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A Study to Assess the Nutritional Status of Kidney Failure Patients Undergoing Maintenance Hemodialysis

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Abstract

Malnutrition is a common and serious complication among patients with end-stage renal disease (ESRD) undergoing maintenance hemodialysis (MHD) and is strongly associated with increased morbidity and mortality. The present study was conducted to assess the nutritional status of patients on maintenance hemodialysis and to identify factors contributing to protein-energy malnutrition in this population. A cross-sectional and follow-up assessment was carried out among patients receiving regular hemodialysis at a dialysis center. Nutritional status was evaluated using a combination of dietary assessment, anthropometric measurements, biochemical parameters, and clinical indicators. Dietary intake was assessed through structured dietary interviews and food diaries to estimate energy and protein consumption. Anthropometric measurements, including body mass index, mid-upper arm circumference, skinfold thickness, and mid-arm muscle area, were used to evaluate body composition. Biochemical parameters such as hemoglobin, blood urea nitrogen, serum albumin, and total protein were analyzed to assess metabolic and nutritional status. The findings revealed that a majority of patients failed to meet the recommended dietary energy and protein requirements. Anthropometric indicators demonstrated varying degrees of muscle and fat depletion, reflecting protein-energy malnutrition. Hypoalbuminemia was significantly associated with inadequate dietary intake, emphasizing the need for sufficient energy and protein consumption. Statistically significant improvements were observed in hemoglobin levels and blood urea nitrogen during follow-up. Serum albumin and total protein showed a highly significant association between baseline and follow-up assessments, confirming their utility as nutritional markers. The study concludes that malnutrition remains highly prevalent among maintenance hemodialysis patients. Regular nutritional assessment and timely dietary intervention are essential to prevent protein-energy malnutrition and to improve clinical outcomes in this vulnerable population.

Keywords: Maintenance Hemodialysis, Protein-Energy Malnutrition, Nutritional Assessment, Serum Albumin, Dietary Intake

INTRODUCTION

Dialysis is a life-sustaining medical procedure that performs the essential functions of the kidneys when renal function is severely impaired. It removes metabolic waste products, excess fluids, and electrolytes from the blood, thereby maintaining chemical balance and supporting blood pressure regulation [1]. Dialysis becomes necessary when kidney function declines by nearly 85–90%, a stage commonly referred to as end-stage renal disease (ESRD). For most patients, dialysis remains a long-term or lifelong therapy unless renal transplantation is possible [2].

Maintenance hemodialysis (MHD) is the most widely used form of renal replacement therapy [3].

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It involves circulating blood through a dialyzer containing a semi-permeable membrane, which allows diffusion and ultrafiltration of waste products and excess water. Hemodialysis is typically performed two to three times per week for 4–6 hours per session. Although this therapy sustains life, it is associated with several metabolic and nutritional complications, among which malnutrition is one of the most seriou [4].

Malnutrition, particularly protein-energy malnutrition (PEM), is highly prevalent among patients undergoing maintenance hemodialysis. It is characterized by inadequate intake and utilization of protein and energy, resulting in weight loss, reduced muscle mass, depleted fat stores, and impaired immune function. Studies indicate that the prevalence of malnutrition in hemodialysis patients ranges from 10% to 54% [5].

Malnutrition in ESRD is multifactorial, arising from reduced dietary intake due to anorexia, nausea, altered taste sensation, dietary restrictions, chronic inflammation, metabolic acidosis, hormonal disturbances, and nutrient losses during dialysis. Additionally, the dialysis procedure itself contributes to amino acid, peptide, vitamin, and blood losses, further increasing catabolic stress [6].

In India, the burden of ESRD is increasing rapidly, with an estimated 100,000 new cases annually. Limited access to nephrology services, financial constraints, and lack of nutritional awareness further aggravate the problem of malnutrition in dialysis patients. Poor nutritional status in hemodialysis patients is strongly associated with increased morbidity, mortality, and reduced quality of life [7].

Assessment of malnutrition in hemodialysis patients requires a comprehensive approach, as no single parameter is sufficient. A combination of dietary assessment, anthropometric measurements, biochemical indicators such as serum albumin and creatinine, and subjective global assessment is recommended [8]. Early identification and appropriate nutritional intervention, including dietary counseling and adequate protein-energy intake, are essential for preventing malnutrition and improving clinical outcomes in patients on maintenance hemodialysis [9, 10].

