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Drug Utilization and Cost Analysis in End Stage Renal Disease Patients: A Prospective Observational Study

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Abstract

Chronic Kidney Disease (CKD) is a condition in which the kidneys are damaged and unable to efficiently remove waste and excess fluid from the blood. Dialysis serves as a treatment for CKD by artificially carrying out the kidney's filtering functions. This prospective observational cross-sectional study was conducted to evaluate drug utilization patterns, economic burden, and health-related quality of life (HRQoL) among patients with end-stage renal disease (ESRD) undergoing dialysis. Over three months, 60 adults, all receiving haemodialysis for longer than three months, were joined from different centres. Data were gathered using a prepared questionnaire focused on sociodemographic background, prescribed medicines, and cost issues. The Kidney Disease Quality of Life-36 (KDQOL-36) questionnaire was used to assess HRQoL, covering aspects, such as physical and mental health, symptom burden, and the overall impact of kidney disease. Statistical analysis, including t-tests, ANOVA, and chi-square tests, was employed to explore associations between HRQoL scores and demographic variables. Most people in the study were male (65%) and fell between the ages of 41 and 60. The most frequent medications given to haemodialysis patients were antihypertensives, erythropoietin, diuretics and phosphate binders, suggesting many patients were on several medications at once. The average monthly cost of dialysis was found to be significant, with many patients depending on out-of-pocket expenditure, posing a substantial financial strain. The study concludes that ESRD patients on dialysis face complex drug regimens, high treatment costs, and compromised quality of life. These findings emphasize the importance of optimizing pharmacotherapy, implementing cost-effective healthcare strategies, and providing comprehensive psychosocial support to improve patient well-being and healthcare outcomes.

Keywords: Statistical analysis, erythropoietin, kidney disease quality of life, end-stage renal disease, chi-square tests

INTRODUCTION

Chronic kidney disease (CKD) is a significant public health concern that can advance to end-stage renal disease (ESRD), necessitating costly treatments, such as dialysis or kidney transplantation for patient survival. It also poses a substantial burden on healthcare systems, productivity, and economic growth. Around 850 million people globally are affected by chronic kidney disease (CKD) and this concern mostly affects low- and middle-income countries. Over 13.24% of Indians are affected by CKD, mainly because diabetes and hypertension are becoming more common. Once CKD develops into ESRD [1-3], patients usually depend on dialysis throughout their lives which creates both economic and emotional stress.

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KIDNEY

The kidneys are bean-shaped organs with a curved inner surface and a rounded outer surface.

In men, they generally weigh between 150 and 200 grams, while in women, they usually weigh about 120 to 135 grams. Their typical size is around 10–12 cm long, 5–7 cm wide, and 3–5 cm thick – comparable to the size of a closed fist (Figure 1) [4].

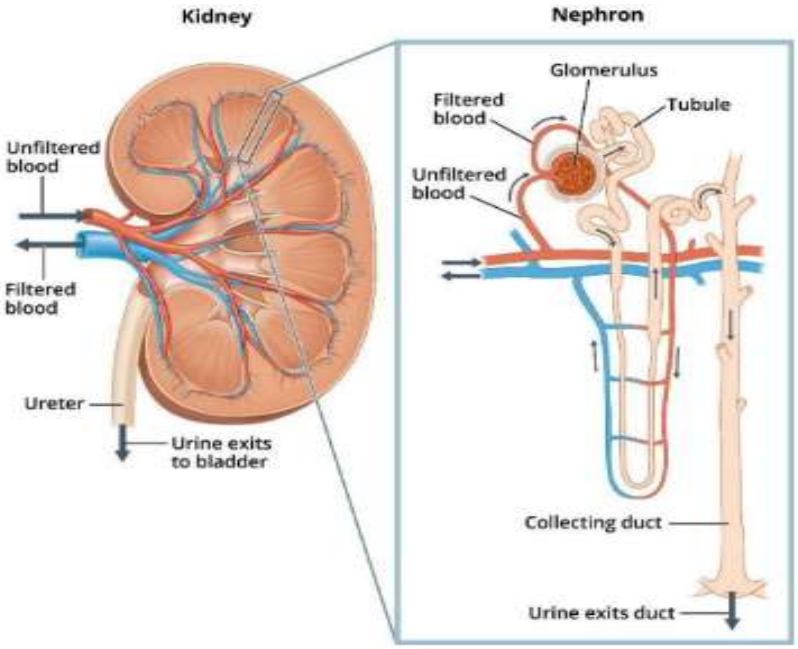

Figure 1. Kidney structure.

