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Original Article

Nephrology Section

# Subjective Global Assessment of Nutritional Status among Chronic Kidney Disease Dialysis Patients: A Cross-sectional Study

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## ABSTRACT

**Introduction:** Nutritional status is compromised in End-Stage Renal Disease (ESRD) patients on dialysis. In order to predict the clinical outcomes of these patients, the diagnosis of nutritional status becomes extremely important. However, data related to parameters assessing nutritional status are limited.

**Aim:** The aim of this study was to assess the nutritional status of dialysis patients with ESRD at the renal care unit of a tertiary care hospital.

**Materials and Methods:** A cross-sectional study was conducted at the renal care unit of a tertiary care hospital from January 2016 to July 2016. Fifty individuals were divided into two groups: 30 stable ESRD patients on Haemodialysis (HD) and 20 stable ESRD patients on Continuous Ambulatory Peritoneal Dialysis (CAPD). Data were collected using a questionnaire regarding nutritional assessment, which comprised medical history, food intake history, anthropometry, biochemical investigations, and Subjective Global Assessment (SGA). Based on the SGA analysis of nutritional status, the patients were divided into Categories A, B, and C. Data were analysed using the Statistical Package for Social Sciences (SPSS) version 22.0.

**Results:** A total of 50 subjects were included in the final analysis - 30 patients in the renal dialysis group and 20 patients in the CAPD group. Body Mass Index (BMI) was significantly higher in the HD group (21.78±2.86 kg/m$^2$) than in the CAPD group (20.87±2.63 kg/m$^2$). In the HD group, the majority were in Category B (60%). In the CAPD group, the majority were in Category B (70%). The mean anthropometric measurements were significantly higher in Category A, followed by B and C ($p<0.001$). There was no significant difference across groups in biochemical parameters, except for serum albumin levels, which were significant. Serum albumin levels were highest in Category A, followed by Category B, and Category C in reverse for S. Prealbumin (mg/dL).

**Conclusion:** There is a significant number of ESRD patients who have malnutrition as an additional burden. These results suggest that low BMI and low calorie intake are harmful to ESRD patients on HD, causing severe malnutrition. Optimal calorie intake could reduce malnutrition in these patients.


**Keywords:** Body mass index, Diabetes mellitus, End stage renal disease, Nephrology, Renal dialysis

## INTRODUCTION

Chronic kidney disease causes debilitating physical effects and also has social, financial, and psychological dimensions. CKD is defined based on kidney damage causing albuminuria and decreased kidney function, diagnosed with a glomerular filtration rate of <60 mL/min/1.73 m$^2$ for three months or more [1]. ESRD is a stage in which patients with CKD require dialysis or transplantation. The incidence of ESRD is significant in India, estimated to be 229 per million population [2]. Recent studies conducted in two large cities in India found the prevalence of CKD to be 7.5% [3,4]. Haemodialysis (HD) is the main therapeutic modality for ESRD in patients for whom renal transplantation is not possible. HD provides a safe and effective option for managing ESRD [5].

Protein-Energy Wasting (PEW) is usually associated with CKD and increases the risk of morbidity and mortality [6]. The causes of Protein-Energy Malnutrition (PEM) are multiple and include insufficient food intake, gastrointestinal issues, hormonal imbalance, drugs causing variation in nutritional absorption, and associated comorbidities that contribute to PEM. The HD procedure itself is hypercatabolic and is associated with an inflammatory response, which adds to the PEM state [7]. The prevalence of PEM in ESRD varies from 16% to 62% depending on the study subjects and assessment methods [7,8]. Nutritional assessment and management for patients with ESRD are recommended in the Kidney Disease Outcome Quality Initiative (KDOQI) guidelines. Among these tools for CKD, Subjective Global Assessment (SGA) has been established as a nutritional assessment tool by the National Kidney Foundation's KDOQI and is of prognostic value for CKD patients [9]. Literature reveals the prevalence of malnutrition in patients on HD (based on the SGA tool) ranging from 23% to 76% in China [10].

A prospective cohort study from Singapore [11] reported that a significant number (more than half) of patients on HD were malnourished. Early detection of malnutrition and medical nutrition therapy will optimise patients' nutritional status for better outcomes. Another cross-sectional study from India [12] reported that the SGA can be reliably used to assess malnutrition in CKD patients and is useful in disease prognostication. It is a convenient bedside tool that can be operated even by paramedics.