RESULTS

The raw scores convey no meaning unless they are systematically arranged and tabulated statistical techniques applied are already mentioned in chapter III and the scores on the various independent and dependent variables have been presented in Appendix I. In this regards (I)-general information (II) anthropometric assessment (III) bio-chemical assessment (IV) dietary assessment (V) knowledge assessment are presented under the Table 1, 2,3,4 & 5 respectively.

Table 1. Distribution of hemodialysis patients according to their demographic characteristics.

Measures	Categories	*N=150*	F in %
Age-	Less than 20	15	10.00
	20-30	30	20.00
	30-40	16	10.67
	40-50	30	20.00
	50-60	41	27.33
	Above 60	18	12.00
SEX	Female	39	26.00
	Male	111	74.00

150 maintenance hemodialysis were selected for the study, 27.33 % patients were seen in age group of 50-60 years, 20% patients were seen in active age group of 20-30 years and same percentage was seen for 40-50 years, remaining 12 % patients were found above 60 years. 10 % patients were below the age of 20 years and around same percentage observed for 30-40 years. The majority of patients were male 111 (74%) and 39 (26%) were female.

Table 2. Distribution of hemodialysis patients according to diagnosis.

Patient diagnosis	***F***	***F* in %**
HTN, ESRD	66	44.00
acute on CRF	30	20.00
Diabetic kidney disease	54	36.00

Around forty percentages of the overall hemodialysis patients (44%) were diagnosed with End Stage of Renal Disease with hypertension, 20 % were converted to acute on chronic renal failure and 36 % were diagnosed with diabetic kidney disease.

Table 3. Distribution of hemodialysis patients according to dietary habits.

Dietary habits	***F***	***F* in %**
Vegetarian	63	42.00
Non Vegetarian	52	34.67
Vegetarian but taking egg.	35	23.33

The number of vegetarian patients were 63 (42 %), 52 (34.67%) were found non- vegetarian and 35 (23.33%) were vegetarian but they was taking egg only not chicken and muttons.

Vegetarian patients had respectively some problems. There are

- Failed to achieve the required protein intake.
- Not able to get the high biological value of protein.

Table 4. Distribution of hemodialysis patients according to duration of dialysis in month.

Durations in months	**F**	**F in %**
1 to 2	35	23.33
2 to 4	77	51.33
4 to 6	13	8.67
6 and above	25	16.67

More than half of the overall hemodialysis patients 77 (51.33%) taking dialysis since 2- 4 months, 35 (23.33 %) since 1-2 months, 13 (8.67 %) since 4- 6 months, and 25 (16.67 %) were taking dialysis since 6 months or more than that.

Table 5. Distribution of hemodialysis patients according to frequency dialysis in week.

No. of dialysis	**F**	**F in %**
Twice	98	65.33
Thrice	34	22.67
Weekly	18	12.00

Dialysis patients distributed in to three groups twice, thrice and weekly. Majority of the patients 98 (65.3%) were taking dialysis twice in a week, 34 (22.6%) thrice in a week, and minimum patients 18 (12 %) patients taking weekly.

ANTHROPOMATRIC ASSESSMENT

In baseline mean weight, body mass index (BMI) and mid upper arm circumference were 56.1kg±9.593 kg, 20.7±3.028 kg/m^2 and 23.3±4.219 cm. respectively.

In follow-up there was no major changes was found in mean weight and body mass index but mid upper arm circumference was seen in decreasing order 21.683±3.12 cm (Table 6).

Table 6. Distribution of the patients according to mean anthropometric variables in baseline and follow-up.

	Variable	Mean	St Dev	Minimum	Maximum
Baseline	Wt	56.123	9.593	35	79
	BMI	20.754	3.028	14.8	31.23
	MUAC	23.367	4.219	16.5	42
Follow up	Wt	55.3	7.459	39	73
	BMI	20.427	2.101	15.8	25.8
	MUAC	21.683	3.12	15.5	31

In baseline 37(24.67%) were under weight, followed by 100 (66.67%) normal BMI, 13 (8.67%) overweight and only 1 patients was found obese.

