# The nutritional status of continuous ambulatory peritoneal dialysis patients at a Johannesburg hospital

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## Abstract

**Objectives:** To assess the nutritional status of continuous ambulatory peritoneal dialysis (CAPD) patients in our hospital using different assessment tools, and to assess the correlation between nutritional status and other parameters such as solute clearance.

**Method:** A cross-sectional study was performed on end-stage renal disease patients treated with CAPD at Charlotte Maxeke Academic Hospital, Johannesburg, South Africa. The nutritional status of each patient was assessed using subjective global assessment (SGA), anthropometric parameters including body mass index (BMI), mid-upper arm circumference (MUAC), triceps skin fold (TSF), arm muscle area (AMA) and arm fat area (AFA), and biochemical parameters including serum albumin and total cholesterol levels. Dialysis adequacy was assessed by solute clearance measurement.

**Results:** The mean age of the patients was 37.9 ± 13.4 years, 54% were males and 74 % were black. The mean BMI was 24.8 ± 3.5 kg/m$^2$, mean MUAC was 28.5 ± 3.9 cm, mean TSF 85.6 ± 41.5 cm, mean serum albumin was 37.1 ± 7.6 mg/dl, while mean serum cholesterol was 5.32 ± 1.7 mmol/l. Based on SGA scores, 42% were well nourished, 50% moderately undernourished, while 8% were severely malnourished. We noted significant correlation between the SGA score and anthropometric parameters (BMI, MUAC) and there was no significant correlation between the nutritional parameters and the solute clearance.

**Conclusion:** Malnutrition is common among CAPD patients in our centre, without a significant correlation between the nutritional status and the solute clearance. There is thus a need for ongoing nutritional assessment and support among these patients.

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## Introduction

The prevalence of malnutrition is high among peritoneal dialysis (PD) patients, occurring in up to 40-66% in some centres.[1-4] Although there is a paucity of data on nutritional parameters and on the adequacy of dialysis in Africa, a review of available studies from this part of the world previously confirmed a high prevalence of malnutrition among end-stage renal disease (ESRD) patients.[4] Malnutrition is associated with increased morbidity, mortality and impaired quality of life among dialysis patients.[5,6] Malnutrition in PD patients may result from many factors, including inadequate nutrient intake, loss of protein and amino acids from the peritoneum and increased catabolism due to factors such as coexisting systemic diseases and infections, for example peritonitis and chronic inflammation.[7]

Monitoring the nutritional status of PD patients is important, as the early identification and management of malnutrition may lead to improved nutritional status and patient outcome.[8,9] However, there is no single parameter that provides a complete assessment of the nutritional status of PD patients,[8] and this is therefore usually assessed by a number of methods.

The aim of this study was to assess the nutritional status of native African PD patients at a Johannesburg hospital using subjective global assessment (SGA), anthropometry and biochemical methods, and to study the correlation between nutritional status and solute clearance as measured by the weekly Kt/V as a marker of dialysis adequacy.

## Method

A cross-sectional study was conducted. It involved 50 adult continuous ambulatory peritoneal dialysis (CAPD) patients who were receiving treatment on an out-patient basis at the PD unit of the Charlotte Maxeke Academic Hospital, Johannesburg, South Africa, and who satisfied the inclusion criteria. These patients had no history of peritonitis in the past month and had no catheter malfunction. They consented to participate in the study.

Using a semi-structured interview form, information was obtained from the patients on their age, race and gender, the aetiology of chronic kidney disease, duration of PD, the type of PD solution and the number of exchanges per day.

The nutritional status of the patients was assessed using anthropometric parameters, 24-hour dietary recall, SGA and measurements of serum albumin and cholesterol.

**Anthropometric assessment**

Weight (kg) and height (m) were measured using Seca scales after complete drainage of the last exchange.

Body mass index (BMI) was calculated as weight in kilograms divided by height in square metres. This was classified into three categories: normal (18.5-24.9 kg/m$^2$), overweight (25-29.9 kg/m$^2$) and obese (≥ 30 kg/m$^2$).[10]

Mid-upper arm circumference (MUAC) was measured using a metric tape measure at the midpoint between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process of the ulna of the dominant arm.

Triceps skin fold (TSF) thickness was measured to the nearest 0.1 mm, taking the average of three measurements on the posterior aspect of the dominant arm, over the triceps muscle and at the midpoint line determined for the MUAC, using a Harpenden calliper (model HSK-BI).

