Assessment of Food Frequency Questionnaire in Patients with Chronic Kidney Disease 5D

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Abstract

Introduction: This prospective cross-sectional study aimed to validate the food frequency questionnaire (FFQ) in dialysis patients at the Department of Nephrology. A total of 257 hemodialysis patients were assessed based on socio-demographic, biochemical, and dietary data. The study found that patients predominantly belonged to the age groups of 50–60 years and above 60 years, with chronic kidney disease (CKD) stage 5D being the most reported condition. The FFQs were designed, validated, and implemented to analyze dietary consumption habits, helping in the formulation of evidence-based dietary recommendations. The findings highlight the significance of structured dietary assessment tools in improving patient outcomes during hemodialysis. **Materials and Methods:** This study was a hospital-based cross-sectional Observational Study conducted in the Department of Nephrology, Sri Venkateswara Institute of Medical Sciences, south Indian a tertiary care hospital, Tirupati, Andhra Pradesh. This study was approved by the Institutional Research and the Ethics Committee of the hospital. The study assessed the clinical profile, risk factors, diet pattern treatment, and outcomes of patients undergoing dialysis. **Purpose of the study:** The purpose of this study is to evaluate the reliability and validity of a FFQ as a dietary assessment tool for patients undergoing hemodialysis. By designing and validating a structured FFQ, the study aims to improve dietary assessments and enhance nutritional interventions for individuals with CKD stage 5D. **Conclusion:** The study successfully validated the FFQs in hemodialysis patients, providing valuable insights into dietary habits that impact treatment outcomes. These findings contribute to the development of evidence-based nutritional strategies aimed at improving the well-being of CKD patients undergoing dialysis.

Key words: Chronic kidney disease, dietary habits, end-stage renal disease, hemodialysis

INTRODUCTION

The renal system, which filters around 200 L of fluid everyday, is essential to the body's ability to maintain equilibrium. Its main function is to remove toxic compounds and metabolic waste products from the circulation while preserving essential components to maintain electrolyte balance, which is made up of the kidneys, ureters, bladder, and urethra, guarantees effective waste elimination and proper body function.[1] The kidneys are located under the rib cage near the back of the body. They resemble beans and are about the size of a fist. Like sieves, the kidneys filter the blood by eliminating waste and extra fluid. After passing through the kidneys and being cleansed, blood returns to the heart. Initially, the renal arteries allow blood to enter the kidneys. Nephrons, which are tiny filtering organs found inside the kidneys, sift through blood. Urine is the body's way of getting rid of waste and extra fluid, while essential elements are reabsorbed. The renal veins allow the cleaned blood to enter the bloodstream again. Ureters are tubes that carry urine from the kidneys to the bladder.[2]

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These cells are in charge of carrying oxygen, which is necessary for healthy body operation. Anemia is a condition marked by a lack of healthy red blood cells and symptoms such as weakness, coldness, exhaustion, and dyspnea. Diseases of the kidneys affect the regulation of blood pressure, which results in high blood pressure. High blood pressure is important because it increases the risk of heart attack, and stroke, and worsens renal damage. Furthermore, the kidneys are essential for maintaining the correct ratio of calcium to phosphate in the blood and bones, as well as for Vitamin D synthesis.[3] As such, problems with renal failure may have an impact on bone health.

MATERIALS AND METHODS

This study was conducted as a prospective cross-sectional analysis over 10 months, from June 2023 to March 2024, in the Nephrology department of Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, a tertiary care teaching hospital in South India. The study aimed to assess the clinical profile, risk factors, dietary patterns, treatment, and outcomes of patients undergoing hemodialysis. The Department of Nephrology at SVIMS is equipped with 20 hemodialysis machines and staffed by six nephrologists, five postgraduate students, one dietician, five technicians, and five nurses. The hospital serves as a referral center for patients from Tirupati and surrounding districts, handling approximately 1200 patients annually in both inpatient and outpatient settings.

The study design was prospective and cross-sectional, focusing on patients diagnosed with chronic kidney disease (CKD) stage 5D who required hemodialysis. Ethical approval was obtained from the Institutional Human Ethical Committee of SVIMS, and administrative clearance was secured from the hospital authorities before commencing the study. The study population included adult patients aged 18 years and above, residing in India, who were diagnosed with CKD stage 5D and undergoing hemodialysis. Patients with acute kidney injury, CKD stages other than 5D, significant cognitive impairment, or comorbid conditions that could affect dietary habits (e.g., cancer, severe gastrointestinal disorders, or advanced liver disease) were excluded from the study.