Types of Kidney Disease

- Acute Kidney Injury (AKI)
- Chronic Kidney Disease (CKD)
- Glomerular Diseases
- Tubulointerstitial Diseases

DIALYSIS

Dialysis is a vital form of renal replacement therapy that compensates for the kidneys' impaired ability to filter blood by utilizing artificial equipment to remove excess fluids, solutes, and toxins. This process is essential for maintaining homeostasis, ensuring a stable internal environment in individuals who experience either a sudden decline in kidney function, known as acute kidney injury (AKI) [5] or a progressive and prolonged deterioration of renal function, referred to as chronic kidney disease (CKD). Previously termed end-stage renal disease (ESRD), CKD often necessitates dialysis when kidney function declines significantly. Dialysis can be employed as a temporary intervention for those experiencing acute kidney failure, providing necessary support until renal function recovers. In cases of chronic kidney disease, it may serve as a bridging therapy until a kidney transplant is possible, or it may become a lifelong necessity for patients who are not eligible for transplantation [6]. As of 2010, around 2.5 million individuals globally were receiving chronic renal replacement therapy (RRT), highlighting its widespread use and importance in managing ESRD. This therapy remains a cornerstone in the treatment of ESRD [7].

There Are Three Broad Types of Dialysis

- Haemodialysis (HD)
- Peritoneal dialysis (PD)
- Continuous renal replacement therapy (CRRT)

MATERIALS AND METHODS

- *Study Design:* Prospective Observational Cross-Sectional Study.
- *Study Site:* Multicentre study.
- *Study Duration:* 3 Months.
- *Sample size:* Non-probability convenience sampling.

STUDY CRITERIA

Inclusion Criteria

- All patients older than 18 have received HD for over 3 months.

Exclusion Criteria

- Patients with psychiatric illness, malignancy, and cognitive defects, were excluded from the study.
- Refusal or inability to get informed consent.
- Patients receiving dialysis as inpatients.

Study Procedure

- A self-designed questionnaire was used to assess the demographic, prescription patterns and cost and KDQOL-36 used for HRQoL.
- The SF-36 questionnaire assesses the HRQOL by 36 items survey that provide the generic core and overall health survey including physical functioning, role limitation caused by physical problems, role limitations caused by emotional problems, pain, general health, energy, fatigue, emotional well-being, and social function [8,9].
- The physical and mental composite summary depicts the results from SF-36.

RESULT

Gender Wise Distribution

Out of 60 patients, majority of them were male 39 (65%) and females were 21 (35%) (Figure 2).

Age Wise Distribution

Out of 60 patients, majority of them, 29 (48%) belongs to the age group of 41–60 followed by 20 (34%) patients in the age group of above 60 years and least 11 (18%) patients among the age group of 21–40 (Figure 3) [10-15].

Education Wise Distribution

Out of 60 patients, 24 (40%) have less than a high school education, 17 (28%) have no education, 14 (23%) have more than a high school education, and only 5 (8%) hold a degree. This highlights the need for simple language and visual aids for those with limited education, while detailed information can benefit those with higher education (Figure 4) [16-18].

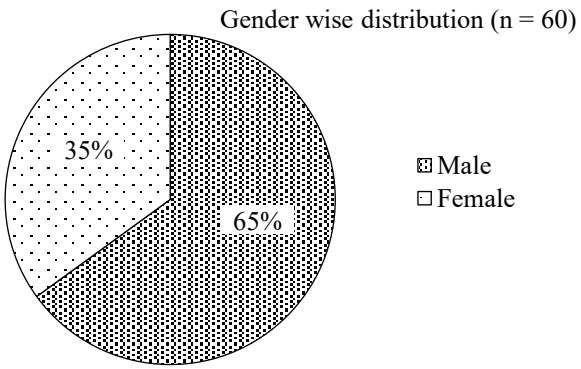

Figure 2. Gender wise distribution.

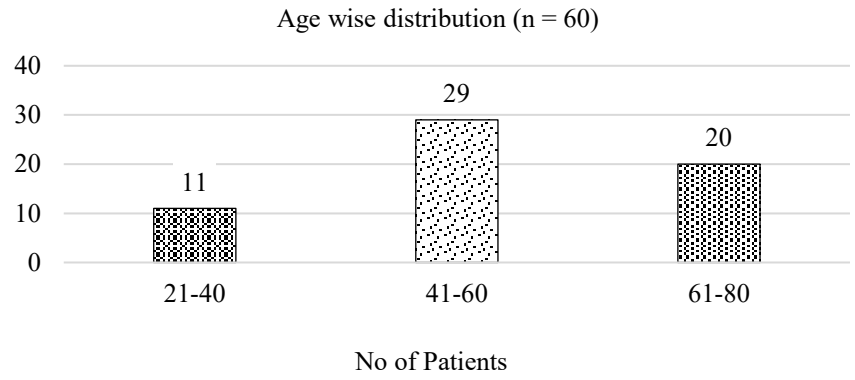

Figure 3. Age wise distribution.