The arm muscle area (AMA) related to total body-muscle mass was determined from the upper arm anthropometric measurements, MUAC and TSF using the formula by Frisancho.[11] AMA was then interpreted using these percentiles as high muscle mass (> 95th percentile), above-average muscle mass (75th-95th percentile), average muscle mass (25th-75th percentile), below-average muscle mass (5th-25th percentile) and wasted (≤ 5th percentile).[12]

**Twety-four-hour dietary recall**

The 24-hour dietary recall was done by an experienced dietitian. Patients were asked to recall in detail all food and beverages consumed over a 24-hour period. The dietitian assisted in estimating the portion sizes using visual food aids and a photo manual developed by the Medical Research Council (MRC) of South Africa.

The findings were recorded under four measurements: "time", "what", "size thereof" and "description", of what the patients reported to have consumed within the 24-hour period.

These were later assessed with FoodFinder 3 for Windows®, a computerised diet-analysis programme developed by the MRC using common South African-based foods, preparation methods and portion sizes.[13]

**Subjective global assessment**

SGA was administered to the patients with the help of the dietitian.

The first part of the SGA comprised the patient history, which included weight change, dietary intake relative to normal over the past two weeks, gastrointestinal symptoms lasting longer than two weeks, and functional capacity.

The second part of the SGA comprised a physical examination, where the loss of subcutaneous fat in four different areas (shoulders, triceps, chest and hands), the presence of muscle wasting and the presence of oedema in various areas (hands, sacrum and/or feet) were assessed. These variables were individually scored and the sum of the scores was used for the overall rating of the patients' nutritional assessment, classified as normal, mild, moderate or severe undernutrition.

**Biochemical tests**

Serum albumin, cholesterol and other biochemical tests, including dialysate and plasma urea and creatinine for the measurement of solute clearance, were assessed by the National Health Laboratory Services at the hospital using the Roche/Hitachi Modular ISE 900 automated analyser (Roche Diagnostics Corporation, Mannheim, Germany).

Peritoneal urea clearance (Kt) was calculated as the value of urea in the 24-hour dialysate sample, divided by the serum urea.

Renal Kt was calculated as the 24-hour urine urea divided by the serum urea. The total Kt was divided by the volume of the distribution of urea (V). This was calculated using the Watson formula, which is based on the age, sex, height and weight of a patient.[14] The value obtained was multiplied by 7 to give the weekly Kt/V.

**Statistical analysis**

Data were recorded as mean ± standard deviation (SD). Pearson's correlation coefficient was used to correlate the SGA scores and the anthropometric parameters as well the weekly Kt/V. The chi-square test was used to assess the relationship with nonparametric measures. All analyses were done using computer-based software, the Statistical Package for Social Sciences (SPSS® version 16.0).

## Results

In this cross-sectional study 50 consecutive patients on CAPD were studied. Twenty-three (46%) were female and 27 (54%) were male. The mean age of the study population was 37.9 ± 13.5 years, with a range of 18 years to 65 years.

Mean duration of CAPD was 19.5 ± 20.7 months, with a range of two months to 147 months. All the patients studied were on four exchanges of 2 litres of 2.5% dextrose solution daily. Mean diastolic blood pressure was 92.2 ± 17 mmHg, with a range of 53 mmHg to 145 mmHg, while the mean systolic blood pressure was 144.9 ± 27.9 mmHg, with a range of 95 mmHg to 231 mmHg.

Hypertension was the most common cause of ESRD in the study population (46.5%). Others were diabetes mellitus (7.0%), glomerulonephritis (7.0%), congenital disease (12.7%) and unknown cause (22.5%).

The mean weekly Kt/V of the patients was 1.73 ± 0.4, with a range of 1.1 to 2.7.

**Anthropometric parameters**

Table I shows the various anthropometric parameters in the study population, using descriptive statistics.

Sixty per cent of the patients had a BMI above the normal range, while only one patient had a BMI of less than 18.5 kg/m$^2$. There was no significant relationship between the BMI, either classified as normal, overweight or obese, and the presence or absence of oedema ($\chi^2 = 5.43$, df = 2, P = 0.06).

The majority (63%) of the patients had an average to high lean body mass (LBM), assessed using AMA and only 23% were below average and only 14% were wasted (below the 5th percentile for AMA). The TSF result showed that 17% had values below the 50th percentile, 29% had values above the 100th percentile and the mean TSF was above average.

