ASSESSMENT OF NUTRITIONAL STATUS OF HEMODIALYSIS PATIENTS: INTERDIALYTIC WEIGHT GAIN (IDWG), DIETARY INTAKE AND BIOCHEMICAL MARKERS

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Abstract

This study aimed to assess the nutritional status of 60 hemodialysis patients in Mumbai, with a focus on interdialytic weight gain (IDWG), dietary intake, and biochemical markers. Data were collected using a structured questionnaire; a food recall for the days of the week (2 dialysis and 1 non-dialysis) food frequency questionnaire; and validated assessment tools: Modified Subjective Global Assessment (M-SGA) and Modified Malnutrition Inflammation Score (M-MIS). The majority of participants were from a low socioeconomic background, and 80% of them had hypertension as a comorbidity. An average IDWG% of 4.94 was noted, with participants exceeding the prescribed limits. There was a significant negative correlation between IDWG% and MUAC, between serum albumin and M-SGA, and between serum albumin and M-MIS. Intake was inadequate at 20 kcal/kg/day and 0.55 g/kg/day for energy and protein, respectively. Males had better nutrient intake and nutritional status than females. According to biochemical parameters, serum albumin levels were suboptimal in both genders, indicating a poor protein-energy status. Additionally, elevated levels of parameters such as blood urea nitrogen and creatinine suggested a poor renal clearance. These findings highlight the importance of dietary evaluation and management in hemodialysis, where combining dietary patterns, biochemical markers, and anthropometric measurements provides a comprehensive approach to patient management.

Keywords: *Hemodialysis, Interdialytic weight gain (IDWG), Nutritional status, Malnutrition*

1. Introduction

Chronic Kidney Disease (CKD) is defined as the progressive loss of kidney function. Kidney damage or an estimated glomerular filtration rate (eGFR) of less than 60 mL/min/1.73 m² that lasts for three months or longer, regardless of the etiology, is characteristic of chronic kidney disease (CKD). Chronic kidney disease impairs kidney function over time, necessitating treatments including dialysis or renal transplantation (Vaidya & Aeddula, 2024b). Hemodialysis aids in maintaining homeostasis in the body by artificially eliminating solutes, excess water, and uremic toxins (Murdeshwar & Anjum, 2023). In India, there are around 175,000 chronic dialysis patients, or 129 per million persons, according to a 2018 estimate (Bharti & Jha, 2020).

The nutritional status plays a crucial role in hemodialysis patients, being important in terms of dietary intake and fluid restrictions; however, there is a high variance in the dietary intake and nutritional status of individuals undergoing hemodialysis. Hemodialysis patients often are unable to meet the recommended requirements of energy and protein; however, nutrients such as sodium, potassium, and fluids are found to be in excess in their diets, which increases the potential of problems such as protein-energy wasting, electrolyte imbalances, and fluid retention (Harika et al., 2019). Interdialytic weight gain (IDWG) is used as a parameter for fluid and salt intake between the two sessions of HD. IDWG was measured as the pre-dialysis weight before HD treatment, minus the post-dialysis weight from the prior session (Jalalzadeh & Mousavinasab et al., 2021). Interdialytic weight gain (IDWG) should be lower than 4.0 to 4.5% of dry weight in hemodialysis patients (Bossola et al, 2022). Interdialytic Weight Gain (IDWG) refers to the increase in volume of fluid, as indicated by weight gain, which serves as an indicator of the amount of fluid entering during the interdialytic period and the patient's compliance with fluid management during hemodialysis therapy (Wahyuni et al., 2019).

Interdialytic weight gain (IDWG) shows a significant correlation with several nutritional parameters, including serum albumin, prealbumin, urea, creatinine, normalized protein catabolic rate (nPCR), and body mass index (BMI). Among these, serum albumin serves as a key marker for both nutritional status and inflammation and is recognized as an independent risk factor for mortality (López-Gómez et al., 2004). Although malnutrition and IDWG are serious concerns among HD patients, their correlation with dietary intake and biochemical markers is poorly understood.

This study has aimed to assess the nutritional status of hemodialysis patients and its association with Interdialytic Weight Gain (IDWG), Dietary Intake, and Biochemical markers.