After dietary counseling number of patients were higher who belongs in normal BMI 122 (81.33 %), 23 (15.33%) were under weight and only 5 (3.33%) patients were overweight (Table 7).

Table 7. Distribution of hemodialysis patients according to Body Mass Index (BMI) in baseline and follow-up.

	BMI (kg/m^2)	Before		After	
Classification	*Principal cut-off points*	*F*	*f in %*	*F*	*f in %*
Underweight	*<18.50*	*37*	*24.67*	*23*	*15.33*
Severe thinness	<16.00	9	6.00	2	1.33
Moderate thinness	16.00 - 16.99	6	4.00	4	2.67
Mild thinness	17.00 - 18.49	22	14.67	17	11.33
Normal range	*18.50 - 24.99*	*100*	*66.67*	*122*	*81.33*
N1	18.50 - 22.99	85	56.67	103	68.67
N2	23.00 - 24.99	15	10.00	19	12.67
Overweight	*≥25.00*	*13*	*8.67*	*5*	*3.33*
Pre-obese1	25.00 - 27.49	7	4.67	5	3.33
Pre-obese2	27.50 - 29.99	5	3.33	0	0.00
Obese	*≥30.00*	*1*	*0.67*	*0*	*0.00*
Obese class I	30.00 - 34.99	1	0.67	0	0.00
Obese class II	35.00 - 39.99	0	0.00	0	0.00
Obese class III	≥40.00	0	0.00	0	0.00

Highly significant association seen between baseline and follow-up Body mass index (BMI) as per p value 0.011. 37 (24.67 %) patients were underweight in baseline and it was decreased 23 (15.33%) in follow-up. After dietary counseling the number of the patients increased who belongs in normal body mass index (Table 8).

Table 8. Association between baseline and follow–up body mass index (BMI).

BMI	Baseline	Follow-up	Chi-square	DF	P-value	Conclusion
Underweight	37	23				Reject HO at 5% l.o.s.
Normal	100	122	9.002	2	0.011*	
Overweight	13	5				

ANOVA test was used to see the effect of number of hemodialysis on weight changes. Change in weight after intervention was same for patients who taking dialysis is twice a week or thrice a week or weekly i.e. There is no significant effect of number of dialysis seen on changing in weight as p value is 0.93 (> 0.05) (Table 9).

Table 9. Effect of Number of dialysis on weight changes.

Number of dialysis.	**Weight (Kg)**		
	Mean	*SD*	*P value*
No. of dialysis			
Twice	-0.63	7.28	0.93 ^{NS}
Thrice	-1.15	8.72	
Weekly	-1.28	14.3	

No significant effect seen between number of hemodialysis and baseline BMI. For the follow up data, test is not applicable because 4 cells with expected counts less than 5. There was significant association found in baseline Body mass index (Table 10).

Table 10. Effect of dialysis doses on body mass index.

		Underweight	**Normal range**	**Overweight**	**Chi-Square**
Baseline	Weekly	22.22	61.11	16.67	p = 0.313^{NS}
	Twice	28.57	63.27	8.16	
	Thrice	14.71	79.41	5.88	
Follow up	Weekly	68.75	29.17	2.08	Not Applicable
	Twice	17.35	79.59	3.06	
	Thrice	8.82	88.24	2.94	

Paired t test was used to see the differences between baseline and follow-up weight and mid upper arm circumference. There was no significant difference was observed in baseline and follow-up weight as per p value (P= 0.345). Highly significant difference was seen in MUAC as per p value 0.00 (P<0.001) (Table 11).

Table 11. Comparison between baseline and follow-up weight and mid upper arm circumference (MUAC).

	Baseline	**Follow up**	**H1**	**T value**	**P value**	**Conclusion**
	Mean ± SD	*Mean ± SD*				
Weight	56.123±9.593	55.3±7.459	$\mu1 \neq \mu2$	1.17	0.245^{NS}	Not significant
MUAC	23.367±4.219	21.683±3.12	$\mu1 > \mu2$	4.65	0.00**	Highly significant

As p value of ANOVA is greater than 0.05 we conclude that there is no significant effect of demographic variable on change in weight, BMI, MUAC (Table 12).

Table 12. Effect of demographic variable on change in Weight, BMI, MUAC after intervention.