Table I: Anthropometric parameters

| Parameter | Mean | SD | Minimum | Maximum |
|---|---|---|---|---|
| Weight (kg) | 66.1 | 12.1 | 48.2 | 100.8 |
| Height (m) | 1.6 | 0.1 | 1.4 | 1.9 |
| BMI (kg/m$^2$) | 24.8 | 3.6 | 18.6 | 35.0 |
| TSF (mm) | 85.6 | 41.5 | 35.0 | 255.0 |
| MUAC (cm) | 28.5 | 3.9 | 21.5 | 39.0 |

### Twenty-four-hour dietary recall

Analysis of dietary history showed that 49% of the patients had suboptimal intake in terms of both protein and energy as specified by the National Kidney Foundation K/DOQI nutritional guidelines. In respect of energy intake, 14% consumed more than 100% of the total calculated energy requirements. In respect of protein intake, 74% consumed less than 75% of recommended protein, of which 27% was less than 50% high biological value protein. This illustrates that despite the majority of the participants consuming adequate amounts of protein, the quality of the protein was poor.

### Subjective global assessment

Analysis of the history aspect of SGA showed that less than half of the patients (46%) experienced weight loss within the preceding six months. A continuous weight loss was noted in 23% of patients. Among those that experienced weight gain, 35% had oedema at the time of examination. Gastrointestinal symptoms were present in 26%. Fatigue and the resultant impaired ability to work were experienced by 34% of patients. None of the patients was bedridden.

Physical examination revealed oedema in 37% of patients. Forty-three per cent had subcutaneous fat loss and 34% had muscle wasting.

Overall SGA scores in this study showed that 42% of the patients were well nourished, 50% were moderately undernourished and 8% were severely undernourished.

Significant correlation was noted between SGA scores and anthropometric parameters like BMI ($r = -0.93$, $p = 0.000$) and MUAC ($r = -0.96$, $p = 0.000$). There was no correlation with biochemical parameters like serum albumin ($r = -0.128$, $p = 0.38$) and serum cholesterol ($r = 0.16$, $p = 0.26$).

### Biochemistry

Mean serum albumin was 37.1 ± 7.6 mg/dl, with a range of 16 g/dl to 49 g/dl. Only 30% had serum albumin lower than 35 mg/dl, while none had serum albumin above 50 mg/dl. There was a significant relationship between serum albumin status (as either hypoalbuminaemia or normal albumin) and the presence of oedema. ($\chi^2 = 15.29$, df = 1, P = 0.000).

Mean serum cholesterol was 5.32 ± 6.5 mmol/l, with a range of 3 mmol/l to 14 mmol/l. Total serum cholesterol was less than 5.3 mmol/l in 30 patients (60%), 5.3 mmol/l to 6.2 mmol/l in eight (16%), and above 6.2 mmol/l in 12 (24%).

The mean weekly Kt/V was 1.7 ± 0.4, with a range of 1.1 to 2.7. This was within the value recommended by international clinical practice guidelines, such as the National Kidney Foundation K/DOQI.[15] There was no significant correlation between weekly Kt/V results and nutritional status assessment parameters.

Table II shows the results of the correlation coefficient between these parameters. The serum-albumin levels were compared in three groups of the study patients based on the weekly Kt/V being above 2, between 1.7 and 2, and below 1.7. There was no significant difference among the three groups ($F = 2.88$, $P = 0.063$, analysis of variance).

Table II: Correlation between weekly Kt/V and nutritional status parameters

| Parameter | r | P value |
|---|---|---|
| BMI | -0.26 | 0.86 |
| MUAC | 0.37 | 0.84 |
| TSF | 0.102 | 0.49 |
| Cholesterol | -0.33 | 0.82 |
| Albumin | -0.21 | 0.09 |

## Discussion

Malnutrition is common among CAPD patients.[16] Studies have also shown that nutritional status is an independent predictor of survival in these patients.[5,6] It is therefore recommended that periodic assessment of nutritional status should be part of the routine care of dialysis patients to facilitate the early recognition of malnutrition and the institution of appropriate therapy.[6,8]

However, there is no single parameter that provides complete assessment of the nutritional status of CAPD patients, and various guidelines therefore recommend that nutritional status should be assessed using a number of assessment tools, such as anthropometry, dietary interviews and diaries, SGA, measurements of serum albumin and prealbumin, and dual-energy X-ray photon absorptiometry.[6,8]

In this study, nutritional status was assessed using anthropometry, dietary recall, SGA and biochemical methods.

