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Research Article

Protein-Energy Malnutrition and Its Progression in Dialysis Patients in West Delhi Centre: A Prospective Study

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Abstract:

Background: There is a high prevalence of protein-energy malnutrition in patients with chronic renal failure who are undergoing maintenance hemodialysis. Apart from this the pathogenic mechanisms of malnutrition are complex and involve an interplay of multiple pathophysiologic alterations including decreased appetite, decreased nutrient intake and dialysis related abnormalities.

Methods: The study subjects were patients of CKD 5 (MHD) of age 18 to 60 years enrolled from Anjuman Medical centre in West Delhi. Total 30 subjects (15 males and 15 females) were enrolled from Dialysis centre and their basic demographic profile socio economic status, dietary habits and physical activity details were recorded. Dietary nutrient (calories, protein, fats, carbohydrates, sodium, potassium, phosphorus and fluid) was calculated by Diet Cal version 10.0 software using a 3-day dietary recall and analysed was done using SPSS software version 21.0. Nutritional status were measured at baseline , 2 months and 3 months. Knowledge, Attitude, practice and Quality of life also recorded at 1 month and at 3 months after nutritional counselling.

Results: The average BMI, weight, and height of males were (24.2 kg/m2, 67.6 kg, and 166 cm) and females were (22.2 kg/m2, 54.8 kg, and 158 cm) respectively. Blood pressure was 129±13 systolic and 79±10 mmHg diastolic. 23.3% had pallor, and 60% of patients were moderate and 33.3% were severely malnutrition. Handgrip was 21.7±6.9 kg. Protein intake changed from 52±15.9 to 73.2±11.4 in males and 47.8±50.4 to 57.0±13.7g in females after three months of the study. And energy improved from 1477±333 to 2253±494 in males and 1201±255 to 2106±346 kcal in females. Similarly, fat and phosphorus intake improved from 49.2±37.9 to 56.5±17.9 ($p>0.080$) and 728.9±287.7 to 1160.0±290.1 ($p>0.000$) respectively. While KAP was (8.5±2.0, 75.3±10.6 and 25.8±2.3) respectively and QoL also improved from 27.0±4.0 to 30.9±2.7 after 3 months of the study.

Conclusion: After 3 months of study, QoL and KAP significantly improved. Further, there were significant changes in intake of energy, protein and phosphorus in all dialysis patients. In nutritional status weight, MUAC and handgrip showed significant increase result. Blood pressure, pallor and MIS score also improved.

Keywords: Protein-Energy Malnutrition (PEM), Knowledge Attitude Practice (KAP), Quality of life (QoL)

Introduction

Protein-energy malnutrition (PEM) is a state of disordered catabolism resulting from metabolic and nutritional derangements in chronic disease states. PEM is the state of decreased body pools of protein with or without fat depletion [1] in the patients on hemodialysis (HD) patients. The National Kidney Foundation –Kidney/Dialysis Outcome Quality Initiative clinical practice guidelines for nutrition in CKD 2020 (NKF K/DOQI, 2020) has recommended for HD patients a dietary protein intake of 1.2-1.3g/kg of body weight/day, of which at least 50% should be of high biologic value, and a dietary energy intake of 35 kcal/kg/day. Protein-energy malnutrition (PEM) manifested by inadequate dietary protein intake or low serum albumin, is a common condition and a predicator of mortality in patients on dialysis. The protein requirement is higher because of the removal of amino acid by the dialysis treatment which is exposure to bio-incompatible dialysis materials [2].

Low-protein diet implementation can slow down the progression of CKD and the prolonged period of potentially lifesaving dialysis treatment for patients reaching ESRD [3].

Malnutrition is exacerbated by HD treatment in terms of dialysis-induced nutrient losses, multiple dialyzer reuse, dialysis-induced inflammation, effectiveness of uremia, and dialysis adequacy, frequency, and duration. PEM adversely affects the muscle mass, nutritional status, and physical function of dialysis patients leading to frailty and subsequently reduces quality of life (QOL), increases risk of cardiovascular disease, hospital admissions and mortality. Other potential manifestations of PEM include decreased body mass index (BMI), decreased body fat, decreased albumin, and lipids. Skeletal muscle mass loss is associated with end stage renal disease patients on dialysis. This adds to the importance and significance of the renal nutrition specialists at dialysis centres for early detection of malnutrition and implementation of strategies to prevent further deterioration. It is important to search actively for PEM, since early diagnosis and treatment can improve the prognosis of patients. Thereby, we proposed this study to compare and analyze the effects of personalized dietary intervention with re-enforcement and conventional dietary prescription on nutritional status, inflammatory markers, physical activity, quality of life and nutrients intake in

dialysis patients.

