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Research Paper

Effects of dietary protein restriction on nutritional status of hemodialysis patients

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ABSTRACT

Background: Protein catabolism increases during hemodialysis, yet research on low protein intake among hemodialysis patients remains limited compared to non-dialysis chronic kidney disease (CKD) populations.
Objective: To investigate the prevalence of dietary protein restriction practices among hemodialysis patients and evaluate their effect on nutritional status.
Methods: A descriptive exploratory study was conducted among 150 hemodialysis patients purposively sampled at one of the largest dialysis centers in Kathmandu district, Nepal. Anthropometric, biochemical, clinical, and dietary (ABCD) assessments were used. Structured questionnaires captured nutritional status, dietary patterns (24-hour recall, food frequency), and dietician consultation history. Height/weight were measured with a wooden height scale and mechanical weighing machine. Pre-dialysis blood samples were analyzed for serum albumin, urea, uric acid, total protein, and creatinine. Data were analyzed using SPSS version 25.
Results: Among 150 patients, 63.3% were male, 71.3% had undergone hemodialysis for 1–5 years, and 82.7% received in-center hemodialysis twice weekly. Based on serum albumin, 66.7% had protein-energy malnutrition (PEM), and 3.3% were classified as underweight by BMI. Low protein intake was attributed to dislike of protein-rich foods, financial constraints, and lack of awareness.
Conclusion: Protein restriction was associated with malnutrition in a substantial proportion of hemodialysis patients. Regular dietician consultation, individualized protein requirements by CKD stage, and consistent multidisciplinary follow-up are recommended.

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1. INTRODUCTION

Nutrition-related chronic diseases are becoming significant public health concerns, not only in developed nations but also in developing countries like Nepal. Chronic kidney diseases (CKD) are prevalent

worldwide, causing significant morbidity and mortality [1], [2], [3]. The global prevalence of CKD is on the rise, and Nepal faces challenges in providing equitable access to Renal Replacement Therapy (RRT), including hemodialysis. Haemodialysis is one of the three renal replacement therapies in which waste products and excess fluid are removed from blood when kidneys stop functioning properly. Individuals with chronic kidney disease (CKD) undergoing hemodialysis have distinct nutritional requirements compared to the general population, often facing protein-energy malnutrition (PEM). PEM is prevalent in 18% to 70% of maintenance haemodialysis patients, contributing to increased morbidity and mortality, including a higher risk of death [4], [5], [6], [7]. Malnutrition in these individuals accelerates from various factors such as insufficient food intake, hormonal imbalances, dietary restrictions, and the hypercatabolic state induced by uremia and hemodialysis [8], [2].

Obstacles to achieving sufficient protein intake in hemodialysis patients emerge from medical, behavioral, and socioeconomic factors. Medical challenges include inadequate dialysis leading to poor appetite and uremic symptoms, even in well-dialyzed patients. Medications and dialysis-related issues can further contribute to poor appetite. Comorbidities in dialysis patients may also impact protein nutrition. Behavioral factors include a lack of knowledge about protein-containing foods, the need for phosphorus restriction affecting protein intake, dietary noncompliance, and difficulty adhering to complex dietary restrictions. Socioeconomic barriers involve the cost of protein-rich foods, limited access to affordable options compatible with renal diets, and challenges in shopping or cooking. Some dialysis units restrict meals during treatment due to various concerns, and overall, the significance of nutritional status and the benefits of nutritional support may be ignored in the hemodialysis population [9]. Low levels of serum albumin, a biochemical marker indicating protein-energy wasting, are strong predictors of higher death risk in haemodialysis patients. The National Kidney Foundation recommends a higher protein intake of 1.2 g/kg body weight/day for hemodialysis patients due to factors like increased catabolism and protein losses during dialysis. However, epidemiological data reveal that over 50% of hemodialysis patients lack protein intake recommendation, with less than 1.0 g/kg/day based on normalized protein catabolic rates [10], [4], [5], [6], [2]. This study aims to investigate the prevalence of protein restriction practices and its effect in nutritional status of haemodialysis patients. Inadequate protein and calorie intake often result in protein-energy malnutrition, impacting the outcomes of dialysis. Various studies have investigated the nutritional status and malnutrition in hemodialysis patients, there is a notable gap in focusing on protein restriction and its effects on nutritional well-being. Protein restriction, commonly advised for non-dialysis chronic kidney disease (CKD) patients, is intended to slow CKD progression, minimize uremic complications, and preserve residual renal function. However, a low protein diet among hemodialysis patients heightens the risk of developing malnutrition [11]. Malnutrition is widespread in this patient group, with nutritional factors strongly related to the risk of death [12].