Demographic characteristics	**Weight**			**BMI**			**MUAC**		
	Mean	*SD*	*p value*	*Mean*	*SD*	*P value*	*Mean*	*SD*	*p value*
Age									
Less than 50	-0.29	7.66	0.44 ^{NS}	-0.28	2.71	0.85 ^{NS}	-1.93	3.77	0.49 ^{NS}
Above 50	-1.38	9.59		-0.38	3.37		-1.43	5.07	
Sex									
Male	-0.74	7.68	0.85 ^{NS}	-0.11	3	0.13 ^{NS}	-1.61	4.74	0.71 ^{NS}
Female	-1.05	11.1		-0.96	3.1		-1.91	3.49	
Diagnosis									
HTN, ESRD	0.39	7.83	0.16 ^{NS}	0.12	2.67	0.07 ^{NS}	-1.36	3.75	0.56 ^{NS}
acute on CRF	-3.22	10.7		-1.4	2.98		-2.42	3.84	
Diabetic kidney disease	-0.98	8.16		-0.27	3.38		z	5.45	
Dietary habits									

Vegeterian or Eggetarian	-0.26	8.63	0.65 NS	-0.26	3.12	0.88 NS	-1.25	3.77	0.49 NS
Non Vegetarian	-1.01	8.68		-0.35	3.02		-1.83	4.64	
Durations in months									
1 to 2	-1.96	10.3	0.26 NS	-1.17	3.55	0.08 NS	-2.71	6	0.33 NS
2 to 4	-0.86	8.29		-0.14	3.03		-1.65	3.68	
4 to 6	3.54	7.43		1.25	2.44		-0.62	4.3	
6 and above	-1.4	7.51		-0.55	2.21		-0.89	4.04	
No. of dialysis									
Twice	-0.63	7.28	0.93 NS	-0.17	2.87	0.55 NS	-1.69	4.59	0.89 NS
Thrice	-1.15	8.72		-0.43	3.06		-1.88	4.12	
Weekly	-1.28	14.3		-1	3.89		-1.26	4.42	

BIO-CHEMICAL ASSESSMENT

Mean hemoglobin in baseline was 7.94±2.15 g/dl, slightly it was increased in follow-up. There was no difference found in blood urea nitrogen (BUN). Follow-up mean creatinine was lower than baseline (9.05±126 mg/dl vs. 11.66±2.76 mg/dl). No significant changes observed in baseline and follow-up serum sodium and potassium. Baseline and follow-up mean serum albumin and total protein were almost same (Table 13).

Table 13. Mean bio-chemical variables in base line and follow-up.

Variables	**N**	**Baseline**				**Follow up**			
		Mean	*SD*	*Min*	*Max*	*Mean*	*SD*	*Min*	*Max*
Hemoglobin	150.00	7.94	2.15	4.00	12.90	8.79	1.65	5.60	13.00
BUN	150.00	129.00	33.37	67.00	207.00	109.33	28.34	56.00	171.00
Creatinine	150.00	11.66	2.76	7.50	18.40	9.05	1.26	7.00	11.90
Serum Na	150.00	134.75	6.11	118.00	153.00	134.69	6.25	120.00	145.00
Serum K	150.00	4.78	0.85	2.70	6.80	4.89	0.83	3.00	6.80
Serum. Alb	150.00	3.38	0.51	1.80	4.30	3.16	0.60	1.90	4.90
Serum TP	150.00	6.74	0.73	4.10	8.20	6.39	0.76	4.50	8.20
Fasting	54.00	123.85	35.75	56.00	200.00	115.57	26.52	56.00	190.00
PP	54.00	210.22	51.35	123.00	315.00	199.85	46.99	113.00	340.00

Majority of patients had below normal range of hemoglobin. The Table 14 reveals significant association between baseline and follow- up patient's hemoglobin as per p value P=0.015*

Table 14. Association in baseline and follow-up hemoglobin (Hb) as per tools.

Bio chemical variable	**Grading**	**Before**		**After**		**p-value**
		F	*f* in %	*f*	*f* in %	
Hb						
< 10 gm/ dl	Group A	121	80.67	104	69.33	0.015*
10 - 12 gm/dl	Group B	26	17.33	43	28.67	
>12gm/dl	Group C	3	2.00	3	2.00	

 # Significant at P=0.05, ## Significant at P= 0.01, NS = non-significant.

Majority revealed normal serum sodium in baseline and follow-up compared to hyponatremia and hyponatremia. Significant association observed between baseline and follow up serum sodium as per P value. (P=0.029) (Table 15).