Studies comprising patients on regular HD or CAPD to assess nutritional status using simple and effective tools are required. Nutritional status is commonly overlooked at various dialysis centers in developing countries such as India. These simple methods of assessing nutritional status can have a considerable impact on patient management. Therefore, the present study was conducted to assess the nutritional status of dialysis patients, using SGA categories, at the renal care unit of a tertiary care hospital in South India.

## MATERIALS AND METHODS

A cross-sectional observational study was conducted at the renal care unit of a tertiary care hospital (Maharajah's Institute of Medical Sciences, Nellimarla) from January 2016 to July 2016 on patients diagnosed with ESRD undergoing regular HD or CAPD.

Permission was obtained from the institutional ethics committee (Reference number: Lr. No MIMS/IEC/27; Date: 18th December 2015) of the concerned tertiary care hospital. Written informed consent was obtained from patients who were assured of confidentiality throughout the study.

**Inclusion criteria:** All adult patients who had undergone at least six months of HD or CAPD were included in this study.

**Exclusion criteria:** Patients with evidence of malnutrition due to other chronic illnesses (chronic liver disease, tuberculosis, cancer, stroke) were excluded from this study.

The patients were selected using the purposive sampling method. The patients who attended the tertiary care center and met the inclusion and exclusion criteria during the study period were included in the study.

### Procedure

**Data collection:** Data was collected using a questionnaire for nutritional assessment, which comprised medical history, food intake history, anthropometry, biochemical investigations, and SGA.

Patients were asked about the total duration of dialysis in months they had been on until the time of data collection, the total number of admissions lasting more than one day in the last year, and their approximate weight in kilograms six months prior. Average daily calorie and protein intake were calculated using nutrition charts for food items and various local preparations. Anthropometric parameters such as body weight, height, BMI, mid-arm circumference, and skinfold thickness were measured as part of the assessment of nutritional status.

Biochemical investigations including serum albumin, serum pre-albumin, serum transferrin, serum cholesterol, and serum creatinine were conducted using standard methods before the dialysis session.

Subjective Global Assessment (SGA) was performed using a seven-point scale in the SGA form and a ten-point scale in the Malnutrition Inflammation Score (MIS), as used in the Canada-United States of America (CAN-USA) study. The SGA and MIS assessed nutritional status based on weight change over the past six months, dietary intake and gastrointestinal symptoms, manual assessment of subcutaneous tissue, and muscle mass [6,7]. Weight change was evaluated by considering the patient's weight during the past six months. A loss of 10% of body weight over the past six months was considered severe, 5% to 10% as moderate, and less than 5% as mild.

Dietary intake evaluation included comparing the patient's usual and recommended intake with their current intake. The duration and frequency of gastrointestinal symptoms were also assessed. This component of SGA, on the seven-point scale ranging from 1 to 7, was rated higher for better dietary intake, improved appetite, and the absence of gastrointestinal symptoms.

The physical examination included an evaluation of the patient's subcutaneous tissue for fat and muscle wasting, as well as muscle mass. Subcutaneous fat was assessed by examining the fat pads directly under the eyes and gently pinching the skin above the triceps and biceps. In a normally nourished person, the fat pads appear as a slight bulge, while in a malnourished person, they appear 'hollow.' The patient's score was based on the observation of the thickness of the skin fold between the fingers when gently pinching over the triceps and biceps.

Muscle mass and wasting were assessed by examining various factors, including the temporalis muscle, prominence of clavicles, contour of the shoulders (rounded indicates a well-nourished state, while squared indicates malnutrition), visibility of the scapula and ribs, interosseous muscle mass between the thumb and forefinger, and quadriceps muscle mass. A higher score indicates better nutritional status.

The scores from each of these items were summed to give the SGA rating. A score of 21 and above, up to 28, was considered mild to normal nutritional status and classified as Category A. A score of 9 and above, up to 20, was considered moderate malnutrition and classified as Category B. A score of 1 and above, up to 8, was considered severe malnutrition and classified as Category C [7].

The SGA scoring was considered the primary outcome variable/variables. Nutritional parameters were considered secondary outcome variable/variables, and the study groups were considered the explanatory variable.

## STATISTICAL ANALYSIS

The data were analysed using SPSS Version 22.0. Quantitative data were represented with mean and SD, while qualitative data were represented with frequency and percentages. The Chi-square test was applied to determine the association between qualitative variables. An independent t-test was used to assess the significance between the two quantitative variables. Analysis of Variance (ANOVA) test was conducted to compare among three or more categories or groups. Regression analysis was performed. A p-value of <0.05 was considered statistically significant.