2. RELATED WORK

[11], [13], [14], [15], [16], [17], [18] In their study showed that the possibility of developing malnutrition and especially hypoalbuminemia is usually because of both low nutrient intake and abnormal nutrient metabolism which is a well-known major risk factor in dialysis patients [19], [14], [20] in their study concluded that low daily protein intake or decrease in its consumption over time is associated with increased risk for death in hemodialysis patients. [21] In India, and [4] in Nepal, highlighted malnutrition among haemodialysis patients, primarily due to insufficient dietary intake, emphasizing the necessity for nutritional supplements to meet requirements alongside regular diets. Additionally, studies by [22], [23], [4], in Nepal indicated mild to moderate malnutrition among hemodialysis patients, likely influenced by poor dietary intake.

3. METHODOLOGY

A descriptive exploratory study was conducted to investigate the impact of protein restriction on haemodialysis patients. The study involved chronic patients undergoing haemodialysis at a prominent unit in Kathmandu, Nepal, with a sample size of 150 patients selected purposively to represent those following low protein diets. Data collection involved structured questionnaires covering nutrition status, anthropometric measurements, biochemical reports, clinical assessments, and dietary information. Interviews were conducted directly with patients, and in some cases, their visitors. Instruments included a wooden height scale (6 feet length) and a mechanical weighing machine for height and weight measurements, respectively. Blood samples were taken before haemodialysis to test biochemical indicators such as serum albumin, urea, uric acid, total protein, and creatinine using specific chemical reagents.

Clinical assessment was based on the haemodialysis treatment flowchart of the same day, which included recent clinical problems, dialysis history, and management plans. Dietary assessment involved structured questionnaires on food preferences, 24-hour dietary recall, protein-related information, food frequency, and dietician consultations. Data quality was ensured through daily checks for completeness, consistency, and accuracy, followed by manual and computer-assisted data processing using SPSS version 25. Statistical analysis was conducted, and findings were presented through relevant tables, pie charts, and graphs for interpretation.

4. RESULTS AND DISCUSSION

4.1 Socio Demographic Information

Table 1. Socio-Demographic Information-I N=150

Demographic Variables	Frequency	Percent (%)
Gender		
Male	95	63.3
Female	55	36.7
Age Group		
0-20	4	2.6
21-40	41	27.33
41-60	68	45.33
60 above	37	24.74
Education		
Illiterate	31	20.7
Literate	21	14
Below SLC	48	32.0
SLC	10	6.7
Higher Secondary	20	13.3
Graduate	15	10.0
Post Graduate	5	3.3

Table 1 shows the socio- demographic variables of hemodialysis patients. Among 150 hemodialysis patients, 63.3% were male and 36.7% were female. Likewise, according to age, 45.33% belong to the age group of 41-60 years whereas 2.6% were below the age group of 20 years. According to their education, 32% were below SLC and 3.3% were post- graduated.

Table 2 also shows the socio- demographic information which includes economic status, ethnicity and marital status of the respondents. According to their economic status, majority of the respondents were from medium socio- economical background (91.3%) and 2.7% were from high class. According to their ethnicity, majority of the respondents were Adhibasi/ Janajati which was 63.3% and only 0.67% was Marwadi. Regarding the marital status of the respondents, 81.33% were married and 1.3% were divorced.

Table 2. Socio-Demographic Information- II N=150

Demographic Variables	Frequency	Percent (%)
Economic status		
Low	9	6.0
Medium	137	91.3
High	4	2.7
Ethnicity		
Brahmin/ Chhetri	40	26.7
Adhibasi/ Janajati	95	63.3
Dalit	5	3.3
Madhesi	6	4.03
Marwadi	1	0.67
Thakuri	3	2
Marital Status		
Married	122	81.33
Unmarried	17	11.33

Divorced	2	1.3

Table 3 shows the remaining demographic variables of the respondents including marital status, occupation and care giver. According to their occupation, most of the respondents were involved in other several activities like army, author, farmer, music teacher, singer, teacher, social worker which was 46.6% and 1.3% were daughter-in-law and mother and father.

