

Methods: This prospective observational study was conducted at Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, India, from March to September 2026. Eighty-five adults receiving maintenance hemodialysis were enrolled. Demographic and clinical characteristics, laboratory measures, dialysis adequacy, and HRQoL were assessed at baseline and six months. HRQoL was assessed using the Kidney Disease Quality of Life Short Form (KDQOL-SF), version 1.3. Within-person changes were analyzed using paired comparisons.

Results: The cohort comprised 85 patients (mean age, 51.4 ± 11.2 years; 61.2% male). Diabetic nephropathy was the most frequently reported cause of kidney failure (42.4%), followed by hypertensive nephrosclerosis (29.4%). Mean hemoglobin increased from 8.92 ± 1.15 to 10.45 ± 1.28 g/dL, serum albumin from 3.18 ± 0.42 to 3.65 ± 0.45 g/dL, and single-pool Kt/V (spKt/V) from 1.12 ± 0.18 to 1.34 ± 0.21 over six months. The lowest baseline HRQoL scores were for Burden of Kidney Disease (32.4 ± 11.5) and Role Physical (31.8 ± 14.2).

Conclusion: Improvements in several biochemical parameters, dialysis adequacy, and reported HRQoL domain scores were observed during the six-month follow-up. These findings highlight the importance of monitoring clinical outcomes and patient-reported quality of life in patients receiving maintenance hemodialysis.

Keywords: End-Stage Kidney Disease; Maintenance Hemodialysis; Health-Related Quality Of Life; KDQOL-SF; Dialysis Adequacy; Anemia.

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Introduction

End-stage kidney disease (ESKD), also termed kidney failure, is the advanced stage of chronic kidney disease (CKD) in which kidney replacement therapy, including maintenance hemodialysis or transplantation, may be required [1]. The global burden of CKD has increased, with diabetes and hypertension contributing substantially to kidney disease burden [2,3]. CKD also presents important clinical and health-system challenges in India [3].

Maintenance hemodialysis is life-sustaining for many people with kidney failure. Patients may nevertheless experience anemia and other complications that affect daily functioning and perceived health [1].

Health-related quality of life (HRQoL) is an important patient-reported outcome alongside biochemical measures and dialysis adequacy [4,5]. It reflects physical, emotional, social, and functional well-being. Lower HRQoL scores have been associated with adverse outcomes in dialysis populations, although such associations do not establish causation [4].

Prospective data that describe changes in laboratory measures, dialysis adequacy, and standardized HRQoL scores in patients receiving maintenance hemodialysis at tertiary centers in eastern India remain useful. This study therefore described six-month changes in selected clinical, biochemical, dialysis-adequacy, and HRQoL measures among patients receiving maintenance hemodialysis at JLNMCH, Bhagalpur.

Materials and Methods

Study Setting and Duration: This prospective observational cohort study was conducted jointly by the Department of Pharmacology and the Department of Nephrology at Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, India. Data collection covered March through September 2026.

Study Population and Sample Size: Eighty-five adults receiving maintenance hemodialysis at the

JLNMCH Dialysis Unit were enrolled consecutively during the study period according to the eligibility criteria. The available study materials did not specify an a priori sample-size calculation; the basis for the target sample size should be confirmed by the study investigators.

Inclusion and Exclusion Criteria

Inclusion criteria:

1. Age ≥18 years and kidney failure treated with maintenance hemodialysis for at least three months before enrollment.
2. Receiving standard four-hour hemodialysis sessions twice or three times weekly.
3. Able to understand and complete the questionnaire and provide written informed consent.

Exclusion criteria:

1. Acute kidney injury or acute-on-chronic kidney injury.
2. Severe active malignancy, advanced congestive heart failure (NYHA class IV), or active systemic infection.
3. Cognitive impairment or psychiatric illness that prevented valid HRQoL assessment.

Data Collection and Clinical Assessments: Baseline demographic details (age, sex, employment, education, and monthly income) and the primary etiology of kidney failure were recorded using a structured proforma. Dialysis was delivered using high- or low-flux polysulfone membranes with bicarbonate-based dialysate, according to the study records.