Methodology

Sample, Sample Size & Sampling Technique: Sample were dialysis patients, sample size was 30 subjects who signed the consent form and sampling technique was convenience sampling technique.

Inclusion criteria- a) Age more than 18 years on more than 3 months of dialysis, b) Those that were willing to sign the consent form

Exclusion criteria- a) Catheters as vascular access in HD, b) HD less than three sessions of 4 hours each per week, c) Hemodynamic instability, d) Hemoglobin less than 7 g/dl, e) Patients living with HIV/AIDS, f) Intake of oral/intravenous formula-based nutritional supplements, g) Who gone through kidney transplant

Statistical Analysis

The data entry was done in SPSS software. The association of the variables which were qualitative in categorical variables {gender, dialysis modality, basic disease, pallor, MIS, MUAC and HGS) were analyzed using Chi-Square test. Continuous variables {age, weight, BMI, dialysis vintage; laboratory investigations; KAP, QOL mean scores and nutrient analysis) were analyzed using paired/unpaired t-test. Demographic variables, laboratory parameters and outcome parameters were calculated/measured at baseline, 3-months, and 6-months follow-up. The detailed analysis of outcome parameters is as discussed above in methodology. The intergroup difference was measured by chi square test, paired and unpaired t-test as aforementioned. To compare at subsequent time intervals repeated measure ANOVA was used. For statistical significance, p value of less than 0.05 was considered statistically significant.

Results

Demographic parameters of the study population 15(50%) of the participants were male, 23(76.6%) were married and 19(63.3%) were literate. Their average age was 39.7 ±10.5, falling between 18 and 60 years old. 1(3.3%) were those who smokes and 3(10%) were alcoholic. 28(93.3%) were non vegetarian. All were having sedentary lifestyle as their physical activity is none, only 4(13.3%) subjects found out doing physical activity for about <100min/week. 19(63.3%) taking dialysis twice in a week rest thrice. 7(23.3%) were diabetic, 22(73.3%) were hypertensive, 6(20%) were having coronary heart disease and 4(13.3%) were having thyroidism.

The nutritional parameters were carefully observed and recorded at distinct time intervals spanning over 1 month, 2 months, and 3 months during the study. Notably, the systolic blood pressure levels were markedly hypertensive at the commencement of the study, but showed considerable improvement by the end of the 3-month period, transitioning to a normalized state. Similarly, the presence of pallor was noted as moderate at the baseline assessment, however, there was a noticeable positive shift towards an alleviated condition of mild pallor at the conclusion of the 3-month observation period. This detailed analysis of the various health markers demonstrates the progression and changes that occurred throughout the duration of the study. The improvements seen in both systolic blood pressure and pallor levels suggest a significant impact resulting from the study interventions.

The data provided in Table 1 illustrates increase in Weight from 67.4± 15.7 to 68.6±15.8 in males and 54.8±6.4 to 57.0±7.3 in females. There is also increase in BMI and the prevalence of malnutrition, particularly focusing on the Mid-Upper Arm Circumference (MUAC) measurements. It is important to note that the MUAC values based on reference value by WHO. By comparing the MUAC measurements of the individuals in the study to these established reference values, it becomes possible to determine whether they fall within the normal range or if there are indications of malnutrition.

Table 1: Anthropometric measurement at different intervals

Parameter	1 Month Male(n=15) (Mean ± S.D)	1 Month Female(n=15) (Mean ± S.D)	3 Months Male(n=30) (Mean ± S.D)	3 Months Female(n=15) (Mean ± S.D)	Common p-value	*p-value b/w timeline
Weight (kg)	67.4±15.7	54.8±6.4	68.6±15.8	57.0±7.3	0.001	a-0.080 b-0.011
Height (cm)	166±8.4	158±7.2	166±8.4	158±7.2	0.000	a-0.000 b-0.000
BMI (kg/m2)	24.2±3.8	20.8±6.0	24.7±4.1	22.8±3.2	0.094	a-0.180 b-0.088
MUAC (cm)	28.7±4.3	29.0±2.8	29.0±4.1	29.7±2.8	0.053	a-0.006 b-0.007

* All the data is expressed as mean standard deviation. A statistical test used is repeated measure ANOVA. **p value of a=male with timeline, b= female with timeline.