Significant association seen between baseline and follow up serum potassium as per P value. (P=0.016). (Table 16).

Table 15. Association in baseline and follow-up Serum sodium (Na) as per tools.

Bio chemical variable	Grading	Before		After		p-value
		F	*f in %*	*f*	*f in %*	*Chi-sq*
Serum sodium (Na)						
< 120mmol/l	Sever hypernatremia	2	1.33	0	0.00	0.029*
120 - 133mmol/l	Moderate Hypernatremia	43	28.67	59	39.33	
133 - 146mmol/l	Normal	101	67.33	91	60.67	
>146mmol/l	Hypernatremia	4	2.67	0	0.00	

 # Significant at P=0.05, ## Significant at P= 0.01, NS = non-significant.

Table 16. Association in baseline and follow-up Serum potassium (K) as per tools.

Bio Chemical variable	Grading	Before		After		p-value
		F	*f in %*	*f*	*f in %*	*Chi-sq*
Serum potassium (K)						
<3.8mmol/l	Hypokalemia	20	13.33	8	5.33	0.016*
3.8 - 5mmol/l	Normal	82	54.67	76	50.67	
>5mmol/l	Hyperkalemia	48	32.00	66	44.00	

 # Significant at P=0.05, ## Significant at P= 0.01, NS = non-significant. Near about fifty percent patients in both group had normal serum potassium. Majority revealed hyperkalemia in baseline and follow-up (32% vs. 44.00%) compared to hypokalemia (13.33Vs 5.33%)

Higher percentage of baseline patients were normal total protein compared to follow-up patients (84.00% vs. 74.67%), rest of the patients in both group were hypoproteinemia. (16% vs. 25.33%) (Table 17).

Table 17. Association in baseline and follow-up Serum albumin as per tools.

S.N.	Bio Chemical variable	Grading	Before		After		p-value
			F	*f in %*	*f*		
1	*Serum albumin*						
	<3.5gm/dl	Hypoalbuminemia	81	54.00	104	69.33	0.006**
	3.5- 5.5gm/dl	Normal albumin	69	46.00	46	30.67	
2	*Total protein*						
	<6gm/dl	Hypoproteinemia	24	16.00	38	25.33	0.046*
	6 - 8.4gm/dl	Normal protein	126	84.00	112	74.67	

 # Significant at P=0.05, ## Significant at P= 0.01, NS = non-significant Majority of the patients in both baseline and follow-up were grouped under hypoalbuminemia followed by normal serum albumin.

Majority of patients had controlled blood sugar because they were on Insulin dependent. There was no significant association seen between baseline and follow- up fasting blood sugar and post prandial blood sugar.

The Table 18 reveals that the significant association observed in all biochemical variables of baseline and follow-up patients exept fasting and post prandial blood sugar.

Table 18. Association between baseline and follow-up fasting and post prandial blood sugar as per tools.

S.N.	Bio chemical variable	Grading	Before		After		p-value
			F	*f in %*	*f*	*f in %*	*Chi-sq*
1	*Blood sugar- fasting*						
	<90mg/dl	Hypoglycemia	8	5.33	6	4.00	0.220
	90 - 130mg/dl	Controlled sugar	24	16.00	35	23.33	
	>130mg/dl	Hyperglycemia	22	14.67	15	10.00	

2	*Blood sugar- PP*						
	<130mg/dl	Hypoglycemia	3	2.00	3	2.00	0.154^{NS}
	130-180 mg/dl	Controlled	13	8.67	15	10.00	
	> 180mg/dl	Hyperglycemia	38	25.33	36	24.00	

 # Significant at P=0.05, ## Significant at P= 0.01, NS = non-significant.

For the baseline data, the Pearson chi-square statistic is 3.561 (p-value = 0.169) and for the follow up data, the Pearson chi- square statistic is 0.086 (p-value = 0.958). Therefore, we can conclude that there is no association between no. of dialysis and serum albumin before and after counseling (Table 19).