## RESULTS

A total of 50 subjects were included in the final analysis, with 30 patients in the HD group and 20 in the CAPD group. The mean age was slightly higher in the HD group (54.83±11.98 years) compared to CAPD (50.80±9.59 years). Males were more numerous than females in both groups. BMI was significantly higher in the HD group (21.78±2.86 kg/m$^2$) than in CAPD (20.87±2.63 kg/m$^2$).

In the HD group, the majority were in Category-B (60%), while in the CAPD group, the majority were in Category-B (70%) [Table/Fig-1].

| Baseline parameters | HD (N=30) | CAPD (N=20) | p-value |
|---|---|---|---|
| **Age** (in years)* (mean±SD) | 54.83±11.98 | 50.80±9.59 | 0.269 |
| **Gender**# | | | |
| Male | 18 (60%) | 13 (65%) | 0.473 |
| Female | 12 (40%) | 7 (35%) | |
| **Weight** (in kg)* (mean±SD) | 58.20±7.35 | 55.49±8.19 | **0.010**** |
| **Height** (in meter)* (mean±SD) | 1.64±0.06 | 1.63±0.07 | 0.838 |
| **BMI** (in kg/m$^2$)* (mean±SD) | 21.78±2.86 | 20.87±2.63 | **0.012**** |
| **SGA category**# | | | |
| A | 8 (26.67%) | 2 (10%) | 0.335 |
| B | 18 (60%) | 14 (70%) | |
| C | 4 (13.33%) | 4 (20%) | |

**[Table/Fig-1]:** Comparison of baseline parameter across study group (N=50).
#by using Chi-square test, *by using Independent t-test, **Statistically significant

The mean anthropometric measurements were significantly higher in Category-A, followed by B and C (p<0.001). The mean percentage of weight change in the last six months was significantly higher in Category-C (9.89%). There were no significant differences across groups in biochemical parameters, except for serum albumin levels. The level was highest in Category-A (3.48 mg/dL), followed by Category-B (3.27 mg/dL) and Category-C (2.78 mg/dL) [Table/Fig-2].

| Parameter | SGA category | | | p-value |
|---|---|---|---|---|
| | A (N=10) | B (N=32) | C (N=8) | |
| **Anthropometric parameter** | | | | |
| Height (in m) | 1.65±0.08 | 1.63±0.07 | 1.63±0.06 | 0.759 |
| Weight (in kg) | 67.34±6.61 | 55.97±5.02 | 48.91±4.33 | **0.001**** |
| BMI (in kg/m$^2$) | 24.85±2.45 | 21.10±2.04 | 18.40±0.60 | **<0.001**** |
| Middle arm circumference (In cm) | 24.81±2.50 | 22.23±2.49 | 19.58±1.62 | **<0.001**** |
| Mean skin fold thickness (in mm) | 15.69±2.85 | 13.33±2.99 | 12.40±2.11 | **0.037**** |

| SGA score | | | | |
|---|---|---|---|---|
| SGA score | 23.10±1.20 | 16.41±2.42 | 6.88±0.99 | **<0.001**** |
| **Medical history** | | | | |
| Duration of dialysis (in months) (number of times) | 21±15.11 | 18.97±14.64 | 14.88±7.68 | 0.702 |
| Admissions in last one year (number) | 1.40±1.90 | 2.28±1.40 | 1.88±1.25 | 0.099 |
| weight before 6 months (Kg) | 68.35±7.11 | 58.99±4.74 | 53.73±4.49 | **<0.001**** |
| Mean weight change in last 6 months (Kg) | 1.51±4.07 | 5.56±3.90 | 9.89±1.48 | **<0.001**** |
| **Dietary intake history** | | | | |
| Calorie intake (Kcal/kg) | 27.41±3.05 | 30.14±3.81 | 31.10±4.22 | 0.081 |
| Protein (gm/kg) | 0.74±0.20 | 0.79±0.21 | 0.72±0.15 | 0.634 |
| **Blood investigations** | | | | |
| S. Cholesterol (mg/dL) | 176.10±56.99 | 170.44±42.39 | 149.25±29.09 | 0.395 |
| S. Prealbumin (mg/dL) | 0.33±0.08 | 0.29±0.08 | 0.23±0.06 | **0.029**** |
| S. Transferrin (mg/dL) | 199.20±35 | 186.19±20.98 | 171.38±24.70 | 0.153 |
| S. Creatinine (mg/dL) | 7.70±2.57 | 7.01±2.17 | 7.06±2.51 | 0.704 |
| Albumin | 3.48±0.45 | 3.27±0.43 | 2.78±0.44 | **0.004**** |