The distribution of malnutrition status present within the sample population revealing that out of the total of 30 subjects assessed, a notable 10 patients were identified as severely malnourished. Furthermore, the findings also highlighted that a significant proportion, comprising 18 individuals, fell under the category of moderately malnourished. This breakdown of malnutrition status among the participants serves as a critical indicator of the health challenges faced by the studied population, emphasizing the importance of addressing nutritional inadequacies to improve overall well-being and

health outcomes. At 1 month, MIS shows prevalence of moderate malnutrition and at 3 months it improves to mild malnutrition of the study population.

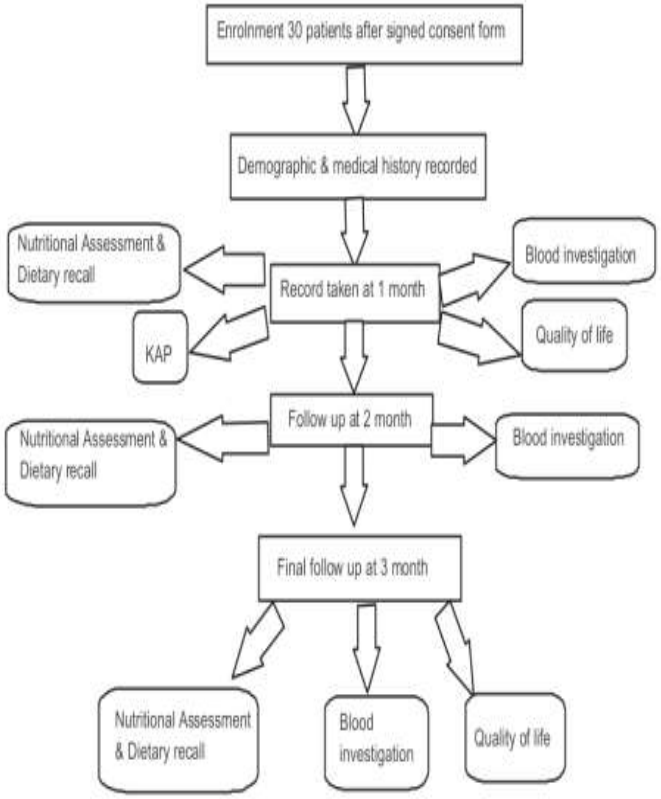

Figure 1: Flow chart of study design

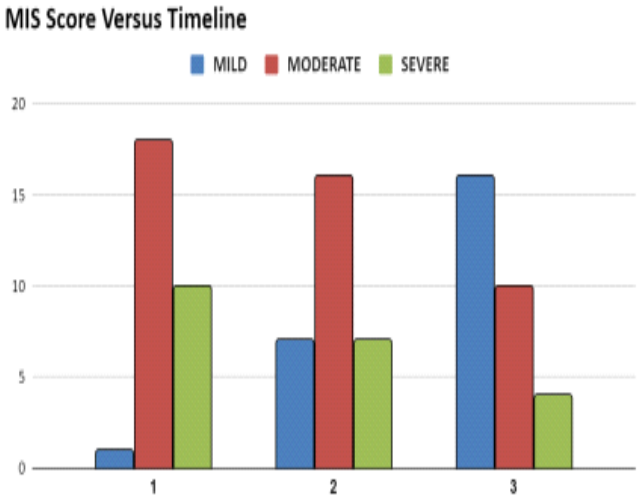

Figure 2: Malnutrition inflammation score of dialysis patients at different months

In the Fig. 2 bar graph, the x-axis shows the timeline(1 months, 2 months and 3 months). The MIS decline with the time, while decrease in MIS depicts the improvement in the score of MIS. During the first month of the study malnutrition score was moderate which means the patients were moderately malnourished as the average MIS comes out to be 8.5. After proper knowledge of diet, they modified their diet and hence in third month their malnutrition score was improved as its average MIS comes to be less than 6 which is mildly malnourished.