Table 3. Socio-Demographic Information- III N=150

Demographic Variables	Frequency	Percent (%)
Occupation		
Business	30	20.0
Job Holder	15	10.0
House Maker	31	20.7
Student	4	2.7
*Others (1)	70	46.6
Care Giver		
All family members	38	25.3
Daughter	4	2.7
Daughter- in- law	2	1.3
Husband	16	10.7
Mother	3	2.0
Mother and Father	2.0	1.3
Self	13	8.7
Son	6	4.0
Wife	48	32.0
Wife and Son	3	2.0
*Others (2)	15	10

4.2 Dialysis Duration

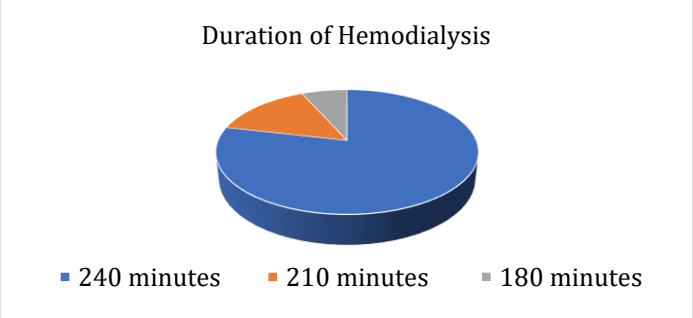


Figure 1. Duration of Dialysis Treatment

Figure 1 shows the duration of dialysis of the respondents in which 78% were doing 240 minutes hemodialysis and 6.70% were doing 180 minutes hemodialysis.

4.3 Hemodialysis Schedule

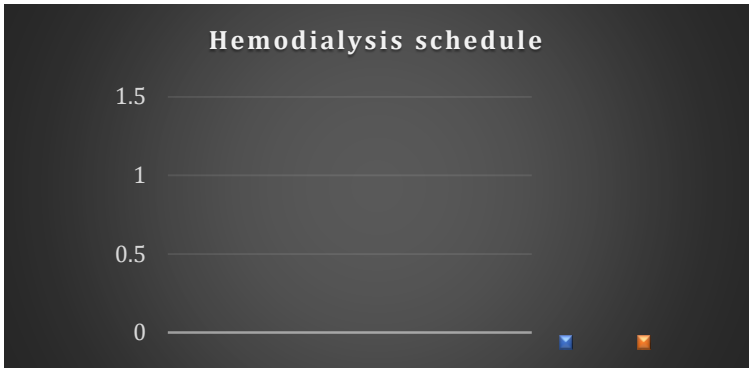


Figure 2. Hemodialysis Schedule

Figure 2 shows the dialysis schedule of the respondents. Majority of respondents were doing twice a week dialysis (82.66%).

4.4 Hemodialysis Vintage

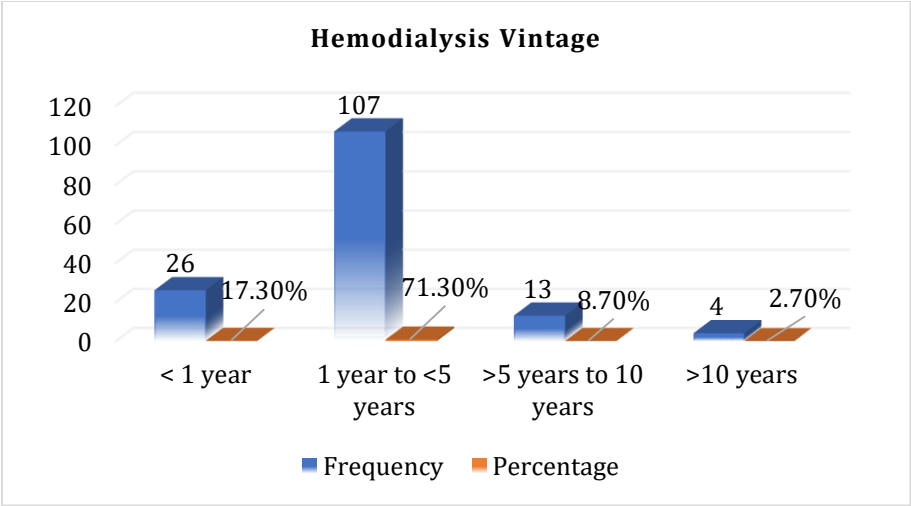


Figure 3. Hemodialysis Vintage

Figure 3 shows the vintage of dialysis in which majority of the respondents were under dialysis for more than a year to 5years (71.3%) and 2.7% more than 10 years.