### Anthropometric parameters

The use of anthropometrics is an indirect and relatively insensitive method of nutritional assessment, although it does have the advantage of being simple and of providing different measures.

The mean BMI of the studied patients was similar to that reported in other South African CAPD patients.[17] Insensitivity and errors are well-recognised problems with anthropometrics, including sensitivity to hydration status. In this study, we encountered the problem of using the actual weight of patients in calculating their BMI, as some of the patients classified as being overweight also had oedema.

Another disadvantage of using anthropometrics is the lack of standard reference values for an indigenous African population. Values obtained are therefore compared mostly with the standard values given for other populations. Despite these challenges, the estimation of LBM and fat mass using anthropometrics was reported to agree reasonably well with results from Database and Expert Systems Applications and anthropometrics was among the various tools recommended for the assessment of nutrition in respect of CAPD in major practice guidelines.[6,8]

### Twenty-four-hour dietary recall

Almost half (49%) of the patients studied had a suboptimal intake of both protein and energy, which is below the recommendations of major international guidelines.[6,8] Higher protein intake is usually recommended for CAPD patients compared to HD patients to compensate for protein loss in the dialysate.[8]

Although dietary recall has the advantage of being easy and quick, with high patient compliance, among its limitations is the use of a single daily intake, which may not represent the patients' usual intake. The dependence of dietary recall on patients' memory and the estimation of portion sizes may not always be correctly interpreted either.

**Subjective global assessment**

SGA has previously been validated in CAPD patients and its usefulness and reproducibility have also been reported.[9] It is therefore one of the recommended tools for the assessment of nutritional status in CAPD patients by most of the major international practice guidelines on PD.[6,8]

Overall SGA scores in this study showed that the majority (58%) of the patients were moderately to severely undernourished. We also noted significant correlation between the SGA score and anthropometric parameters. However, our percentage of malnutrition was lower than that reported from Durban, where 76.2% of CAPD patients studied were malnourished, although a different assessment tool was used in that study.[4] But our findings were similar to those by Tapiawala et al using the SGA tool in India, who reported that 50% of the patients were malnourished.[18] They also noted significant correlation between the SGA score and anthropometric parameters. Our score was higher than that found in North American and European patients, where Young et al reported 32.6% and 8.0% for mild to moderate and for severe malnutrition respectively. Similarly, 44.9% and 2% of Korean patients were reported to be mildly to moderately or severely malnourished respectively. Both studies used the SGA tool.[19,20]

**Biochemical methods for nutritional assessment**

The mean serum albumin level in the study patients fell within the reference range for our laboratory. We did note, however, that 28% of the patients had a serum albumin level below the lower limit of the normal range, which in our laboratory is 34 g/l to 48 g/l.

Severe hypoalbuminaemia was noted in 14% of PD patients in Durban.[4] A lack of relationship between the weekly Kt/V and serum albumin was also reported among CAPD patients in Durban, where there was no difference in the serum albumin level between a group of PD patients with a Kt/V below 2.1 and a group with a Kt/V above 2.1.[4]

Harty et al,[16] in a review of dialysis adequacy and nutrition in CAPD patients, reported that a positive correlation between Kt/V and serum albumin has been found in only a few studies, whereas the majority of cross-sectional studies have reported no correlation, or an inverse one.

Serum albumin alone is not sufficient as a clinical marker for malnutrition in CAPD patients, as it is known to be affected by many factors, including hydration status, underlying inflammatory processes resulting, in part, from the use of bioincompatible PD solutions, and underlying access infections or other occult infections.[8]

This study noted a significant relationship between oedema status and serum albumin status.

Mean serum cholesterol in the study patients was within normal limits. Serum cholesterol is recommended mostly for use as a screening tool for malnutrition in chronic kidney disease.[8] A relationship between low serum cholesterol and increased mortality was not observed in the CAPD population.[7]

## Limitations

Among the limitations of this study are its cross-sectional nature, the use of actual weight in determining BMI, which might classify patients incorrectly as obese, some anthropometric parameters that were not measured, and the studied patients possibly previously having been counselled by a dietitian, nurse or physician on dietary management, which might have influenced what was reported in the 24-hour recall, and which might therefore entail recall bias.

## Conclusion

Malnutrition is common among CAPD patients in our centre and is higher than that reported for other populations. SGA is a useful tool for assessing nutritional status in this population.

There is a need for the ongoing nutritional assessment of and support for CAPD patients.

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