2. Methodology

A cross-sectional study was conducted among 60 Hemodialysis participants over 18 years from a tertiary care hospital in Mumbai, Maharashtra. The participants were recruited using convenience sampling method. The inclusion criteria included participants who had received hemodialysis treatment for more than 3 months, underwent hemodialysis 2-3 times a week, and were residents of Mumbai. The subjects with Acute kidney injury, pregnant women, lactating mothers, and alcohol consuming subjects were excluded from the study. Inter System Biomedical Ethics Committee (ISBEC), an independent ethics committee, provided the approval for the study.

Data collection was done after the purpose of the study was clearly explained to all the study participants. Written informed consent was obtained. The questionnaire was administered to the participants for data collection. The questionnaire included sections of socio-demographic information, anthropometric measurements, biochemical parameters, Modified Subjective Global Assessment, Malnutrition Inflammation Score, 3-day dietary recall (2 dialysis days and 1 non-dialysis day), and a Food Frequency Questionnaire. Data analysis was performed using SPSS (Statistical Package for Social Sciences) software (version 20).

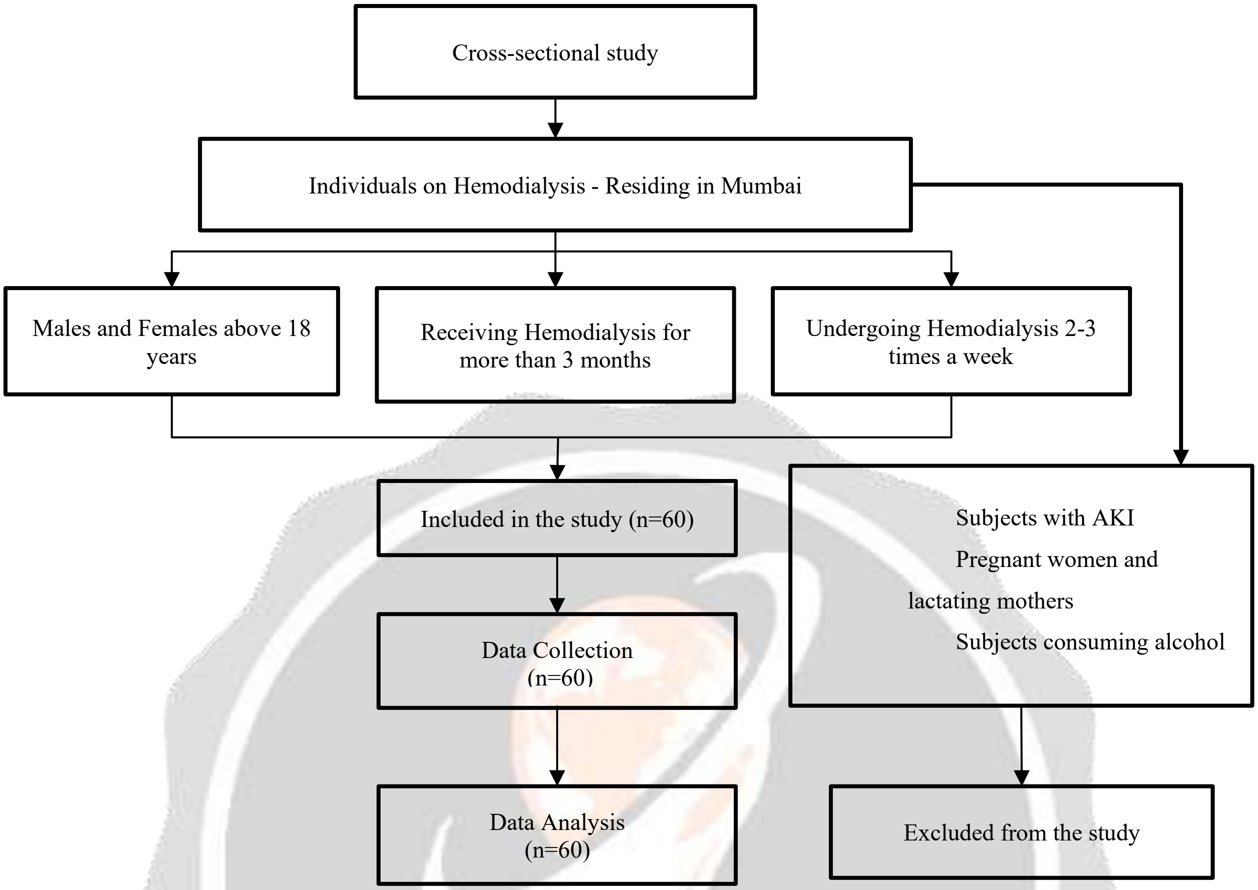

FIGURE 1: Flowchart Summary of the Study Methodology

3. Results & Discussion

3.1 Demographic Characteristics

In the study, the male participants were 66.7% and the female participants were 33.3%. All the enrolled participants were from the dialysis unit of a tertiary care hospital. The participants' mean age was 45±14.5 years. In the age groups of 18-40 years, the majority of the participants were unemployed (p=0.001). The monthly income of the majority of the participants was below Rs. 15000. A large portion of the participants had comorbidities such as hypertension and diabetes. Most participants underwent dialysis thrice a week (n = 47, 78.3%), while the rest (n = 13, 21.7%) underwent dialysis twice a week.

3.2 Anthropometric Measurements

Table 1: Mean Anthropometric Measurements of the study participants

Anthropometric Measurements	**Mean (SD)**
Height (cm)	161.41 ± 11.09
Pre Dialysis Weight (kg)	60.73 ± 11.94
Post Dialysis Weight (kg)	58.38 ± 11.70
Mid Upper Arm Circumference (cm)	28.13 ± 3.72