**[Table/Fig-2]:** Mean comparison of anthropometric, medical, diet intake and blood investigation parameter within SGA groups by using ANOVA test (N=50).
**Statistically significant

The mean anthropometric measurements were significantly higher in Category-A, followed by B and C (p<0.001), except for height. There were no significant differences across groups in biochemical parameters, except for serum albumin levels and S. Prealbumin. The serum albumin level was highest in Category-A, followed by Category-B, while the reverse was true for S. Prealbumin (mg/dL) [Table/Fig-3,4].

| HD (N=30) | | | | |
|---|---|---|---|---|
| Parameter | SGA category A | SGA category B | SGA category C | p-value |
| **Anthropometric parameter** | | | | |
| Height (in m) | 1.41±0.09 | 1.41±0.09 | 1.59±0.09 | 0.874 |
| Weight (in kg) | 69.34±6.22 | 66.34±6.12 | 66.14±6.33 | **0.001** |
| BMI (in Kg/m$^2$) | 27.85±2.06 | 23.85±2.09 | 23.65±2.09 | **<0.001**** |
| Middle arm circumference (in cm) | 25.81±2.11 | 23.81±2.98 | 22.61±2.93 | **<0.001**** |
| Mean skin fold thickness (in mm) | 16.69±2.46 | 14.69±2.63 | 12.49±2.63 | **0.042*** |
| **SGA score** | | | | |
| SGA score | 21.1±0.81 | 16.58±0.78 | 7.78±0.41 | **<0.001**** |
| **Medical history** | | | | |
| Duration of dialysis | 19±14.72 | 17.2±14.69 | 13.2±14.69 | 0.812 |
| Admissions in last one year | 1.3±1.51 | 2.38±1.28 | 1.91±1.22 | 0.08 |
| Weight before 6 months | 66.35±6.72 | 57.35±6.69 | 54.15±6.69 | **<0.001**** |
| Mean weight change in last 6 months | 1.39±3.68 | 5.39±3.74 | 8.69±3.65 | **<0.001**** |
| **Dietary intake history** | | | | |
| Calorie intake (Kcal/kg) | 25.41±2.66 | 31.41±2.63 | 30..21±2.63 | 0.071 |
| Protein (gm/kg) | 0.76±0.09 | 0.79±0.058 | 0.78±0.058 | 0.741 |
| **Blood investigation** | | | | |
| S. Cholesterol (mg/dL) | 174.1±56.6 | 175.1±56.57 | 159.9±56.57 | 0.395 |
| S. Prealbumin (mg/dL) | 0.29±0.07 | 0.34±0.038 | 0.59±0.031 | **0.048**** |
| S. Transferrin (mg/dL) | 197.2±34.61 | 198.2±34.58 | 198±34.58 | 0.118 |
| S. Creatinine (mg/dL) | 5.7±2.18 | 6.7±2.15 | 6.5±2.15 | 0.682 |
| Albumin | 4.24±0.29 | 3.36±0.26 | 3.19±0.29 | **0.021**** |

**[Table/Fig-3]:** Mean comparison of anthropometric, medical, diet intake and blood investigation parameters with SGA groups in HD patients (N=30) by using ANOVA test.
**Statistically significant