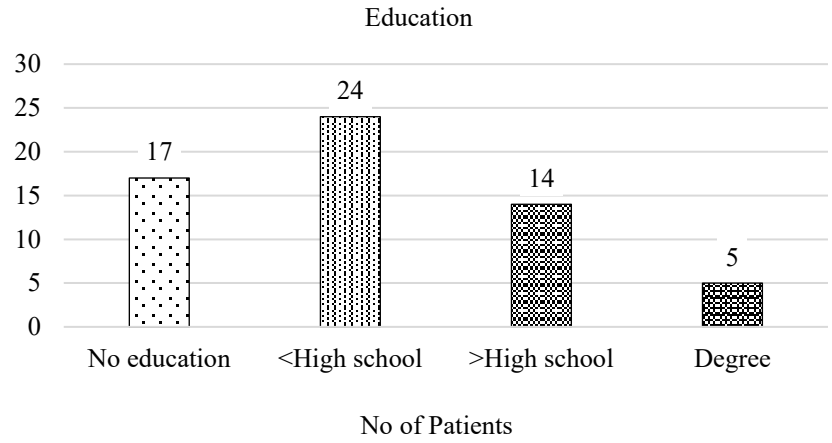

Figure 4. Education wise distribution.

Distribution of Occupation

Out of 60 patients, 33 (55%) of patients are unemployed, 15 (25%) are engaged in skilled labor, 05 (8%) work in administration and business, 4 (7%) are housewives, and 3 (5%) are teachers. This distribution indicates that a significant number of patients may face financial or social challenges, requiring tailored support strategies to improve their healthcare engagement (Figure 5).

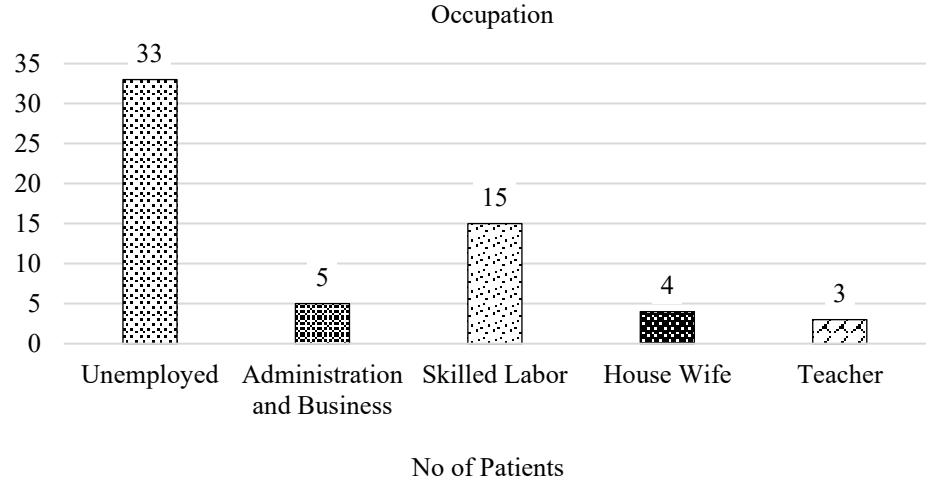

Figure 5. Distribution of occupation.

Distribution on Food Habits

Regarding dietary habits in out of 60 patients, 55 (92%) follow a non-vegetarian diet, while only 5(8%) are vegetarian. This emphasizes the need to consider dietary preferences when planning nutritional counselling and medical advice for improved health outcomes (Figure 6).

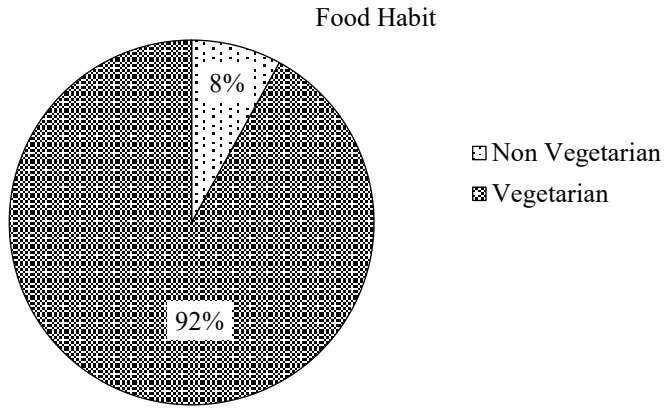

Figure 6. Distribution on food habits.

Water Intake Analysis

Out of 60 patients most patients consume 800 ml or less, with 36 (60%) patients consuming 800 ml and 22 (37%) patients consuming 750 ml. Only 1 (2%) patient reported higher water intake levels of 1000 ml and 850 ml, respectively. This pattern highlights the need for careful hydration guidance in ESRD patients to prevent fluid overload and related complications (Figure 7).