Inter Dialytic Weight Gain (kg)	2.80 ± 1.23
Inter Dialytic Weight Gain% (kg)	4.94 ± 2.20

***Data represented as Mean (SD)**

Anthropometric measures revealed that the average weight of the patients was 60.73 ± 11.94 kg prior to dialysis and 58.38 ± 11.70 kg following dialysis. A smaller percentage of the participants were overweight or obese (28.3%), and underweight (15%), but the majority (56.7%) had an underweight BMI. However, the average Inter Dialytic Weight Gain (IDWG) was 2.80 ± 1.23 kg, and the average IDWG% was 4.94 ± 2.20%. Excessive IDWG% was seen in males, showing an IDWG% of (n=25, 64.1%), in contrast to (n=14, 35.9%) in females, which was beyond the limit of 4.0–4.5%. This may be a cause of concern as IDWG ≥4% of DW is an independent all-cause mortality predictor in HD patients. Excessive IDWG coupled with malnutrition increases the risk of mortality in HD patients (Dantas et al., 2019). It could lead to adverse clinical outcomes, including cardiovascular-related complications and increased mortality risk.

The mid-upper arm Circumference (MUAC) is regarded as a great indicator of nutritional status, especially when there is fluid buildup that compromises weight accuracy, even though its measurement of 28.13 ± 3.72 centimeters suggests an average nutritional reserve. The patients with more fluid retention between sessions would have fewer muscle and fat stores, thus probably indicating a state of their nutritional reserves.

3.3 Modified Subjective Global Assessment

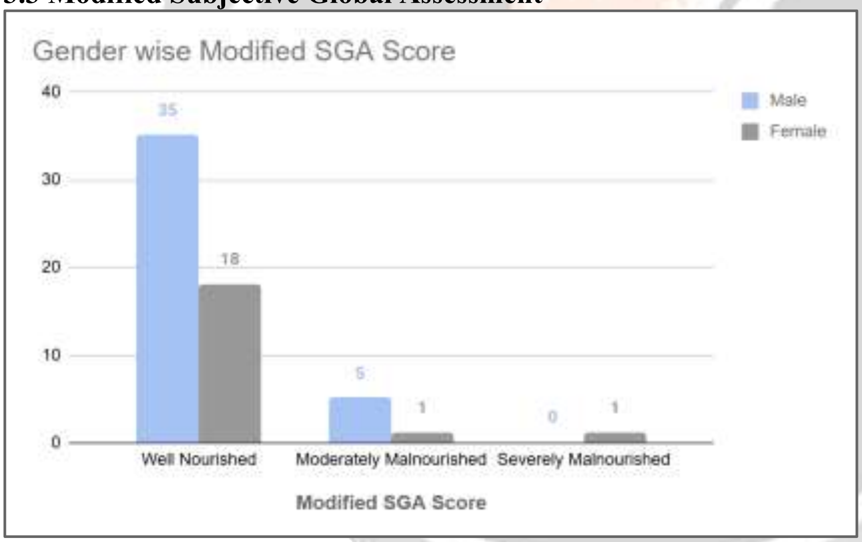

Figure 1: Genderwise Modified Subjective Global Assessment (M-SGA)

The nutritional status was analysed based on nutritional assessment tools like the 7-point Modified Subjective Global Assessment (M-SGA). In various studies, the modified Subjective Global Assessment is a reliable method for assessing nutritional status (Janardhan et al., 2011). It can be used to assess various degrees of malnutrition in hemodialysis patients (Mahmoud et al, 2021). This revealed that the males had better nutritional status compared to females, of (58.3%) males and (30%) females under well nourished category, while 8.3% of males and 1.7% of females were in the moderate malnutrition category, and only 1.7% of females were in the severe malnutrition category.