Table 2: Handgrip at different intervals

Parameter	**1 MONTH (n=30) (Mean ± S.D)**	**2 MONTHS (n=30) (Mean ± S.D)**	**3 MONTHS (n=30) (Mean ± S.D)**	**Common p-value**	****p-value b/w timeline**
Male (kg)	24.2±7.1	23.5±7.1	25.2±7.0	0.000	a-1.000 b-0.000 c-0.001
Female (kg)	15.5±3.7	16.0±4.9	17.9±4.7	0.000	a-1.000 b-0.001 c-0.000

* All the data is expressed as mean standard deviation. A statistical test used is repeated measure ANOVA. **p value of a=baseline with 2 months, b= baseline with 3 months, c= 2 months with 3 months.

Table 2 clearly illustrates the physical function measured by handgrip strength (HGS), with the findings indicating that over 90% of the subject exhibited signs of malnutrition based on this specific parameter. This significant percentage highlights a concerning prevalence of malnourishment within the subject group, underscoring the importance of addressing nutritional considerations in their care. By spotlighting the impact of inadequate nutrition on physical function, the study sheds light on the intricate relationship between diet and health outcomes.

TABLE 3: Biochemistry investigation compared with 1 month, 2 months and 3 months

Parameter	**1 month (n=30) (Mean ± S.D)**	**2 MONTHS (n=30) (Mean ± S.D)**	**3 MONTHS (n=30) (Mean ± S.D)**	**Common p-value**	****p-value b/w timeline**
Hemoglobin (g/dl)	10.1±1.5	10.9±1.5	11.2±1.5	0.002	a-0.070 b-0.001 c-0.914
Urea (mg/dl)	110.9±36.1	119.6±28.1	113.4±24.9	0.325	a-0.619 b-1.000

					c-0.526
Creatinine (mg/dl)	9.5±2.3	9.0±2.1	8.5±2.4	0.080	a-0.816 b-0.136 c-0.689
Serum sodium (meq/l)	129.3±24.6	135.6±4.6	136.0±3.4	0.066	a-0.531 b-0.439 c-1.000
Serum potassium (meq/l)	5.9±5.3	4.9±0.6	5.2±5.4	0.012	a-1.000 b-1.000 c-1.000
Serum calcium (meq/l)	8.1±1.6	8.5±1.0	8.6±1.7	0.035	a-0.689 b-1.000 c-0.722
Serum phosphorus (meq/l)	5.1±1.4	5.0±2.0	5.2±1.9	0.007	a-1.000 b-1.000 c-1.000
Albumin (g/dl)	3.64±0.4	4.2±0.4	4.4±0.3	0.005	a-0.028 b-0.000 c-0.001

* All the data is expressed as mean standard deviation. Statistical tests used repeated measure in SPSS. **p value of a=baseline with 2 months, b= baseline with 3 months, c= 2 months with 3 months.

The data presented in Table 3 displays the various laboratory parameters observed at different time points. The presence of mild anemia, indicated by a mean hemoglobin level of 10.1±1.5 g/dl. Interestingly, the subsequent follow-up assessments showed a noteworthy rise in serum albumin and serum calcium levels. Conversely, a significant reduction in serum potassium levels was also noted, which was found to be statistically significant with a p-value of 0.012.

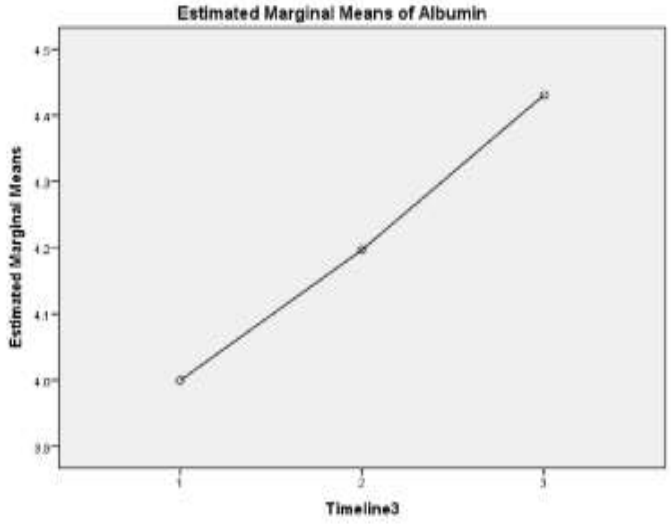

Figure 3: Albumin of dialysis patients as nutritional status

Figure 3 linear graph depicts the serum albumin increased proportionally with the time. At baseline we can see that the albumin is less than 4g/dl. As albumin is the predicator of protein intake which shows the malnutrition of subject. At 3 months, the serum albumin increased to 4.4g/dl which is normal. This shows that the protein intake is adequate not malnourished.