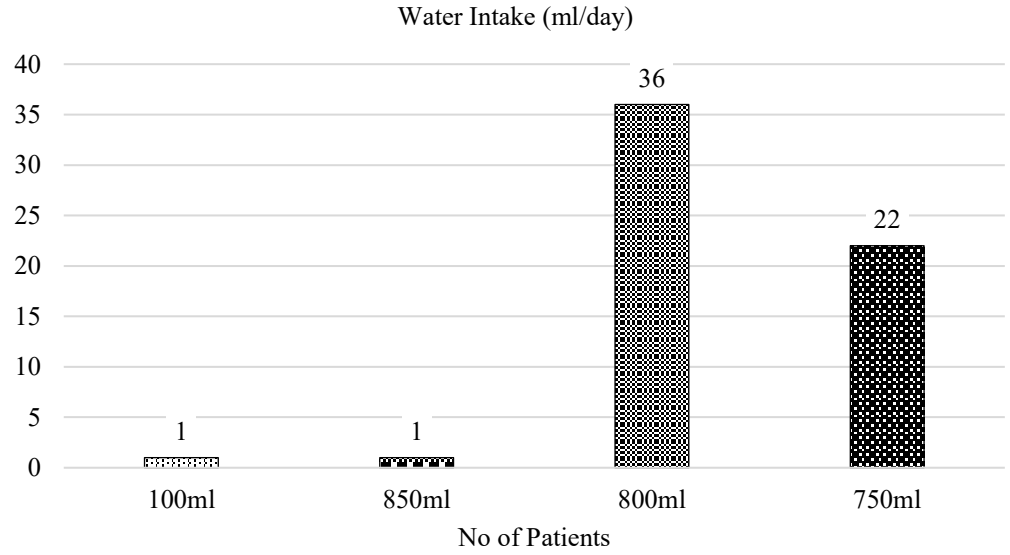

Figure 7. Water intake analysis.

Co-Morbidities

In terms of co-morbidities, 42 (70%) of patients have hypertension, 9(15%) have both hypertension and diabetes mellitus, 2 (3%) have hypertension along with thyroid issues, another 2 (3%) have diabetes mellitus alone. Additionally, 1 (2%) has hypertension, diabetes mellitus, and COPD, 2 (3%) have

thyroid conditions alone, and 2 (3%) have no co-morbidities. This highlights the prominence of hypertension (Figure 8).

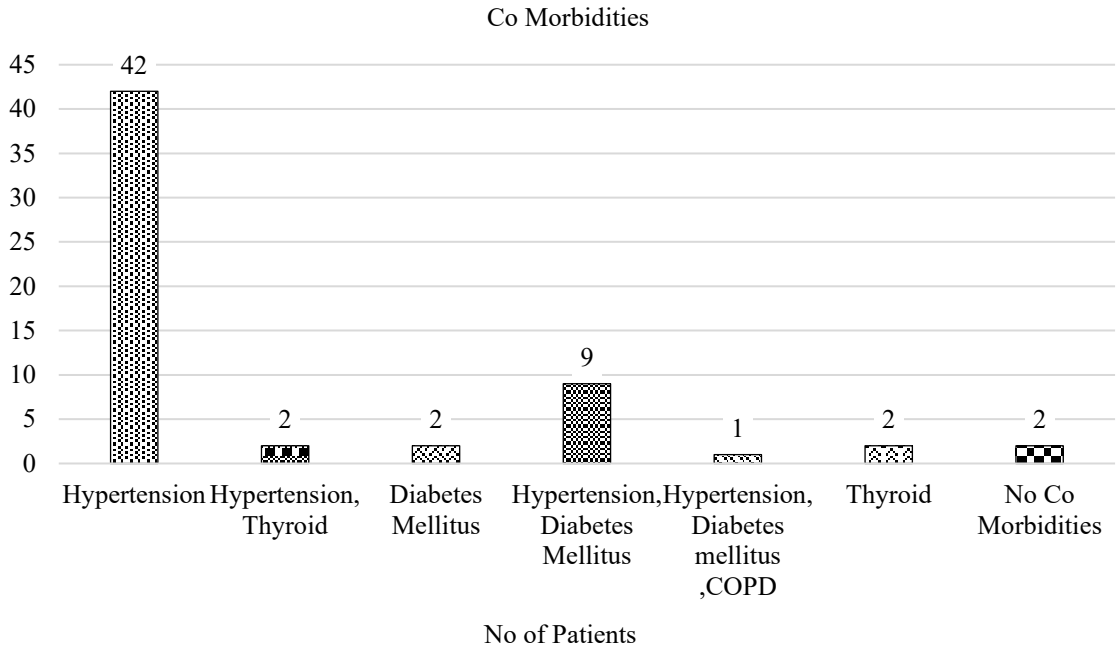

Figure 8. Co-morbidities.

Social History

17% of patients have a history of smoking, 7% consume alcohol, and 2% have a history of both smoking and alcohol use. Notably, 75% reported no such history, which may reflect lifestyle differences impacting their overall health (Figure 9).