Clinical and laboratory parameters were assessed at baseline and at the end of the six-month follow-up. These included hemoglobin, serum albumin, serum ferritin, serum calcium, serum phosphate, and pre- and post-dialysis blood urea nitrogen. Single-pool Kt/V (spKt/V) was calculated using the Daugirdas equation [7].

Quality of Life Assessment: HRQoL was assessed using the Kidney Disease Quality of Life Short Form (KDQOL-SF), version 1.3, administered in Hindi or English according to participant preference. The instrument combines the SF-36 generic core with kidney disease-targeted scales. Scores are transformed to a 0–100 scale according to the instrument scoring manual, with higher scores indicating better HRQoL [8].

Statistical Analysis: Continuous variables were summarized as mean ± standard deviation or median (interquartile range), as appropriate. Categorical variables were summarized as counts and percentages. Baseline and follow-up continuous measurements were compared using paired t-tests; categorical associations were assessed using Pearson's chi-square test or Fisher's exact test, as appropriate. All tests were two-sided, with $p < 0.05$ considered statistically significant. The reported test statistics and p-values should be confirmed against the paired study dataset before journal submission.

Results

Socio-Demographic and Baseline Clinical Characteristics: Eighty-five patients were reported to have completed the six-month study protocol. The mean age was 51.4 ± 11.2 years. Patients aged 40–60 years represented 51.8% of the cohort. There were 52 men (61.2%) and 33 women (38.8%). Diabetic nephropathy was recorded in 36 patients (42.4%), hypertensive nephrosclerosis in 25 (29.4%), chronic glomerulonephritis in 13 (15.3%), and other or unknown etiologies in 11 (12.9%).

Table 1: Baseline demographic and clinical characteristics of the study population (N = 85).

Parameter	Category / Metric	Value (N = 85)
Age (Years)	Mean ± SD	51.4 ± 11.2
Age Distribution	< 40 years / 40–60 years / > 60 years	18 (21.2%) / 44 (51.8%) / 23 (27.1%)
Gender	Male / Female	52 (61.2%) / 33 (38.8%)
Etiology of ESRD	Diabetic Nephropathy	36 (42.4%)
	Hypertensive Nephrosclerosis	25 (29.4%)
	Chronic Glomerulonephritis	13 (15.3%)
	Other / Unknown Etiology	11 (12.9%)
Dialysis Frequency	Twice Weekly / Thrice Weekly	58 (68.2%) / 27 (31.8%)
Vascular Access	Arteriovenous (AV) Fistula / CVC	64 (75.3%) / 21 (24.7%)

Table 1 summarizes the baseline demographic and clinical characteristics. Fifty-eight patients (68.2%) received dialysis twice weekly and 27 (31.8%) three times weekly. An arteriovenous fistula was reported in 64 patients (75.3%); 21 (24.7%) had a central venous catheter.

Biochemical Outcomes and Dialysis Adequacy: Changes in laboratory measures and dialysis adequacy over the six-month observation period are summarized in Table 2. In the absence of a comparison group, these findings represent within-cohort changes and do not establish that a particular management intervention caused them.

Table 2: Biochemical parameters and dialysis adequacy at baseline and six months.

Biochemical Parameter	Baseline (Mean ± SD)	6 Months (Mean ± SD)	t-value	p-value
Hemoglobin (g/dL)	8.92 ± 1.15	10.45 ± 1.28	-8.18	< 0.001*
Serum Albumin (g/dL)	3.18 ± 0.42	3.65 ± 0.45	-7.03	< 0.001*
Serum Ferritin (ng/mL)	210.5 ± 45.2	325.8 ± 52.4	-15.37	< 0.001*
Serum Calcium (mg/dL)	8.12 ± 0.65	8.85 ± 0.58	-7.73	< 0.001*
Serum Phosphate (mg/dL)	5.85 ± 0.92	4.62 ± 0.74	9.62	< 0.001*
Dialysis Adequacy (spKt/V)	1.12 ± 0.18	1.34 ± 0.21	-7.33	< 0.001*

Mean hemoglobin increased from 8.92 ± 1.15 g/dL at baseline to 10.45 ± 1.28 g/dL at six months (reported $t = -8.18$, $p < 0.001$). Mean serum albumin increased from 3.18 ± 0.42 to 3.65 ± 0.45 g/dL, and mean spKt/V increased from 1.12 ± 0.18 to 1.34 ± 0.21. The reported paired comparisons indicated statistically significant within-cohort changes. Figure 1 presents the hemoglobin and serum albumin values at baseline and six months.