3.4 Modified Malnutrition Inflammation Score

The Modified Malnutrition Inflammation Score tool was used to assess the nutritional status and inflammation in the hemodialysis patients. Modified MIS scores have a significant relation with inflammation and malnutrition. This can help modify the modifiable nutritional status factors, and a better nutritional status can be achieved (Chan Yoke et al., 2019).

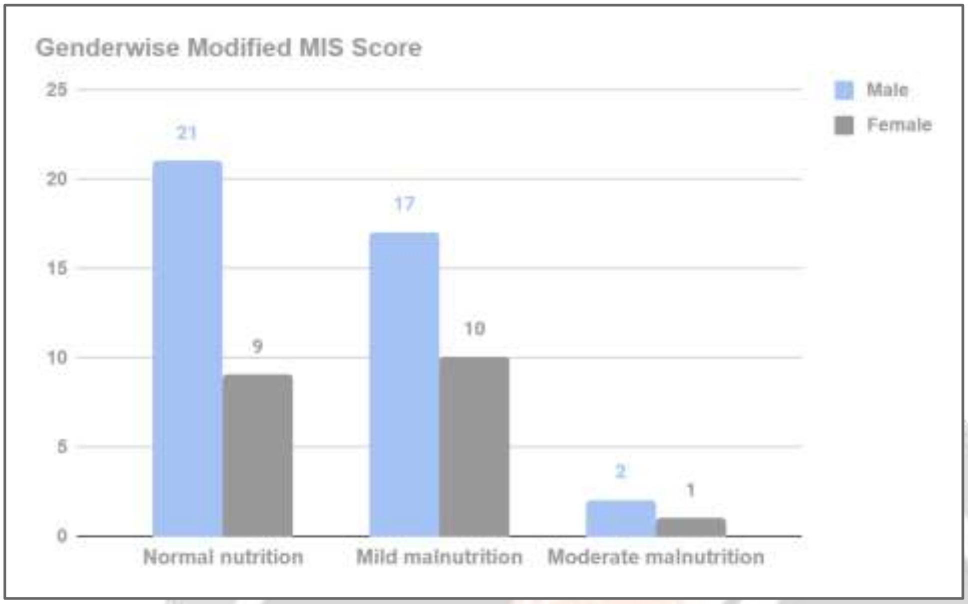

Figure 2: Genderwise Modified Malnutrition Inflammation Score (M-MIS)

Malnutrition is one of the most prominent factors affecting quality of life. With the help of the Modified MIS score, it can be detected in early stages, thereby highlighting patients at risk (Visideo et al., 2022). The assessment of nutritional status using the Modified Malnutrition Inflammation Score (MIS) revealed that the majority of study participants were under normal nutrition category, with a slightly higher number of (35%) male participants than (15%) female participants. Mild malnutrition was observed in 28.3%) males and 16.7%) females. Moderate malnutrition was seen in 3.3%) males and 1.7%) females. With no gender disparity observed in mild and moderate malnutrition across the participants (p = 0.854).

3.4 Biochemical Markers:

Table 2: Association of Biochemical Markers with Nutritional Assessment Scores

Biochemical Parameter	M-MIS Score (r)	p-value	M-SGA Score	p-value	Strength of correlation
Serum Albumin (g/dL)	-0.58	0.000*	-0.53	0.000*	Moderate to strong
Total Protein (g/dL)	-0.33	0.014*	-0.31	0.019*	Weak to moderate