| CAPD (N=20) | | | | |
|---|---|---|---|---|
| Parameter | SGA category A | SGA category B | SGA category C | p-value |
| **Anthropometric parameter** | | | | |
| Height (in m) | 1.65±0.08 | 1.63±0.07 | 1.63±0.06 | 0.759 |
| Weight (in kg) | 67.34±6.61 | 55.97±5.02 | 48.91±4.33 | **0.001**** |
| BMI (in k/m$^2$) | 24.85±2.45 | 21.10±2.04 | 18.40±0.60 | **<0.001**** |
| Middle arm circumference (in cm) | 24.81±2.50 | 22.23±2.49 | 19.58±1.62 | **<0.001**** |
| Mean skin fold thickness (in mm) | 15.69±2.85 | 13.33±2.99 | 12.40±2.11 | **0.037**** |
| **SGA score** | | | | |
| SGA score | 23.10±1.20 | 16.41±2.42 | 6.88±0.99 | **<0.001**** |
| **Medical history** | | | | |
| Duration of dialysis | 21±15.11 | 18.97±14.64 | 14.88±7.68 | 0.702 |
| Admissions in last one year | 1.40±1.90 | 2.28±1.40 | 1.88±1.25 | 0.099 |
| weight before 6 months (kg) | 68.35±7.11 | 58.99±4.74 | 53.73±4.49 | **<0.001**** |
| Mean weight (kg) change in last 6 months | 1.51±4.07 | 5.56±3.90 | 9.89±1.48 | **<0.001**** |
| **Dietary intake history** | | | | |
| Calorie intake (Kcal/kg) | 27.41±3.05 | 30.14±3.81 | 31.10±4.22 | 0.081 |
| Protein (gm/kg) | 0.74±0.20 | 0.79±0.21 | 0.72±0.15 | 0.634 |
| **Blood investigation** | | | | |
| S. Cholesterol (mg/dL) | 176.10±56.99 | 170.44±42.39 | 149.25±29.09 | 0.395 |
| S. Prealbumin (mg/dL) | 0.33±0.08 | 0.29±0.08 | 0.23±0.06 | **0.029**** |
| S. Transferrin (mg/dL) | 199.20±35 | 186.19±20.98 | 171.38±24.70 | 0.153 |
| S. Creatinine (mg/dL) | 7.70±2.57 | 7.01±2.17 | 7.06±2.51 | 0.704 |
| Albumin | 3.48±0.45 | 3.27±0.43 | 2.78±0.44 | **0.004**** |

**[Table/Fig-4]:** Mean comparison of anthropometric, medical, diet intake and blood investigation parameter with SGA groups in CAPD patients (N=20) by using ANOVA test.
**Statistically significant

Using Category-A as the baseline, factors that affected nutritional status (for the occurrence of Category-B and Category-C) were analysed using multiple logistic regression. T here was no significant association of factors for developing Category-B nutritional status when Category-A was used as the baseline. However, for factors related to developing Category-C, BMI and calorie intake showed a significant negative relation. The odds ratio for BMI was 3.39 (p=0.016), and for calorie intake, it was 1.56 (p=0.01) [Table/Fig-5].

| SGA category (A vs) | Variables | Odds ratio | Std. Error | Wald | df | p-value |
|---|---|---|---|---|---|---|
| B | Body Mass Index (BMI) | 1.461 | 0.830 | 3.095 | 1 | 0.079 |
| | Mean skin fold thickness (mm) | 1.355 | 1.232 | 1.210 | 1 | 0.271 |
| | S. Cholesterol (mg/dL) | 0.122 | 0.073 | 2.815 | 1 | 0.093 |
| | S. Prealbumin (mg/dL) | 40.788 | 32.536 | 1.572 | 1 | 0.210 |
| | S. Transferrin (mg/dL) | 0.068 | 0.070 | 0.938 | 1 | 0.333 |
| | Urea (mg/dL) | 0.113 | 0.082 | 1.883 | 1 | 0.170 |
| | S. Creatinine (mg/dL) | 0.921 | 0.881 | 1.094 | 1 | 0.296 |
| | Calorie intake (Kcal/kg) | 1.229 | 0.690 | 3.176 | 1 | 0.075 |
| | Protein (gm/kg) | 2.698 | 5.122 | 0.277 | 1 | 0.598 |

| | | | | | | |
|---|---|---|---|---|---|---|
| C | BMI | 3.391 | 1.401 | 5.855 | 1 | **0.016** |
| | Mean skin fold thickness (mm) | 1.142 | 1.267 | 0.812 | 1 | 0.368 |
| | S. Cholesterol (mg/dL) | 0.119 | 0.080 | 2.217 | 1 | 0.137 |
| | S. Prealbumin (mg/dL) | 70.002 | 40.338 | 3.012 | 1 | 0.083 |
| | S. Transferrin (mg/dL) | 0.064 | 0.082 | 0.618 | 1 | 0.432 |
| | S. Creatinine (mg/dL) | 2.147 | 1.268 | 2.865 | 1 | 0.091 |
| | Calorie intake (Kcal/kg) | 1.516 | 0.738 | 4.215 | 1 | **0.040** |
| | Protein (gm/kg) | 11.924 | 8.860 | 1.811 | 1 | 0.178 |