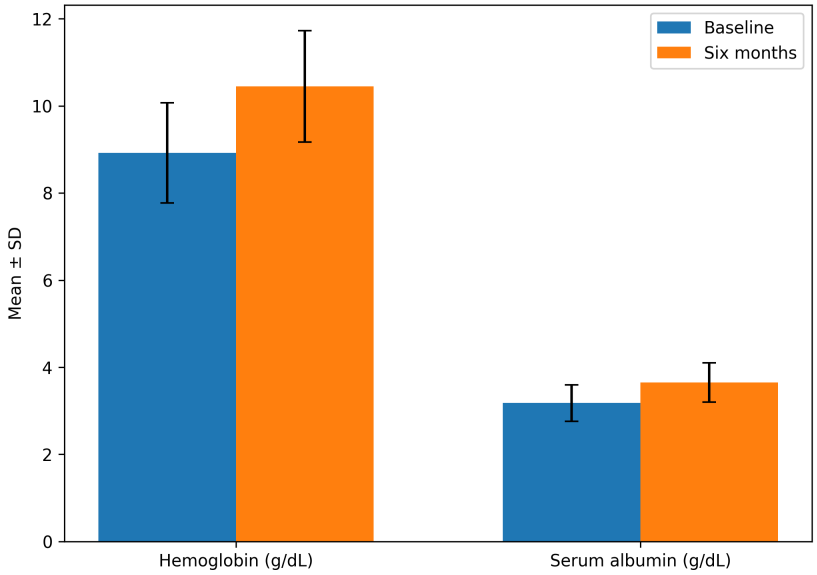


Figure 1: Mean hemoglobin and serum albumin concentrations at baseline and six-month follow-up. Error bars represent standard deviations.

Health-Related Quality of Life (KDQOL-SF) Domain Analysis: At baseline, the lowest reported HRQoL scores were for Burden of Kidney Disease (32.4 ± 11.5) and Role Physical (31.8 ± 14.2), suggesting substantial perceived limitations in these domains. Figure 2 presents the baseline scores for the eleven reported KDQOL-SF domains.

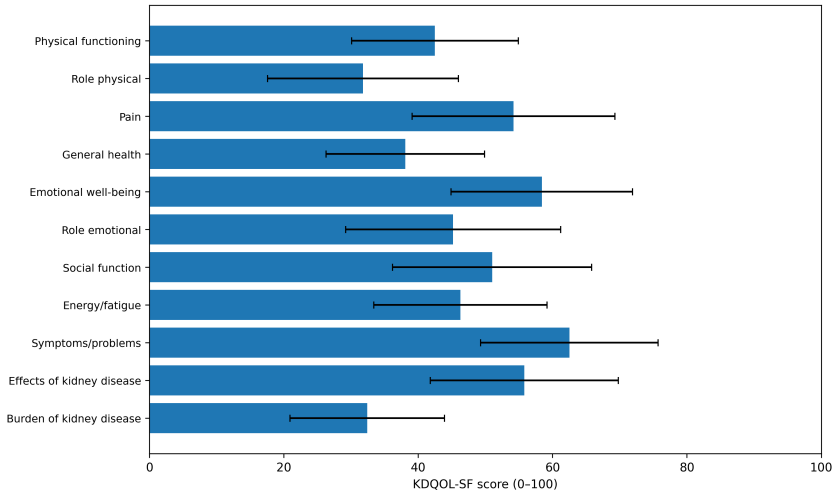


Figure 2. Baseline mean scores for the eleven reported KDQOL-SF domains among patients receiving maintenance hemodialysis (N = 85). Error bars represent standard deviations.

Table 3 presents baseline and six-month scores for the eleven HRQoL domains reported in this study.