The study procedure involved the recruitment of patients based on inclusion and exclusion criteria after obtaining written informed consent. A 41-item food frequency questionnaire (FFQ) was designed and validated based on guidelines from the Kidney Foundation Hospital and Research Institute. Data were collected from patients' medical records, including admission notes, discharge summaries, and diet charts. Demographic details such as age and sex were recorded, and patients were interviewed to obtain a detailed medical history. Physical and systemic examinations were conducted, and findings were documented using a pre-designed pro forma.[4] Information on medication, dietary intake, fluid intake, and output during hospitalization was gathered from treatment charts and nurses' notes.[5]

Statistical analysis was performed using the Statistical Package for the Social Sciences version 20. The minimum sample size required for the study was 257 patients. Descriptive and inferential statistical analyses were conducted, with bivariate analysis performed using the Chi-square test. The study aimed to validate the FFQ as a dietary assessment tool for hemodialysis patients by analyzing sociodemographic, biochemical, and dietary data.[6] The findings were used to evaluate the reliability and validity of the FFQ in assessing dietary habits and their impact on patient outcomes in CKD stage 5D.[7]

Study population

The study randomly reviewed all the patients visited to the department of nephrology and included those patients admitted with a diagnosis of CKD and required hemodialysis.

Study criteria

Inclusion criteria

- Adults (age18 years and above) diagnosed with CKD stage 5D
- Patients residing in India
- Both genders (males and females)
- Patients with stable CKD 5D condition, as defined by their treating physician
- Patients with hypertension and diabetes mellitus.

Exclusion criteria

- Includes acute kidney injury or other acute renal conditions
- Patients with CKD stages other than stage 5D (e.g., Stages 1–4)
- Individuals with significant cognitive impairment or inability to comprehend and complete the FFQ accurately
- Patients with comorbid conditions that significantly affect dietary habits or nutritional intake, such as cancer undergoing active treatment, severe gastrointestinal disorders, or advanced liver disease.

Limitations

Although our study provided insightful information, there are a few important limitations that should be noted. First off, the study was conducted on a relatively small sample size of 257 patients, which may limit the generalizability of the findings to a broader population, especially across different regions or ethnic groups.[8] Second, the study was conducted in a single tertiary care hospital in South India, which may not represent the dietary habits and clinical profiles of

CKD patients in other geographical locations. Third, the study design was cross-sectional, which limits the ability to assess long-term dietary patterns and their impact on CKD progression or outcomes. Finally, the study did not account for potential confounding factors such as physical activity levels, medication adherence, or other lifestyle factors that could influence dietary habits and CKD outcomes.[9]

RESULTS

The study evaluated the dietary patterns and biochemical parameters of CKD 5D patients undergoing hemodialysis. A total of 257 patients were included, with a mean age of 61.1 ± 12.7 years. The majority were male (66%) and married (97%). The analysis revealed significant changes in biochemical markers post-dialysis. Serum creatinine levels decreased from 11.4 ± 3.8 mg/dL to 4.0 ± 2.03 mg/dL, whereas serum urea levels dropped from 182.8 ± 36.2 mg/dL to 68.1 ± 37.1 mg/dL. Electrolyte levels also changed notably, with sodium levels reducing from 145.8 ± 11.4 mEq/L to 125.4 ± 8.7 mEq/L and potassium levels from 4.4 ± 1.2 mEq/L to 2.9 ± 0.4 mEq/L.

Serum creatinine

The mean serum creatinine level decreased from (11.4 mg/dL ± 3.8) to (4.0 mg/dL ± 2.03) in the study population. This variation occurs due to, during dialysis, excess waste products, including creatinine, are removed from the blood, as shown in Table 1.

Serum urea

Before dialysis, patients with abnormal serum urea levels had a substantially higher mean level (182.8 mg/dL ± 36.2) when compared to the post-dialysis (68.1 ± 37.1). This is due to serum urea is a waste product that builds up in the blood when kidney function is impaired, during hemodialysis, the blood passes through a special filter that removes urea and other waste products from the bloodstream, as shown in Table 2.