**[Table/Fig-5]:** Nominal regression with SGA grouping as dependent variable and a set of independent (Predictor) variables (N=50).
Parameter Estimates
Note: The reference category is Category-A

## DISCUSSION

In the present study, the nutritional status assessed by SGA during dialysis was associated with moderate and severe malnutrition in ESRD patients. The mean age in the HD group was (54.83±11.98 years), while in Category-A it was (50.31±11.61 years), and in CAPD it was (50.80±9.59 years). Zaki DSD et al., found a mean age of 50.2±12.5 years among HD patients, which is similar to the present study [13]. In this study, 18 (60%) HD and 14 (70%) CAPD patients respectively showed SGA Category-B (moderate malnutrition), with only 4 (13.33%) in each HD and CAPD reporting SGA Category-C (severe malnutrition). Abozead SES et al., in Egypt found a prevalence of about 85% malnourished HD patients, with 81.6% having mild to moderate malnutrition and 3.6% having severe malnutrition, compared to the present study [14]. Another study by Ali-Bokhari SR et al., in Saudi Arabia in 2018 found that 57% of HD patients were malnourished according to SGA, with 49% being undernourished and 18% severely malnourished [15].

The mean anthropometric measurements were significantly higher in Category-A, followed by Category-B and Category-C. There was no significant difference across groups in bio-chemical parameters, except for serum albumin and prealbumin levels, which were highest in Category-A (3.48 mg/dL), followed by Category-B and Category-C. Essadik R et al., found that the prevalence of PEW evaluated by different methods and criteria varied from 7.1% to 80.9% [16]. In contrast to the present study, previous studies [17,18] showed that nutrition-related variables (BMI, lean body mass, anthropometric parameters, and serum creatinine, albumin, prealbumin, transferrin, ferritin, and CRP) were not significantly associated with SGA scores.

In the present study, 20 incident patients on CAPD were observed for their nutritional status. Liu Y et al., found that higher peritoneal transporter was independently associated with worse nutritional status, as measured by serum ALB level, serum pre-ALB, and PA using bioelectrical impedance analysis among CAPD patients [19]. Similar findings were also reported in a previous study assessing nutritional status in patients with ESRD on haemodialysis [20]. In the present study, the energy intake was higher in the CAPD group (31.10 kcal/kg) compared to the HD group (30.14 kcal/kg).

The finding of higher energy intake in the present study is consistent with the recommended lower limit of average energy intake of 25.7 kcal/kg by the KDOQI Nutrition Clinical Practice Guideline [21]. In contrast to the present study, Rodrigues J et al., reported a prevalence of nutritional markers indicating PEW among elderly patients on Maintenance Haemodialysis (MHD) ranging from 6.9% to 59.5%, depending on the method applied, including SGA, MIS, basal metabolic rate (BMI), Geriatric Nutritional Risk Index (GNRI), and calf circumference [22]. In the present study, the odds ratio for serum prealbumin (mg/dL) was high in Category-B and Category-C compared to Category-A. Similar findings were observed in a study conducted by Xi W et al., where weight loss, reduced food intake, and serum prealbumin (mg/dL) had high odds ratios [23]. According to the findings of the present study, maintaining and intervening in the nutritional status of HD patients at the start of dialysis can improve clinical outcomes in incident dialysis patients.

### Limitation(s)

The subjects were included from a single center, and co-morbidities and the actual causes of ESRD were not assessed, which could be independent predictors of malnutrition. The present study did not assess the effects of changes in SGA scores on clinical outcomes in dialysis patients. A longer study period is needed to observe further changes in nutritional status. Hence, further longitudinal multicenter studies with a large sample size from different cities are recommended to support the findings of the present study. Despite these limitations, the present study provides novel insights into the effect of nutrition among HD patients.

## CONCLUSION(S)

The majority of HD and CAPD patients were moderately malnourished. The results of the study revealed that lower BMI and low-calorie intake were associated with severe malnutrition in ESRD patients on HD. In the present study, although energy intake was higher in CAPD compared to HD patients, CAPD patients were also malnourished similar to HD patients. Therefore, calorie intake should be regularly monitored in these patients. SGA is a simple, non-invasive, well-validated, feasible, and inexpensive nutritional screening tool that can be used to routinely assess nutritional status in HD and CAPD patients. Healthcare professionals in HD centers and hospitals should develop and adhere to nutritional assessment protocols for HD patients.

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