4.5 Dietary Information

Table 4. Type of Diet Intake N=150

Type of Diet	Frequency	Percent (%)
Normal diet	36	36
Renal Diet	96	64

Table 4 shows type of dietary intake in which 64% followed renal diet and 36% were following normal diet.

Table 5. Dietary Habits N=150

Dietary Habits	Frequency	Percent (%)
Dietary habits		
Vegeterian	11	7.33
Non- vegetarian	114	76
Lacto-ovo vegetarian	25	16.67

Table 5 shows the dietary habit of hemodialysis patients. 76% were non vegetarian and 7.33% were vegetarian.

Table 6. Dietary Protein Knowledge N=150

Dietary Protein Knowledge	Frequency	Percentage
Knowledge about the sources of protein		
Yes	110	73.3
No	40	26.7

Table 6 shows that 73.3% of respondents had some knowledge about the sources of protein and 26.7% had no knowledge.

Table 7. Protein Intake Information N=150

Types of Protein Intake	Frequency	Percentage
Protein intake		
Animal source only	26	17.3
Plant source only	24	16.0
Both	100	66.7
Include legumes/ pulses in diet		
Yes	127	84.7
No	23	15.3
Eat meat		
Yes	114	76.0
No	36	24.0
Responsible professionals recommended white meat consumption		
Doctor	4	3.5
Nurses	23	20.18
Dietician	30	26.32
Self	1	0.88
All	56	49.12
Reasons for white meat consumption		
Contains low protein	25	21.93
Contains high protein	6	5.26
Maintains uric acid	4	3.51
Don't know	75	65.79
*Others	4	3.51

Table 7 shows the information regarding source of protein intake. Majority of the respondents included both animal and plant sources in their diet (66.7%), whereas 16% included only plant sources of protein in their diet. 84% of the respondents included legumes/ pulses in their diet and 15.3% didn't include legumes/ pulses in their diet. Similarly, 76% respondents eat meat and 24% didn't eat meat. Majority of the respondents (35.09%) eat meat everyday whereas 3.51% eat once a month. Among them 73.7% respondents eat white meat. Regarding the recommendation of white meat, most of the respondents said all (included doctors, nurses and dietician) and 0.88% said by self. Majority of the respondents (65.79%) didn't know the reason for white meat consumption, and 3.51% said that consumption of white meat maintains blood pressure, for good health and easy to digest.

Table 8. Protein Intake Information- II N=150

Types of Protein Intake	Frequency	Percent (%)
Reason for avoiding red meat		
Contains high protein	31	27.19
Contains high potassium	7	6.14
Don't know	36	31.58
Increase uric acid	26	22.81
Increase blood pressure	10	8.77
*Others	4	3.51

Include eggs in diet		
Yes	139	92.7
No	11	7.3
Frequency of egg consumption	n-139	
Daily	115	82.73
Alternate	13	9.35
Once a week	2	1.44
Twice a week	6	4.32
Sometimes	3	2.16
Part of egg consumed		
White part only	91	65.47
Yellow part only	2	1.44
Whole part	46	33.09
Number of eggs consumed per day		
1	12	8.62
2	75	53.96
3	26	18.71
>3	26	18.71

Table 8 shows the information about dietary protein. In which, the reason behind avoiding the red meat according to the respondents were unknown reason (31.58%), and 3.51% said that red meat consumption increases urea, contains high salt, cause food allergy etc. 92.7% of the respondents eat egg whereas 7.3% don't consume eggs.

Table 9. Protein Intake Information- III N=150

Protein Intake Information	Frequency	Percentage (%)
Do you drink milk?		
Yes	84	56.0
No	66	44.0
Do you eat yoghurt?		
Yes	84	56.0
No	66	44.0
Do you eat cheese?		
Yes	17	11.3
No	133	88.7

Table 9 Shows the information related to intake of other protein containing diets in whic h 56% of respondents drink milk, 56% of respondents eat yoghurt and 11.3% eat cheese.