Food and Nutrient Intake of Patients

Protein allowance for Dialysis patients should be more than 1.1g/kg according to Giorgina et al. Journal of Nephrology (2021). Here assumed weight is taken as 60kg and hence protein and other variables is counted accordingly. Energy should be 30-40 kcal/kg , fat should be 25-30% and carbohydrates be 55-60% of energy. Potassium should be between 1950-2730(meq/d), sodium 2000-2300(meq/d) and phosphorus 800-1000(mg/d).

Table 4: Dietary intake of males and females at 1 month and at 3 months

	1 Month		**3 Month**		
Parameter	**Male (n=15) (Mean ± S.D)**	**Female (n=15) (Mean ± S.D)**	**Male (n=15) (Mean ± S.D)**	**Female (n=15) (Mean ± S.D)**	****p-value**
Protein (g/kg)	52.3±15.9	47.8±50.4	73.2±11.4	57.0±13.7	a-0.025 b-0.146
Fats (g/kg)	45.9±14.6	53.0±52.4	63.3±16.3	48.7±16.5	a-0.436 b-0.882

Carbohydrates (g/kg)	176.7±33.2	150.7±58.4	206.9±41.3	178.8±41.8	a-0.077 b-0.005
Energy (kcal/kg)	1477±333	1201±255	2253±494	2106±346	a-0.049 b-0.027
Potassium (meq/d)	1636.4±621.0	2987.0±5345.6	3132.0±510.1	1988.4±583.7	a-0.638 b-0.456
Sodium (meq/d)	3099.1±851.8	2554.2±540.7	2614±859.5	2566.0±683.5	a-0.816 b-0.554
Phosphorus (mg/d)	1274.7±207.8	1023.4±293.1	855.5±289.8	652.0±209.4	a-0.001 b-0.000

* All the data is expressed as mean standard deviation. A statistical test used is repeated measure ANOVA. **p value of a-male with timeline and b-female with timeline

The Table 4, illustrates the dietary intake patterns among male and female hemodialysis patients both at the baseline and after a period of 3 months. Throughout the study, it was observed that the participants were consistently consuming lower amounts of protein and total calories compared to the recommended guidelines stipulated by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (NKF K/DOQI, 2020). This discrepancy in intake was particularly noticeable within the span of just one month. However, the intake of potassium and sodium was within the acceptable range, indicating that patients were managing these aspects of their diet well. On the other hand, there was a slight concern regarding the elevated levels of phosphorus consumption among the individuals. Notably, significant changes were detected in the nutritional analysis, specifically pertaining to the intake of protein, energy, and phosphorus, over the transition from the initial one-month period to the subsequent three-month time frame, as evidenced by statistical significance with a p-value of less than 0.05.

Assess nutrition Knowledge, Attitude and Practice

TABLE 5: Mean±Std. Deviation of knowledge score for Male/Female

Mean±Std. Deviation Male (n=15)	Mean±Std. Deviation Female (n=15)	(n=30) p-value
7.7±3.0	9.4±1.6	0.000

* The data is expressed as mean standard deviation.

TABLE 6: Level of knowledge in patients

S.No.	Level of Knowledge	Number of subjects (%) (n=30)
1.	Poor level of knowledge (0-4)	2 (6.6%)
2.	Average level of knowledge (5-8)	9 (30%)
3.	Good level of knowledge (9-12)	17 (56.6%)

*Non- parametric data is presented as percentage; Statistical tests used- student's t-test.

As illustrated in the Table 5, females have better knowledge than males.

As illustrated in the Table 6 provided above, the majority of patients, total 17 individuals, achieved a good level of knowledge by scoring in the range of 9-12 marks. This breakdown highlights the varying levels of understanding and awareness among the patients involved in the study, with a noticeable majority falling into the category of good knowledge.

TABLE 7: Level of attitude in patients

S.No.	Level of attitude	Number of subjects(n=30)
1.	Poor level of attitude (1-35)	0
2.	Average level of attitude (36-65)	6
3.	Good level of attitude (66-100)	24

*Non- parametric data is presented as percentage; Statistical tests used- student's t-test.