Table 19. Effect of number of dialysis doses on baseline and follow-up serum albumin.

	No. of dialysis	**<3.5gm/dl**		**3.5gm/dl-5.5gm/dl**		**Chi square test**
		Hypoalbuminemia		*Normal*		
		F	*f in %*	*F*	*f in %*	
Baseline	Weekly	10	55.56	8	44.44	Chi-Square = 3.561, DF = 2, P-Value = 0.169^{NS}
	Twice	48	48.98	50	51.02	
	Thrice	23	67.65	11	32.35	
Follow-up	Weekly	12	66.67	6	33.33	Chi-Square = 0.086, DF = 2, P-Value = 0.958 ^{NS}
	Twice	68	69.39	30	30.61	
	Thrice	24	70.59	10	29.41	

NS: Not significant

DIETARY ASSESSMENT

Table 20 shows the comparison between baseline and follow-up mean nutrients intake of the patients. Baseline calorie, protein, fat and carbohydrate intake were 1272 ± 294.7 kcal/day,41.37±12.03gm/day, 30.5±12.42gm/day, 200.13±43.88 gm/day respectively.

After dietary counseling nutrients intake of patients were increased, mean calories protein, fat and carbohydrate intake were 1654±239.6 Kcal/day, 62.55±10 gm/day, 46.37±8.24 gm/day and 243.29±42.22 gm/day respectively.

Highly significant differences observed in both group.

Table 20. Differences in Baseline and Follow-up nutrient intake.

Nutrients	**Baseline Mean ± SD**	**Follow up Mean ± SD**	**H1**	**T value**	**P value**	**Conclusion**
Calorie	1272±294.7	1654.2±239.6	$\mu1<\mu2$	-13.77	0.00**	Highly significant
Protein	41.37±12.03	62.55±10.44	$\mu1<\mu2$	-16.70	0.00**	Highly significant
Fat	30.5±12.42	46.37±8.24	$\mu1<\mu2$	-13.36	0.00**	Highly significant
CHO	200.13±43.88	243.29±42.22	$\mu1<\mu2$	-9.15	0.00**	Highly significant

μ1: Baseline. μ2: Follow-up

The 3 days dietary record shows that most of the patients fail to attain the recommended energy In follow-up case the dietary intake were increased in comparison of baseline but not as per requirement because loss of appetite.

The highly significant difference seen in baseline and follow-up mean calories, protein, fats and carbohydrates (Table 21).

Table 21. Differences between required and follow-up nutrient intake.

Nutrients	Baseline mean ± SD	Follow up mean ± SD	H1	T value	P value	Conclusion
Calorie	1974.2±201.7	1654.2±239.6	μ1 > μ2	13.74	0.00**	Highly significant
Protein	78.03±9.74	62.55±10.442	μ1 > μ2	14.96	0.00**	Highly significant
Fat	58.71±10.94	46.37±8.24	μ1 > μ2	11.46	0.00**	Highly significant
CHO	286.43±33.01	243.29±42.22	μ1 > μ2	10.67	0.00**	Highly significant

μ1: Required. μ2: Follow-up

There was no effects of demographical variables were found on patient's nutrient intake. Only gender wise correlation seen in calorie and carbohydrate intake of the patients. It was also indicated that patients who were vegetarian but taking egg, their protein and fat intakes were high (Table 22).

Table 22. Effect of demographic variables on increase / change in calories, protein, fat, carbohydrates.