4.6 Biochemical Indicators

Table 10. Biochemical Indicators N=150

Laboratory Values	Frequency	Percentage (%)
Uric acid		
Male 3.4- 7mg/dl	80	53.3
>7mg/dl	15	10
Female 2.5-6 mg/dl	50	33.3
>6mg/dl	5	3.4
Blood urea		
10-50 mg/dl	3	2
>50 mg/dl	147	98
Creatinine		
0.7-1.4 meq/l	0	0
>1.5 meq/l	150	100
Total protein		
<6.0 gm/dl	13	8.7
6.8-8.0 gm/dl	137	91.3

Serum albumin		
<4.0 g/dl	100	66.7
≥4.0 g/dl	50	33.3

Table 10 shows the biochemical indicators of the hemodialysis patients in which 53.3% male and 33.3% of the female had normal uric acid level. The blood urea level of 2% respondents were within normal range i.e., 10-50 mg/dl, creatinine level of all respondents was >0.7 1.4mEq/l. The total protein level was <6.0gm/dl in 8.7% respondents and 6.0-8.0gm/dl in 91.3% respondents. Similarly, 66.7% of the respondents' serum albumin level was below normal i.e., <4.0g/dl and remaining 33.3% respondents had normal serum albumin level.

4.7 Body Mass Index (BMI)

A high body mass index (BMI) is associated with lower mortality in patients undergoing hemodialysis. Short-term weight gains and losses are also related to lower and higher mortality risk, respectively.

Table 11. Body Mass Index (BMI) N=150

Body Mass Index (BMI)	Frequency	Percentage (%)
Under Weight		
<18.50	5	3.3
Normal Range		
18.50-22.9	94	62.7
Overweight		
23.00-24.9	46	30.7
Obese ≥25	5	3.3

Table 11 shows the Body Mass Index of the respondents according to Asian classification in which 62.7% of respondents had normal BMI, 30.7% were overweight, 3.3% were under weight, and 3.3% obese.

4.8 Weight Changes of Respondents within Six Months

Table 12. Weight Changes of Respondents within Six Months N=150

Weight Changes	Frequency	Percent (%)
No weight loss	108	72
Weight loss		
0-2 kg	31	20.7
2.1-4 kg	6	4
4.1-6 kg	3	2
6.1-8 kg	2	1.3

Table 12 shows the weight changes status of the respondents within six months. There were no weight loss among 72% of the respondents whereas 20.7% had 0-2kg weight loss, 4% had 2.1-4kg weight loss, 2% had 4.1-6kg weight loss and 1.3% had 6.1-8kg weight loss.

4.9 Appetite of the Respondents

Table 13. Appetite of the Respondents

Appetite	Frequency	Percent (%)
Appetite Status		
Normal	122	81.3
Change in appetite	28	18.7
N=28		
Appetite increased	10	35.71
Appetite decreased	18	64.29

Table 13 shows information regarding the appetite of the respondents in which 81% had normal appetite and 18.7% had abnormal appetite. Among those abnormal appetite respondents (n=28), 35.71% had increased appetite and remaining 64.29% had decreased appetite.

4.10 Dietician Visit

Table 14. Dietician Visit

Dietician Visit	Frequency	Percent (%)
Yes	146	97.3
No	4	2.7

Table 14 shows that 97.3% of hemodialysis patients consult with dietician.

4.11 Discussion

The study investigated the prevalence of protein restriction and effect of dietary protein restriction among hemodialysis patient. In this study, 63.3% were male and 36.7% were female which resembles with the study done by [4] in which 67.5% were male and 32.5% were female which was conducted in the same dialysis center. The increasing incidence of disease fall in middle adulthood due to lack of timely screening of chronic disease such as diabetes and hypertension which is similar with study done in hemodialysis unit in Lalitpur by [18].