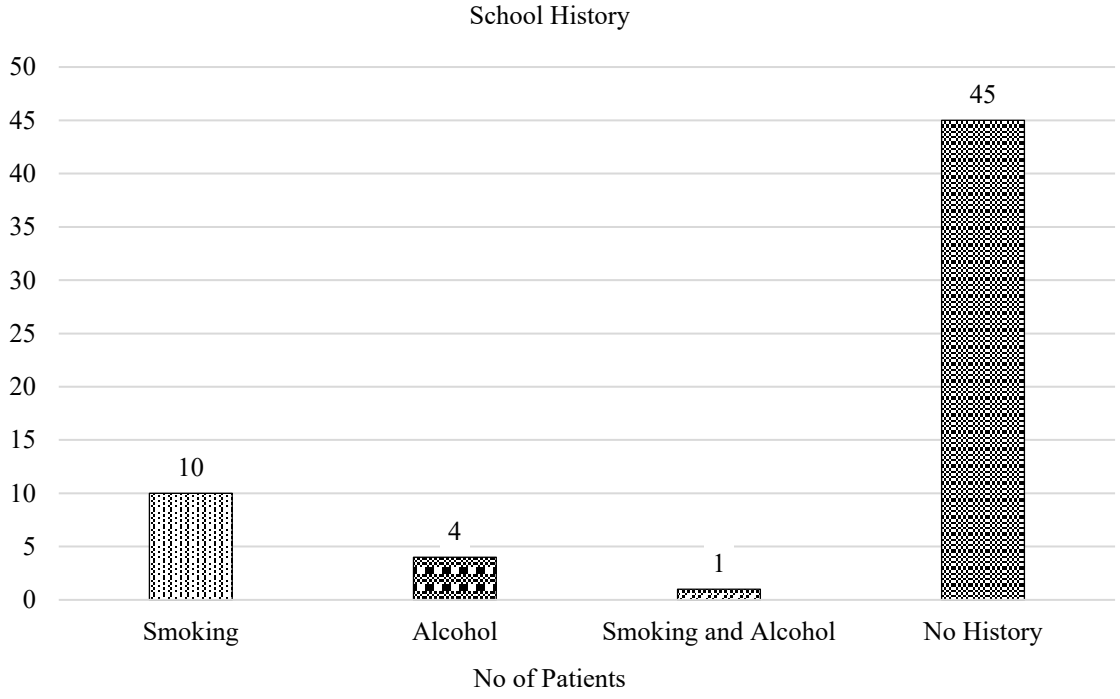

Figure 9. Social history.

Change of Weight

Among the 60 patients observed, the majority, accounting for 58% (35 patients), experienced a weight reduction of 0–1 kg following dialysis. Additionally, 35% (21 patients) had a weight change of 1–2 kg. A smaller proportion, comprising 3% (2 patients), experienced a weight reduction of 3–4 kg, while another 3% (2 patients) showed a weight change of 4–5 kg. This distribution indicates that most patients experienced a relatively modest reduction in weight post-dialysis, with significant weight changes being less common (Figure 10).

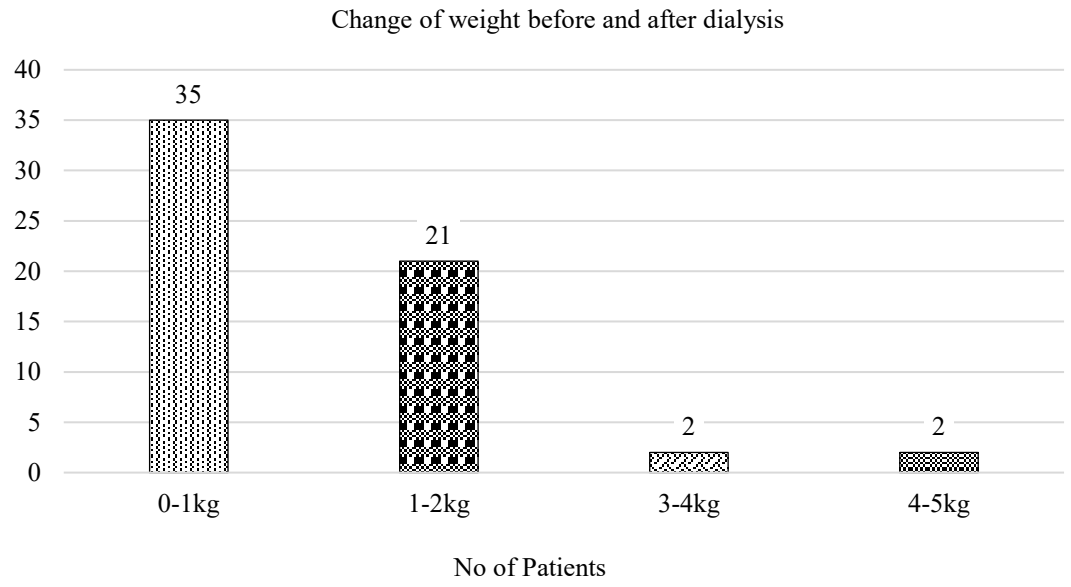

Figure 10. Change of weight.