Demographic characteristics	Cal			Pro			Fat			Cho		
	Mean	*SD*	*p value*	*Mean*	*SD*	*p value*	*Mean*	*SD*	*p value*	*Mean*	*SD*	*p value*
Age												
Less than 50	421.6	350.9	0.146	22.75	15.4	0.206	17.61	16.72	0.132	50.62	60.94	0.105
Above 50	340.8	325.5		19.54	15.61		14.03	11.68		35.3	53.47	
Sex												
Male	427.4	320.8	0.006**	22.61	14.76	0.057	17.02	13.14	0.101	51.37	56.74	0.003**
Female	253.8	364.1		17.12	17.11		12.58	17.75		19.81	54.76	
Diagnosis												
HTN, ESRD	436	304.6	0.229	21.37	14.2	0.958	18.01	14.01	0.229	50.59	56.43	0.379
acute on CRF	335.2	377.5		20.44	17		12.83	17.84		37.81	59.76	
Diabetic kidney disease	342.6	356.2		21.37	16.5		14.94	12.98		37.05	58.25	
Dietary habits												
Vegeterian or Eggetarian	459.1	358.6	0.113	26.38	15.9	0.019*	20.14	13.38	0.039*	42.22	60.56	0.909
Non Vegetarian	357.1	331.5		19.49	15.1		14.47	14.7		43.47	57.07	
Durations in months												
1 to 2	358.7	319.2	0.768	17.99	13.67	0.236	17.11	16.08	0.463	34.57	48.37	0.489
2 to 4	382	368		21.91	15.51		16.56	13.68		43.47	65.08	
4 to 6	473.8	418.2		27.92	19.55		16.54	18.55		63.86	55.93	
6 and above	368.4	227.6		19.92	15.41		11.62	12.67		43.46	45.5	
No. of dialysis												
Twice	382.3	339.8	0.768	19.61	15.59	0.102	15.62	13.63	0.63	47.68	60.21	0.416
Thrice	407.2	313.8		26.16	13.33		17.69	13.4		35.84	51.88	
Weekly	334.8	399.9		20.4	17.88		13.78	20.86		32.42	54.5	

All p values are greater than 0.05, there is no correlation was observed between daily dietary increase and knowledge score before and after counseling (Table 23).

Table 23. Correlation between baseline and follow-up knowledge and daily nutrient intake.

	Inc Cal	Inc Pro	Inc Fat	Inc CHO
Baseline knowledge	r=0.098	r=0.02	r=0.122	r=0.091
	P=0.233^{NS}	P=0.807 ^{NS}	P=0.137 ^{NS}	P=0.27 ^{NS}
Follow up knowledge	r=0.077	r=-0.007	r=0.073	r=0.06
	P=0.346 ^{NS}	P=0.928 ^{NS}	P=0.373 ^{NS}	P=0.469 ^{NS}

NS: Not significant correlation

KNOWLEDGE ASSESSMENT

All over dietary and dialysis knowledge was poor in baseline patient and after education through multi and print media on nutrition and dialysis health; their knowledge was upgraded regarding diet in hemodialysis (Table 24).

Table 24. Distribution of baseline and follow-up patients as per their knowledge.

	Baseline		Follow-up	
	F	***f* in %**	***f***	***f* in %**
What is dialysis?				
Excretion of waste product from body.	88	58.67	110	73.33
dialysis is taste	35	23.33	21	14.00
extraction of blood	27	18.00	19	12.67
When maintenance dialysis required?				
when kidney failure	62	41.33	34	22.67
when GFR < 15 ml/min.	52	34.67	93	62.00
when Hb low	36	24.00	23	15.33
dietary principle for dialysis				
low protein salt, K, low fat high fat	48	32.00	3	2.00
high protein, low salt , low k adequate fat	59	39.33	130	86.67
High protein, high k, low salt.	43	28.67	17	11.33
source of high protein				
Roti, Rice , bread	48	32.00	15	10.00
Paneer , egg, dal milk	59	39.33	124	82.67
Veg , fruit, fruit juice	43	28.67	11	7.33
Source of high salt food items				
Achar, papad, namkin, chatni	89	59.33	133	88.67
veg, salad, fruit juice	37	24.67	12	8.00
roti , veg , dal , Rice	24	16.00	5	3.33
Water intake should				
low	70	46.67	26	17.33
High	32	21.33	0	0.00
as per urine out put	48	32.00	124	82.67
high source of potassium				
Green leafy veg, salad, dal fruit , fruit juice	66	44.00	111	74.00
Roti , Rice , dalia, salad	52	34.67	23	15.33
Paneer , egg , meat, fish	32	21.33	16	10.67
what about your weight				
Low	45	30.00	17	11.33
high	59	39.33	18	12.00
as per height	46	30.67	115	76.67
what is the meaning of maintenance dialysis				
Twice weekly	76	50.67	137	91.33
Monthly	44	29.33	6	4.00
Rarely	30	20.00	7	4.67
during dialysis for anemia correction use				
fruit, fruit juice , veg soup	70	46.67	30	20.00
only iron tablets and injections advised by Doctor	48	32.00	100	66.67
A + B	32	21.33	20	13.33

More than fifty percent (58.67 %) patients in baseline were aware about dialysis.