Serum Creatinine (mg/dL)	-0.21	0.092	-0.19	0.104	Weak (NS)
Blood Urea Nitrogen (mg/dL)	-0.22	0.087	-0.20	0.096	Weak (NS)
Urea (mg/dL)	-0.20	0.102	-0.21	0.091	Weak (NS)
Serum Sodium (mEq/L)	-0.14	0.284	-0.16	0.241	Very weak (NS)
Serum Potassium (mEq/L)	-0.17	0.206	-0.15	0.263	Very weak (NS)
Serum Calcium (mg/dL)	-0.10	0.422	-0.12	0.348	Very weak (NS)
Serum Phosphorus (mg/dL)	-0.26	0.048*	-0.28	0.037*	Weak to moderate
Hemoglobin (g/dL)	-0.26	0.048*	-0.28	0.037*	Weak to moderate

***p<0.05 is considered to be statically significant**

Serum Albumin levels showed a strong negative correlation with both nutritional assessment scores, such as M-SGA (r=-0.53, p=0.000) and MIS Score (r=-0.58, p=0.000). In terms of total protein, both M-SGA (r=-0.33, p=0.014) and MIS (r=-0.31, p=0.019) showed signs of significance. Although there is a slight link between kidney-specific markers, including blood creatinine, BUN, urea, calcium, sodium, and potassium, and nutritional assessment tools. Serum Phosphorus (r =-0.26, p=0.48) and Hemoglobin (r =-0.26, p=0.48) showed an inverse relationship with nutritional evaluation tools.

3.5 Dietary Recall

Table 3: Average Dietary Intake of the Study Participants

Nutrient	Day	Mean SD		p-value
		Male (n=40)	Female (n=60)	
Energy (Kcal)	DD1	1253.70 ± 194.90	1050.35 ± 265.21	0.001*
	DD2	1195.88 ± 207.12	1062.00 ± 212.57	0.023*
	ND	1147.18 ± 197.18	1600.85 ± 160.33	0.008*
Protein (g)	DD1	31.47 ± 10.16	23.02 ± 7.55	0.002*
	DD2	30.07 ± 9.69	23.67 ± 7.59	0.012*
	ND	31.58 ± 12.96	22.51 ± 4.91	0.005*
Carbohydrate (g)	DD1	144.44 ± 33.38	110.83 ± 44.77	0.004*
	DD2	134.43 ± 39.67	105.91 ± 29.98	0.006*
	ND	128.08 ± 40.16	102.61 ± 27.47	0.013*
Fat (g)	DD1	60.40 ± 8.65	56.15 ± 10.26	0.098
	DD2	57.89 ± 8.75	59.06 ± 11.01	0.657
	ND	55.15 ± 7.91	54.33 ± 7.20	0.699
Sodium (mg)	DD1	1296.96 ± 469.13	893.09 ± 421.22	0.002*
	DD2	1137.16 ± 403.72	997.22 ± 311.39	0.179
	ND	1137.52 ± 356.47	962.55 ± 394.12	0.089
Potassium (mg)	DD1	1288.04 ± 380.52	1009.57 ± 434.38	0.013*
	DD2	1141.50 ± 309.84	972.37 ± 299.69	0.049*

	ND	1177.13 ± 349.92	1081.44 ± 354.05	0.324
Calcium (mg)	DD1	311.43 ± 142.91	234.91 ± 113.67	0.042*
	DD2	295.92 ± 133.63	234.25 ± 93.04	0.070
	ND	304.68 ± 135.01	241.43 ± 97.20	0.067
Phosphorus (mg)	DD1	605.99 ± 203.19	442.04 ± 162.86	0.003*
	DD2	587.27 ± 201.53	451.79 ± 130.53	0.008*
	ND	626.85 ± 223.79	448.57 ± 102.92	0.001*
Iron (mg)	DD1	8.21 ± 2.89	5.78 ± 2.65	0.003*
	DD2	7.89 ± 3.13	5.98 ± 1.96	0.016*
	ND	7.93 ± 2.64	5.68 ± 1.38	0.001*
Fiber (g)	DD1	19.98 ± 7.90	14.74 ± 6.33	0.013*
	DD2	19.26 ± 7.89	14.44 ± 5.32	0.017*
	ND	19.90 ± 7.62	14.98 ± 4.74	0.011*