Dialysis Vintage

Among the 60 patients studied, the duration since dialysis varied considerably. Most of the patients, accounting for 50% (30 patients), had been dialyzed for a period of 6–10 years. This was followed by 28% (17 patients) who had a dialysis duration of 1–5 years. Additionally, 15% (9 patients) had been living with the condition for over 10 years, while a smaller group of 7% (4 patients) had received their dialysis within the past year. This distribution reflects that a significant portion of patients had a longer history of their condition 1 Time 8 Times 10 Times 12 Times 15 Times (Figure 11) [21].

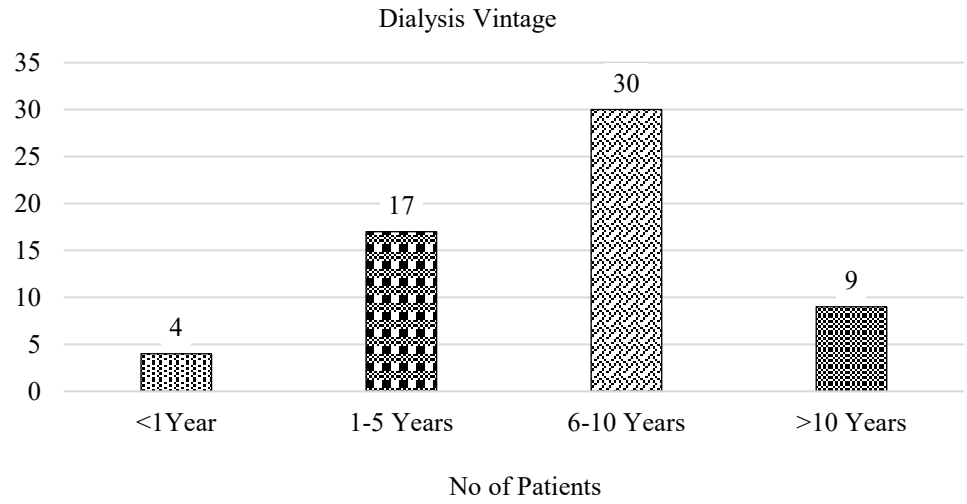

Figure 11. Dialysis vintage.

Frequency of Dialysis (Monthly)

Among the 60 patients analysed, the frequency of dialysis sessions per month varied. The majority, accounting for 65% (39 patients), underwent dialysis 12 times a month. Additionally, 30% (18 patients) received dialysis 8 times a month. A small proportion of patients had other frequencies, with 2% (1 patient) each undergoing dialysis either 3 times, 10 times, or 15 times a month. This distribution highlights that most patients followed a typical thrice-weekly dialysis schedule, while a few had less common dialysis patterns (Figure 12).

Vascular Site

Among the 60 patients studied, the majority, accounting for 97% (58 patients), had a fistula as their vascular access site for dialysis. In contrast, only 3% (2 patients) were using a central venous catheter. This indicates that fistula access was the predominant choice in this patient group, aligning with its known benefits for long-term dialysis management (Figure 13).

DRUG UTILIZATION EVALUATION

Drugs Use in Dialysis Patients

Drug utilization patterns the most prescribed drugs are Nifedipine (16%), a Calcium Channel Blocker, and Metoprolol (13%), a Beta-Adrenergic Blocker. The overall prescription distribution highlights a focus on cardiovascular and supportive therapies (Table 1) [23].

Drug Interaction

Out of 55 prescriptions, METOPROLOL + TORSEMIDE (16%) having a higher drug interaction rate, whereas AMLODIPINE + CARVEDILOL (1%) and ASPIRIN +PANTOPRZAOLE (1%) having a lower drug interaction rate Economic burden of dialysis (Table 2).