Electrolytes-sodium and potassium

Before dialysis, the study population with abnormal serum sodium levels had a higher mean value (145.8 mEq/L ± 11.4), which decreased in the post-dialysis i.e. (125.4 ± 8.7) and abnormal Pre-dialysis potassium levels are high (4.4 ± 1.2) which gets decreased to (2.9 ± 0.4) after dialysis, this variation of sodium and potassium levels between pre and post dialysis is due to during hemodialysis, electrolytes like sodium are also removed from the bloodstream as part of the waste removal process. The dialysis machine's solution, called dialysate, contains a lower concentration of sodium compared to the patient's blood. As the blood passes through the dialyzer and comes into contact with the dialysate, sodium ions diffuse across the membrane, helping to lower the serum sodium levels in the blood, as shown in Tables 3 and 4.

Dietary intake patterns shifted significantly post-dialysis. The proportion of patients consuming more than three meals per day increased from 30% to 66%, and adherence to recommended cooking methods improved from 26% to 70%. A higher intake of green leafy vegetables (60%) and mixed vegetables (70%) was observed, along with a rise in fruit consumption from 36% to 62%. Protein intake showed an increase, with more patients preferring egg whites (60%) and seafood, including prawns (96%) and dry fish (94%). The consumption of milk and dairy products decreased from 72% to 30%, while tea and coffee intake reduced from 70% to 36%, as shown in Table 5.

Table 1: Pre and post dialysis serum creatinine in the study population

Pre-dialysis serum creatinine		Post-dialysis serum creatinine	
Abnormal		Abnormal	
n (%)	Mean±SD	*n* (%)	Mean±SD
93 (36)	11.4±3.8	131 (51)	4.0±2.03

SD: Standard deviation

Table 2: Pre- and Post-dialysis serum urea in the study population

Pre-dialysis serum urea		Post-dialysis serum urea	
Abnormal		Abnormal	
n (%)	Mean±SD	*n* (%)	Mean±SD
113 (44)	182.8±36.2	130 (51)	68.1±37.1

SD: Standard deviation

Table 3: Pre and post dialysis sodium in the study population

Pre-dialysis sodium		Post-dialysis sodium	
Abnormal		Abnormal	
n (%)	Mean±SD	*n* (%)	Mean±SD
148 (58)	145.8±11.4	192 (75)	125.4±8.7

SD: Standard deviation

Table 4: Pre- and post-dialysis potassium levels in the study population

Pre-dialysis potassium		Post-dialysis potassium	
Abnormal		Abnormal	
n (%)	Mean±SD	*n* (%)	Mean±SD
88 (34)	4.4±1.2	180 (70)	2.9±0.4

SD: Standard deviation

Table 5: Summary of dietary data after implementation of FFQs

Food item FFQ	Parameters	Pre-dialysis (*n*)/percentage	Post-dialysis (*n*)/percentage	*P*-value
No of meal/day	≤3 meals	180 (70)	87 (34)	0.5
	>3 meals	77 (30)	170 (66)	
Follow cooking method	Yes	67 (26)	180 (70)	0.5
	No	190 (74)	77 (30)	
Vegetable intake preference	Yes	82 (32)	160 (62)	0.49
	No	175 (68)	98 (38)	
Vegetables	Green leafy vegetables	102 (40)	154 (60)	0.01
	Mixed vegetables	67 (26)	180 (70)	
	Salad	31 (12)	211 (82)	
	Mash	26 (10)	241 (94)	
Fruit in take preference	Yes	93 (36)	160 (62)	0.5
	No	165 (64)	98 (38)	
Daily egg intake	Yes	154 (60)	175 (68)	0.5
	No	103 (40)	82 (32)	
Egg intake preference	Both whole and egg white	102 (40)	162 (63)	0.01
	Egg white	98 (38)	154 (60)	
Fish and products preference	Sea water fish	77 (30)	181 (70)	0.008
	Freshwater fish	98 (38)	196 (76)	
	Prawns	26 (10)	246 (96)	
	Dryfish	31 (12)	241 (94)	
Chicken	Fried chicken/grilled/roast	196 (76)	67 (26)	0.24
	Curry/gravy	36 (14)	226 (88)	
	Kabab	26 (10)	237 (92)	
Cooked veg	Carrot	82 (32)	187 (73)	<0.01
	White radish	67 (26)	199 (77)	
	Pink radish	58 (23)	211 (82)	
	Fresh peas	26 (10)	247 (96)	
	Ladies finger	21 (8)	247 (96)	
	Cabbage	36 (14)	241 (94)	
	Brinjal	67 (26)	211 (82)	
	Babycorn	17 (7)	196 (76)	
	Yellow pumpkin	26 (10)	237 (92)	
	Tomato	37 (14)	241 (94)	
Milk and dairy products intake preference	Yes	186 (72)	77 (30)	0.5
	No	77 (30)	186 (72)	
Beverages	Tea/coffee	180 (70)	92 (36)	<0.01
	Carbonated drinks	196 (76)	68 (26)	
	Other rinks	26 (10)	241 (94)	
Miscellaneous	Bakery and sweets	21 (8)	219 (85)	0.12
	pasta	17 (7)	251 (98)	
	Fast food/Chinese foods	201 (78)	82 (32)	
	Noodles	207 (81)	52 (20)	
	Biscuits	77 (30)	219 (85)	
	Cake	180 (70)	56 (22)	
	Bread/Bun	92 (36)	196 (76)	
	Roti	81 (32)	227 (88)	
	Paratha	67 (26)	191 (74)	