When dialysis required only (34.67%) patients in baseline were aware and after counseling 62% patients were aware about the requirement of dialysis.

Follow-up patients 86.67% had better nutritional knowledge regarding dietary principal in hemodialysis as compared with baseline patients 39.33% and same frequency seen for high source of protein after dietary education knowledge upgraded.

Around sixty percent (59.33%) had knowledge regarding rich source of salt.

Poor knowledge seen regarding 24 hour fluid requirement and after counseling still they had a lot of confusion regarding fluid.

More than forty (44.00%) in baseline and 74% in follow-up patients know potassium rich items.30.67% in baseline and 76.67% in follow-up patients were give the correct answer regarding weight.

Fifty percent of patients aware about the meaning of maintenance dialysis, in baseline number of patients were increased.

On the other hand more than forty percent in baseline patients knew that anemia will be corrected by taking iron rich diet as fruit and fruit juices and after dietary counseling it was improved and they know anemia will be corrected by table and injections only. (Table 25).

Table 25. Percentage of patient who given correct answer regarding diet and dialysis.

Knowledge	Baseline		Follow-up	
	f	*f* in %	*f*	*f* in %
What is dialysis?	88	58.67	110	73.33
When maintenance dialysis required?	52	34.67	93	62.00
Dietary principle for dialysis	59	39.33	130	86.67
Source of high protein	59	39.33	124	82.67
Source of high salt food items	89	59.33	133	88.67
Water intake should	48	32.00	124	82.67
High source of potassium	66	44.00	111	74.00
What about your weight	46	30.67	115	76.67
What is the meaning of maintenance dialysis?	76	50.67	137	91.33
During dialysis for anemia correction use	48	32.00	100	66.67

Highly significant differences seen between baseline knowledge and intervention knowledge. More than fifty percent of the baseline patients were aware about the diet and dialysis therapy and it was increased 79% after counseling (Table 26).

Table 26. Effect of multi and print media on patient's knowledge.

Knowledge score	Mean	SD	Min	Max	H1	T value	P value	Conclusion
Baseline	4.21	1.56	0.00	8.00	$\mu1<\mu2$	-27.75	0.00**	Highly significant
Follow-up	7.85	1.25	4.00	10.00				

After dietary counseling and education only calorie wise correlation observed between knowledge and nutrient intake. (Table 27).

Table 27. Correlation between follow-up nutrient intake and knowledge.

Follow up	Follow up knowledge
Calorie	r=0.196, p=0.016*
Protein	r=0.12, p=0.144^{NS}
Fat	r=0.156, p=0.057 ^{NS}
Carbohydrate	r=0.169, p=0.039*

*r: Coefficient of correlation, *: significant correlation, NS: Not significant correlation*

CONCLUSION

A large proportion of patients undergoing maintenance dialysis were unable to meet the recommended requirements for dietary energy and protein intake. Anthropometric parameters such as body mass index, skinfold thickness, percentage body fat, mid-upper arm circumference, and mid-arm muscle area proved to be valuable clinical indicators for evaluating protein-energy nutritional status in these patients.

Low serum albumin levels were found to be associated with inadequate intake of both dietary energy and protein, suggesting that improvement in serum albumin concentration requires a simultaneous increase in energy and protein consumption. A statistically significant relationship was observed between baseline and follow-up hemoglobin levels, while blood urea nitrogen (BUN) showed a highly significant change over the same period. Although no single parameter can independently assess nutritional status with complete accuracy, serum albumin remains one of the most practical and widely accepted markers of protein-energy status in patients on maintenance dialysis. In addition, a highly significant association was noted between baseline and follow-up values of serum albumin and total protein.

Malnutrition was strongly linked with increased morbidity and mortality, largely due to complications arising from protein-energy malnutrition. Therefore, early identification and regular monitoring of nutritional status are essential to improve patient outcomes.

Dietary assessment methods, including structured dietary interviews and food diaries, were found to be clinically effective tools for evaluating both protein and energy intake among maintenance dialysis patients and should be incorporated routinely into nutritional monitoring and intervention strategies.

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