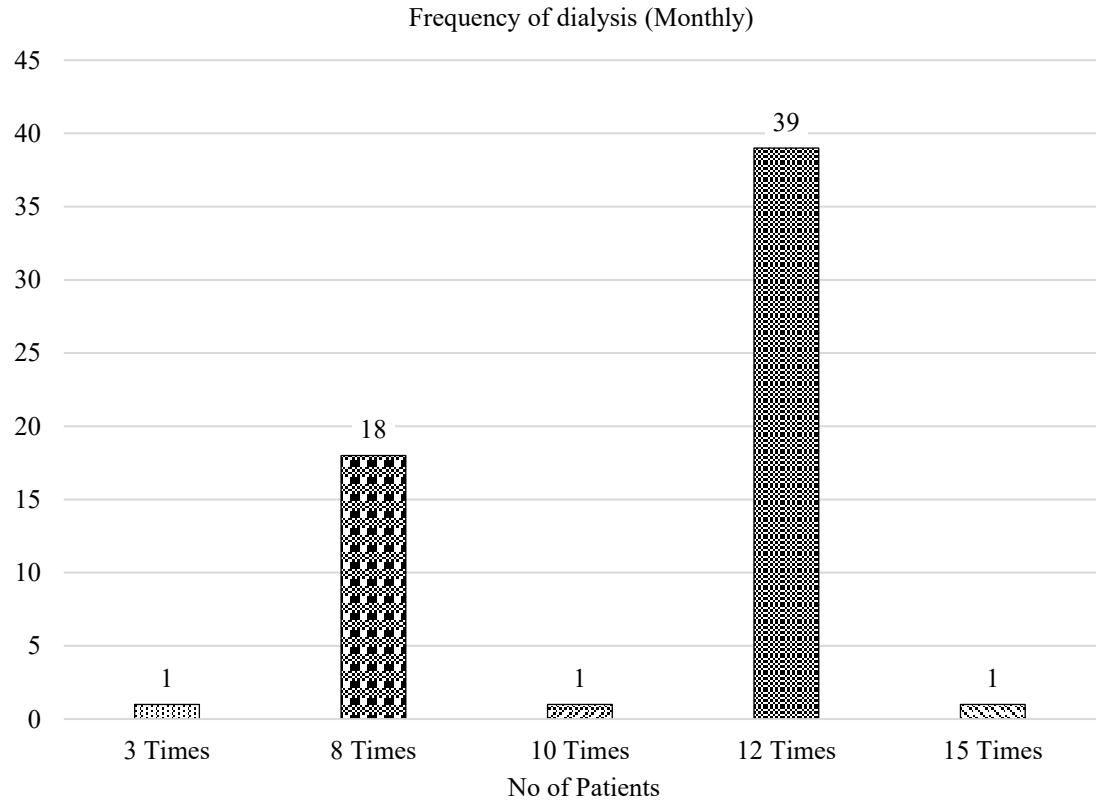

Figure 12. Frequency of dialysis (monthly).

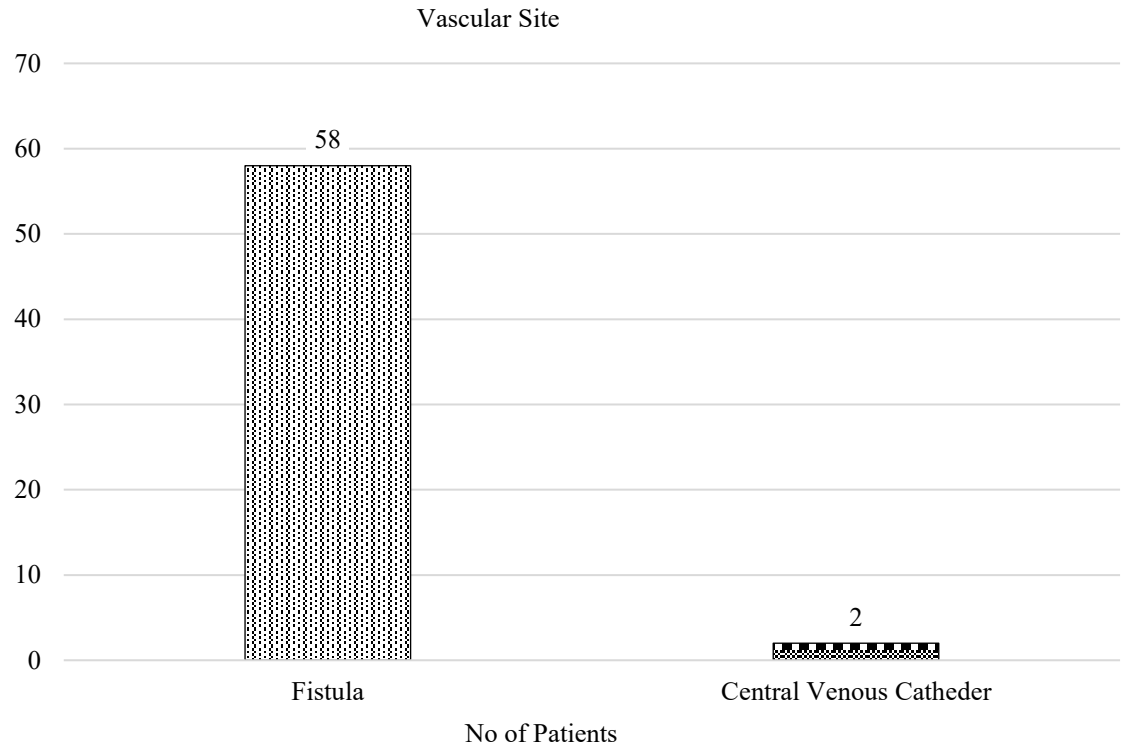

Figure 13. Vascular site.