***Data represented as Mean (SD) *p<0.05, DD1 - Dialysis Day 1, DD2- Dialysis Day 2, ND- Non Dialysis Day**

According to the results of the study, 8.3% of individuals were ovo-vegetarians, 25% were vegetarians, and 66.7% were non-vegetarians. The 3-day recall's nutritional intake revealed that the individuals' daily energy intake was 20 kcal/kg/BW. The first day of dialysis (p=0.001), the second day of dialysis (p=0.023), and the day without dialysis (p=0.008) showed a significant difference between the two groups. However, the energy intake was below the KDOQI 2020-recommended 30 kcal/kg BW/day for MHD patients (Ikizler, T. A., Arnett, D. K., Bell, L., et al,2020). The daily protein intake was 0.55 g/kg. Each day, including the non-dialysis day (p=0.005), dialysis day 1 (p=0.002), and dialysis day 2 (p=0.012), saw significantly higher protein intakes by males than by females, significantly below the KDOQI 2020 recommendation of 1.0–1.2 g/kg BW/day for hemodialysis patients. Even though males consumed more protein than females, energy intake and protein intake remained insufficient as per the KDOQI Guidelines. The intake of protein was similar across the 3 days, wherein vegetarian participants were getting their protein from pulses like Bengal gram dal, Green gram dal, etc, and paneer, while ovo vegetarians were consuming pulses and eggs, and non-vegetarian participants were getting their protein from dietary sources such as eggs, chicken, fish, and pulses.

The average carbohydrate intake was 2.14 g/kg/day, while fiber intake was inadequate for intake with males consuming more than females (p <0.05). For fat intakes, the average intake was 0.98 g/kg body weight, with a monthly intake of cooking oil estimated at around 912 ± 210.49 ml. Males ingested more sodium on Day 1 of dialysis compared to other days (p= 0.002); females, however, did not show such a pattern. Meanwhile, we observed that potassium, also consumed more on dialysis days 1 and 2 (p=0.013 and 0.049), showed no difference on the non-dialysis days. Calcium consumption was also higher for males, but only on dialysis day 1 (p=0.042). In males, phosphorus consumption increased on all three days: dialysis day 1 (p=0.003), dialysis day 2 (p=0.008), and non-dialysis day (p=0.001). Likewise, the iron and fiber consumption was significantly greater in males than in females across all three days (p<0.005).

The majority of the participants were consuming processed food such as biscuits, rusk, khari biscuit, wafers; however, the consumption of these processed items was similar across the 3-day recall, with no significant difference in terms of eating habits of processed foods on dialysis and non-dialysis days.

The IDWG among hemodialysis patients can be managed more efficiently by certain modifications, such as restriction of a sodium-rich diet and pharmacological therapies. Behavioral management also plays a key role in terms of adapting to these changes in hemodialysis patients. In conclusion, a personalized approach can help achieve better IDWG control and improve nutrition status comprehensively (Bossola et al., 2025).

3.6 Food Frequency

The Renal foods specific food frequency analysis revealed that the consumption of wheat flour was found to be significantly higher in males (p=0.002). In pulses and legumes, males had a higher intake of Bengal gram whole (p=0.006), whereas females consumed moth beans and field beans brown more frequently (p<0.05). The consumption pattern of nuts and oilseeds was similar in both genders. The intake of watermelon was significantly higher in females within the group of fruits (p=0.004). No significant difference was found between the two genders in the consumption of green leafy vegetables, roots and tubers, and condiments. Males had a higher consumption of egg, poultry whole (p=0.049), as well as chicken thigh skinless (p=0.017). The consumption pattern of fish and seafood, milk and milk products, and miscellaneous packaged products showed no significant differences.

According to food frequency data, the evidence suggested that rice, wheat, and some types of pulses were being eaten daily, with low intakes of fruits, nuts, dairy, and protein-rich animal foods. Less dietary diversity, coupled with economic constraints and dietary restrictions to control phosphorus and potassium, influences micronutrient inadequacies and suboptimal nutritional state. The general food practices in these patients were high in refined carbohydrates and saturated fat but deficient in dietary fiber, calcium, and iron, which may increase the deterioration due to malnutrition and mineral bone disorder in dialysis patients.

4. Conclusion

This study suggested that the nutritional status of dialysis patients was associated with Interdialytic weight gain, food intake, and biochemical markers. It was observed that most of the subjects had an IDWG% > 4%. The nutritional and dietary status was better for males as compared to females. However, the biochemical parameters, serum albumin levels, were suboptimal in both sexes, indicating poor protein-energy malnutrition. On the other hand, high blood levels of urea nitrogen and creatinine suggested poor renal clearance. These findings emphasize the need for dietary evaluation in the management of hemodialysis patients. The inference drawn is that incorporating dietary information coupled with anthropometric measurements and biochemical parameters will help in the overall well-being of the patient.

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