Majority of the respondents' educational status was below SLC (32.0%) whereas minority of the respondents had completed their graduation (3.3%). 91.3% were from medium economic status which reflects the poor socioeconomic state of patients of developing world, which undertake them from earlier diagnosis and treatment of these preventable disease and later resulting with chronic diseases and poor dietary adherence. Among the respondents, their wife was the care giver. Majority of the respondents were under dialysis for 1year to < 5years (71.30%) which is similar with the study conducted by [18]. Study done in Jeddah [24], Kathmandu [22], Jordan [25], Iran [26], Brazil [27], and Palestine [28] have shown malnutrition prevalence in 22.4% to 67.9% of the patients under chronic hemodialysis. In this study 66.7% of the patients suffered from malnutrition according to their serum albumin level which was similar in comparison with the previous studies. According to BMI, 62.7% were in normal range, 30.7% were overweight, 3.3% were underweight and 3.3% were obese.

Similar result found in the study of [4]. The protein consumption is statistically significant with BMI, serum uric acid, serum total protein and serum albumin which is supported by the study conducted in Saudi Arabia [29] who concluded that the frequency of malnutrition is high in their population and poor protein intake was the primary contributing factor for this condition and also suggested that intake of enough protein may be effective way in preventing malnutrition. Similarly, BMI shows positive correlation with the change in weight (weight loss) in six months and serum albumin in this study. The prevalence of dietary protein restriction was found among 39.33% of the respondents due to various reasons such as dislike of the taste of protein containing foods, self- recommendations, dietician advice, unaffordability, and some other reasons.

Intake of protein containing diet was higher in this study than found by [30] in Korea. 66.7% of the respondents included both animal and plant source of protein in their diet, 17.3% include only animal source and 16% included only plant source. The major sources of protein were found to be legumes, pulses, meat, eggs, milk and yoghurt whereas cheese was very rare among the respondents. The study showed the majority of respondents have dietary habit of breakfast, lunch, tiffin, snacks and dinner whereas 90% of the respondents skip their supper. Hemodialysis patients commonly have poor dietary habits, particularly with regard to the intake of foods with low levels of consumption of cereals, fruits and vegetables [31]. It is complex to balance restrictions on some nutrients on the one hand with the need to increase others in the foods consumed by patients on hemodialysis, which may result in inadequate intake, particularly of protein containing diets. In summary, the analysis of dietary patterns among the patients in this study showed the need for a number of changes including diet with greater sources of protein and need of proper dietician counselling.

5. CONCLUSION

The study revealed that most respondents included protein in their diet and those who did not verbalized dislike for the taste of protein- rich foods as the primary reason for restriction. Results indicated that 66.7% of the patients were malnourished based on Serum Albumin levels, with 30.7% overweight,

3.3% underweight, and 3.3% obese according to BMI. Skipping meals like breakfast, snacks, and supper seemed linked to insufficient knowledge of protein-rich foods, noncompliance with dietary recommendations, and difficulties in adhering to complex dietary restrictions. Economic barriers, such as the cost and accessibility of suitable protein options for renal diets, also hindered intake.

Age, education, and economic status showed positive correlations with protein intake, BMI, and Serum Albumin. BMI correlated positively with nutritional variables like weight changes within six months and serum albumin level, with statistical significance. Protein intake also correlated positively with BMI, serum uric acid, serum total protein, and serum albumin. Some patients never received diet counselling or visited a dietician, highlighting a need for regular dietary guidance by trained professionals.

Such counselling, along with monitoring of dietary habits, significantly improved the nutritional status of haemodialysis patients compared to other dialysis staff interventions. Given the varying protein requirements among dialysis patients, routine follow-ups by multidisciplinary teams are crucial. The study emphasized the importance of hospitals providing regular diet counselling, monitoring, and evaluation tailored to each patient's biochemical indicators and health status due to the inadequate knowledge and consumption levels regarding protein diets among haemodialysis patients.

5.1 Recommendation

Healthcare settings, including in- center services, require widespread provision of diet counselling, especially for renal patients. Increasing the number of registered dieticians can ensure accurate information dissemination about dietary needs. Patients and their caregivers need clear, accessible information about kidney disease and appropriate diets, considering factors like affordability and availability, communicated in simple language. Dialysis patients and families should undergo intensive nutrition counselling with personalized care plans, including regular assessments of growth and physical development.

These plans should be reviewed every 3 to 4 months or as advised by the patient care team. Further research is necessary to evaluate adherence to dietary recommendations among haemodialysis patients and assess caregivers' knowledge and practices. Regular monitoring and evaluation of nutritional status for all dialysis patients are recommended.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Rojee Gurung	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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