Table 3. KDQOL-SF domain scores at baseline and six months.

KDQOL-SF Domain	Baseline Score	6-Month Score	t-value	p-value
Physical Functioning	42.5 ± 12.4	48.2 ± 11.8	-3.07	0.003*
Role Physical	31.8 ± 14.2	38.5 ± 13.6	-3.14	0.002*
Pain	54.2 ± 15.1	61.0 ± 14.2	-3.02	0.003*
General Health	38.1 ± 11.8	44.6 ± 12.1	-3.54	< 0.001*
Emotional Well-being	58.4 ± 13.5	63.2 ± 12.8	-2.38	0.019*
Role Emotional	45.2 ± 16.0	52.4 ± 15.1	-3.01	0.003*
Social Function	51.0 ± 14.8	57.2 ± 13.9	-2.82	0.005*
Energy/Fatigue	46.3 ± 12.9	53.8 ± 12.2	-3.90	< 0.001*
Symptom/Problem	62.5 ± 13.2	68.4 ± 12.5	-3.00	0.003*
Effects of Kidney Disease	55.8 ± 14.0	62.1 ± 13.2	-3.02	0.003*
Burden of Kidney Disease	32.4 ± 11.5	37.8 ± 11.0	-3.13	0.002*

All eleven reported HRQoL domain scores increased over six months. The magnitude and clinical importance of these changes should be interpreted in light of the observational design and the scoring procedures used.

Discussion

This prospective observational study describes six-month changes in selected laboratory measures, dialysis adequacy, and reported HRQoL domains among 85 patients receiving maintenance hemodialysis at a tertiary-care center in Bhagalpur. The cohort had a mean age of 51.4 years and was predominantly male. Diabetic nephropathy and hypertensive nephrosclerosis were the most frequently reported etiologies. These descriptive findings should be interpreted in the context of the single-center design and the enrolled population [2,3].

Hemoglobin increased during follow-up. Anemia in CKD is multifactorial and may reflect reduced erythropoietin production, iron deficiency, inflammation, and shortened red-cell survival [6]. Treatment details were not available to determine the contribution of erythropoiesis-stimulating agents, iron therapy, nutritional changes, or changes in dialysis prescription to the observed differences. The findings should therefore not be attributed to a specific treatment.

Serum albumin may be influenced by nutritional status, inflammation, and illness severity [1,4]. The increase in mean albumin observed in this cohort should be interpreted cautiously because the observational design and absence of a control group prevent causal attribution. The increase in spKt/V suggests improved measured dialysis adequacy; spKt/V is commonly estimated using the Daugirdas equation [7].

Baseline scores were lowest in the reported Role Physical and Burden of Kidney Disease domains. The reported HRQoL domain scores increased at six months. These findings underscore the value of assessing patient-reported outcomes alongside laboratory markers, but the study cannot establish that changes in hemoglobin or dialysis adequacy directly caused HRQoL changes [4,5,8].

Limitations: This was a single-center observational study with 85 participants, which may limit generalizability. Follow-up lasted six months, and there was no comparison group; therefore, temporal changes cannot be attributed to a particular treatment or management strategy. Potential confounding factors, including comorbidities, medication changes, dietary intake, inflammation, socioeconomic circumstances, and dialysis prescription, were not analyzed as adjusted covariates.

Conclusion

In this prospective observational study of 85 patients receiving maintenance hemodialysis, improvements were observed in mean hemoglobin, serum albumin, single-pool Kt/V, and the eleven reported health-related quality-of-life domains over six months. The lowest baseline quality-of-life scores were recorded for the Burden of Kidney Disease and Role Physical domains, indicating substantial perceived limitations in these areas. These findings emphasize the importance of integrating biochemical monitoring, assessment of dialysis adequacy, and patient-reported outcomes into the ongoing evaluation of patients receiving maintenance hemodialysis.

Declarations

Ethics Approval: This studywas approved by the Institutional Ethics Committee of Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, India

Availability of data and materials: The datasets analysed during the current study are available from the corresponding author on reasonable request.

Funding:

Conflict of interest: The authors declare no conflict

of interest.

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