According to the data presented in Table 7. The majority of the patients, comprising 24 individuals, demonstrated a commendable level of knowledge with scores falling within the range of 66 to 100.

TABLE 8: Practice questions and percentage of responses

Practice questions (n=30)	Most of the time (%)	Some of the time(%)	None of the time(%)
Do you follow CKD Diet?	93.3	6.7	0
Do you dine out or order packaged food?	0	56.6	43.3
How often do you leach your vegetables before cooking?	80	0	20
How often do you leach your pulses before cooking?	80	0	20
Do you follow the water intake advised to you?	33.3	66.6	0
Are you on a salt restricted diet?	36.6	56.6	6.7
How often do you consume Daal/meat/Paneer?	46.6	53.3	0

How often do you consume Fruits?	46.6	50	3.3
Have you undergone routine blood tests to check your kidney function every month?	100	0	0
Do you always take the medications prescribed by the doctor for your disease?	100	0	0

*Non- parametric data is presented as percentage; Statistical tests used- student's t-test.

As depicted in Table 8 above, it is evident that a significant portion of the patient population, approximately (93.3%) follow CKD diet and all the patients undergoes routine blood investigation and have their medications regularly. It was found that (66.6%) patients does not follow the intake of water. It was found that (43.3%) patients dine out or order packed food. These findings underscore the necessity for enhanced patient education and guidance regarding the vital aspects of maintaining a healthy lifestyle and dietary choices in the management of chronic kidney disease.

TABLE 9: Quality of life at 1 month and 3 months.

PARAMETER (n=30)	1 MONTH (Mean ± S.D)	3 MONTHS (Mean ± S.D)	Common *p-value
Quality of Life	27.0±4.0	30.9±2.7	0.000

* The data is expressed as mean standard deviation. Statistical tests used repeated measure in SPSS.

The data presented in Table 9 depicts a comparison of the Quality of Life (QoL) between the 1-month and 3-month time points. Notably, the analysis revealed a notable increase in QoL measurements. This increase was found to be statistically significant, as indicated by a p-value of 0.000 following the 3-month assessment. The findings suggest that there may be substantial positive effects on individuals' quality of life when considering a longer-term perspective.

Discussion

This pragmatic study is about protein-energy malnutrition and its progression in dialysis patients. This highlights the need of systematically planned dietary studies with long term follow ups. Baseline demographic parameters showed that our study population comprised of young adults. The age group in our study differs significantly from other studies done for nutritional status evaluation [4] studied the nutritional parameters during a 5-year follow up in HD patients, mean age of all the patients was more than 60 years, with male comprising of 62.3% of the total. In a study of evaluation of nutritional status in hemodialysis patients [5] mean age of the patients was more than 50 years with males and females 75% and 25% respectively. Similarly, in the observational study [6] studied the impact of malnutrition on outcome in hemodialysis patients, mean age of subjects was more than 60 years with 68.8% of males. The difference in mean age might be because of our strict inclusion criteria in which subjects with multiple co-morbidities were excluded. Secondly, there might be lack of caretakers to help elderly patients to give consent for study participation and further follow ups. Our study population comprised of equal male and female patients which is in coherence to various studies in dialysis population. Planning and practically executing a dietary study itself comes with its difficulties and barriers. Initially, patients seem interested to be the part of these studies; but multiple factors were seen in our study like lack of caretakers, lack of interest and motivation to pursue diet/follow ups because immediate results are lacking and lack of technology. 30 interested eligible patients completed their 3 months follow up after signing consent. In which 15 patients were males and rest were females. The results of our study shows improving in nutritional status, dietary intake, KAP, physical function including quality of life in dialysis patients.