COST ANALYSIS

Economic Burdens of Dialysis

The table presents dialysis-related expenses collected from 60 patients, highlighting significant cost variations. Direct costs range from ₹700 to ₹10,000, while indirect costs vary between ₹100 and ₹4,000. The average monthly expense is ₹44,227, resulting in an annual cost of approximately ₹5.3 lakh. This data underscores the considerable financial burden faced by dialysis patients, emphasizing the need for cost-effective treatment approaches (Table 3).

Mode of Payment for Dialysis

Mode of Payment for Dialysis. The data reveals that the Unemployed group is the largest user of all payment methods, with 25% using CMCHIS, 12% using Insurance, and 18% using Personal Savings. The Unemployed represent a significant portion across all payment methods, highlighting their dependence on these financial resources (Table 4).

Table 1. Drug utilization pattern.

S. N.	Drug	Classification	ATC CODE	No of Drugs
1	Nifedipine	Calcium Channel Blocker	C08CA05	26 (16%)
2	Metoprolol	Beta Adrenergic Blockers	C07AB02	22 (13%)
3	Moxonidine	Alpha-2-Agonist	C02AC05	4 (2%)
4	Clonidine	Central Sympatholytics	C02AC01	20 (12%)
5	Prazosin	Alpha-Adrenergic-Blockers	C02CA01	14 (8%)
6	Cilnidipine	Calcium Channel Blockers	C08CA14	10 (6%)
7	Trimetazidine	Coronary Vasodilators	C01EB15	2 (1%)
8	Carvedilol	Alpha+Beta-Adrenergic-Blockers	C07AG02	6 (4%)
9	Benidipine	Calcium Channel Blockers	C08CA15	4 (2%)

10	Amlodipine	Calcium Channel Blockers	C08CA01	12 (7%)
11	Nebivolol	Beta Adrenergic Blockers	C07AB12	3 (2%)
12	Toresimide	Loop Diuretic	C03C	6 (4%)
13	Aspirin	Platelet Aggregation Inhibitor	B01AC06	3 (2%)
14	Folic Acid	Folic Acids	B03BB	21 (13%)
15	Paracetamol	Analgesic and Antipyretic	N02BE01	5 (3%)
16	Alprazolam	Anxiolytic	NO5BA12	9 (5%)
	Total			**167**

Table 2. Drug interaction.

S. N.	Drug Interaction	No of Prescriptions
1	Nifedipine + Prazosin	4 (7%)
2	Torsemide + Folic Acid	5 (9%)
3	Clonidine + Metoprolol	7 (13%)
4	Clonidine + Nebivolol	2 (4%)
5	Pantoprazole + Ferrous Fumarate	5 (9%)
6	Clonidine + Prazosin	2 (4%)
7	Nebivolol + Torsemide	2 (4%)
8	Nifedipine + Metoprolol	2 (4%)
9	Clonidine + Carvedilol	6 (11%)
10	Amlodipine + Carvedilol	1 (2%)
11	Torsemide + Pantoprazole	7 (13%)
12	Aspirin + Pantoprazole	1 (2%)
13	Metoprolol + Torsemide	9 (16%)
14	Clonidine + Alprazolam	2 (4%)

Table 3. Economic burdens of dialysis.

Expense (INR)	Direct cost	Indirect cost	Expense per Dialysis	Expense per month	Annual Expense
Minimum	700	100	800	3600	43200
Maximum	10000	4000	10500	12600	151200
Average	3327	690	4017	44227	530721

Table 4. Mode of payment for dialysis.

Mode of Payment	Occupation	No of Patients	Total
CMCHIS	Administration and Business	0 (0%)	
	Housewife	3 (5%)	
	Skilled Labor	9 (15%)	
	Teacher	1 (2%)	
	Unemployed	15 (25%)	28 (47%)
Insurance	Administration and Business	0 (0%)	
	Housewife	1 (2%)	
	Skilled Labor	4 (7%)	
	Teacher	0 (0%)	
	Unemployed	7 (12%)	12 (20%)
Personal savings	Administration and Business	5 (8%)	
	Housewife	0 (0%)	
	Skilled Labor	2 (3%)	
	Teacher	2 (3%)	
	Unemployed	11 (18%)	20 (33%)

DISCUSSION

This study provides valuable insights into drug use, costs, and HRQoL in ESRD patients, highlighting common prescriptions, the burden of polypharmacy, and the need for cost-effective dialysis strategies tailored to patient outcomes in India [19-25].

CONCLUSIONS

This study highlights key demographic and clinical trends in dialysis patients, emphasizing the need for targeted, multidisciplinary interventions – especially in the Indian context – to improve quality of life, treatment adherence, and healthcare outcomes.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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