FFQ: Food frequency questionnaire

DISCUSSION

The study highlights several key findings regarding the demographic and clinical characteristics of patients at high risk of developing CKD stage 5D, as well as the impact of dialysis on various biochemical parameters and dietary habits. The majority of the study population was aged over 60 years (54%), with a mean age of 61.1 ± 12.7 years, which is higher than the mean age reported in other studies, such as that by Apeksha Ekbote *et al*. (49.8 ± 12.3 years). This discrepancy may be attributed to the selection of an older study sample, as the study focused on individuals above 60 years of age. In addition, males constituted a larger proportion of the high-risk population (66%), which aligns with findings from Aljazi Bin Zarah *et al*., who reported that males (52%) are more likely to develop CKD 5D than females. This gender disparity may be linked to lifestyle factors such as smoking, alcohol consumption, and higher stress levels among males.

The study also examined the impact of dialysis on biochemical parameters. Fasting blood sugar levels decreased significantly from 119.7 ± 10.9 mg/dL pre-dialysis to 116.5 ± 10.6 mg/dL post-dialysis, with a similar trend observed in post-prandial blood sugar levels. This reduction is likely due to the diffusion of plasma glucose into the dialysate during hemodialysis. In addition, HbA1c levels decreased from 6.7 ± 0.13% pre-dialysis to 6.0 ± 0.13% post-dialysis, further supporting the role of dialysis in improving glycemic control. Serum creatinine and urea levels also showed significant reductions post-dialysis, with creatinine levels dropping from 11.4 ± 3.8 mg/dL to 4.0 ± 2.03 mg/dL and urea levels decreasing from 182.8 ± 36.2 mg/dL to 68.1 ± 37.1 mg/dL. These changes underscore the effectiveness of dialysis in removing waste products from the bloodstream.

In addition, hemodialysis had a notable impact on blood pressure and blood glucose levels. The mean systolic blood pressure dropped from 136.9 ± 14 mmHg to 135 ± 12 mmHg, and diastolic blood pressure decreased from 86.5 ± 9.9 mmHg to 75.4 ± 8.4 mmHg. In diabetic patients, fasting blood sugar levels reduced from 119.7 ± 10.9 mg/dL to 116.5 ± 10.6 mg/dL, and postprandial levels from 215.8 ± 10.3 mg/dL to 205.2 ± 5.7 mg/dL. These findings indicate that hemodialysis, combined with dietary modifications, significantly impacts the nutritional and metabolic profile of CKD 5D patients.

CONCLUSION

This prospective cross-sectional study aimed to validate the FFQs in patients undergoing dialysis in the Department of Nephrology. A total of 257 hemodialysis patients' socio-demographic details, biochemical data, and dietary data were analyzed and validated. The patient population is predominantly between the age group of 50–60 years and >60 years, most reportedly with CKD 5D. For these patients, we designed, validated, and implemented FFQs. The findings obtained from these patients help in shaping evidence-based dietary consumption habits during hemodialysis that impact patient well-being and improve treatment outcomes.

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