Serum albumin was well known indicator of nutritional state. In a study [7] serum albumin didn't correlate as marker of nutritional status in dialysis patients without underlying inflammation. [8] in their cross sectional study concluded that serum albumin correlated poorly with several other markers of nutritional status; reason being apart from nutritional state, inflammation and fluid overload affect serum albumin level. [9] also proposes to consider albumin as marker of illness rather than nutrition in dialysis patients. Studies in CKD including dialysis population have consistently shown the strong mortality-predictability of several markers such as low BMI, hypoalbuminemia, low serum cholesterol levels, and reduced dietary protein intake [10] HD is a high catabolic process that promotes a significant loss of essential nutrients, such as amino acids, vitamins, protein and glucose [8].The nutritional status may deteriorate over time if these nutrients are not sufficiently replenished. In our patients, baseline mean serum albumin was low-normal; this is similar to values seen in prevalent dialysis patients [8,9,11]. It is similar to the levels of serum albumin in other dietary studies [12,13,14] has also shown significantly lower albumin in CAPD patients as compared to MHD patients. Mean value of albumin at 3 months in our study is higher than compared to baseline. Among various nutritional parameters, low serum albumin has been shown to be a strong predictor of mortality in dialysis patients.

Mean BMI in our population is found out to be normal like in other studies [12,13,15,16]. Normal-high BMI has association with increased survival in dialysis patients and low BMI is associated with increased risk of mortality. The higher dry weight, BMI and mean hemoglobin at first follow up in intervention group can't be solely attributed to diet at this stage; it is likely the augmented result of rigorous individualized follow up. Effect of dietary re-enforcement was seen on multiple biochemical parameters. Dry weight and BMI were significantly higher at 3 months in the intervention group. Our results differ from the study [12] in which there was no significant difference in BMI at the end of 7 months. This might be because this study evaluated the effects of individualized dietary counseling without any intervention to address the dietary deficits, as was done in our study.

Physical function assessment was done by hand grip strength. Handgrip strength is one of the major factors for diagnosis of sarcopenia and frailty. Physical function assessment by hand grip strength in our study showed that most of the patients

(90.32%) had hand grip values less than cutoff for their age and gender. Prevalence of malnutrition solely on the basis of this parameter has not been addressed in the available studies. In an Iranian study of 83 HD patients, handgrip strength was significantly associated with nutritional assessment markers on the basis of MIS [17]. In various other studies [18], correlation of hand grip strength and MIS/SGA score have been seen which shows a strong negative correlation.

Conclusion

The study concluded a concerning prevalence of severe malnutrition in dialysis patients, affecting over 40% of the individuals based on the Malnutrition Inflammation Score (MIS). Initial assessments indicated that the average daily intake of calories (23.5 kcal/kg/day) and protein (0.84 g/kg/day) fell below the recommended levels for this patient population undergoing dialysis treatment. Follow-up evaluations revealed significant enhancements in various aspects of the patients' well-being. Quality of life scores exhibited a notable increase, indicating an overall improvement in the patients. Moreover, assessments of physical strength demonstrated a positive trend, suggesting advancements in muscle mass and functionality among the dialysis patients. Furthermore, the study noted a substantial enhancement in the patients' knowledge of kidney disease, which is crucial for their active participation in managing their health condition. Additionally, key anthropometric indicators such as weight, Mid-Upper Arm Circumference (MUAC), MIS, and pallor showed significant improvements, reflecting positive changes in the patients' nutritional status and overall health. Of particular significance was the nutrient analysis conducted at the three-month mark, which revealed a significant increase in the average daily intake of essential nutrients such as calories, protein, sodium, potassium, and phosphorus. Therefore, it is essential to conduct routine dietary assessments for all patients undergoing dialysis before implementing any dietary restrictions, particularly related to protein. While increasing protein intake can have numerous benefits, such as supporting muscle health, it may also result in elevated phosphorus levels. Fortunately, this potential issue can be effectively managed by adjusting the dosage of phosphate binders. Moreover, patients often need guidance on managing their potassium intake, as restrictions in this area can help support their overall well-being and health status. Additionally, regulating fluid and sodium intake is crucial for dialysis patients, as it can aid in controlling blood pressure levels. By monitoring and adjusting these aspects of their diet, healthcare providers can further support the holistic care of individuals undergoing dialysis. These findings emphasize the critical role of personalized nutritional strategies in dialysis care. By optimizing nutrient intake and addressing malnutrition effectively, healthcare providers can not only enhance the physical health outcomes of dialysis patients but also contribute to improvements in their quality of life, physical strength, and overall well-being. Dialysis patients commonly experience a range of health issues, including malnutrition, inflammation, and a decreased quality of life. This targeted approach not only helps combat malnutrition and inflammation but also contributes to better physical function, knowledge, attitudes, and overall quality of life for dialysis patients.

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