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Assessment of Malnutrition among Chronic Kidney Disease Patients in a Tertiary Hospital in Nigeria: A Cross-Sectional Analysis

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ABSTRACT

Introduction: Malnutrition is common among patients with chronic kidney disease (CKD) and it contributes significantly to high morbidity and mortality. Early identification and treatment of malnutrition are important so as to improve outcomes. The aim of this study is to assess the prevalence and severity of malnutrition among CKD patients using simple and easily available tools.

Methods: This was a cross-sectional study involving 35 CKD patients, 15 pre-dialysis and 20 on maintenance haemodialysis (MHD). Thirty-five apparently healthy patients with no CKD were studied as the comparison group. Assessment of nutritional status was done using body mass index (BMI), triceps skinfold thickness (TSF), mid-arm muscle circumference (MAMC), and serum albumin. Malnutrition was present when BMI was< 18.5kg/ m^2, TSF and MAMC were less than 90% of the ideal, and serum albuminwas < 35g/L.

Results: The prevalence of malnutrition in all the CKD patients was significantly higher (88.6%) compared to 42.8% in the controlgroup with no CKD(*P*= <.001). Malnutrition prevalence was 73% among patients yet to commence dialysis and 100% among hemodialysis patients(*P*= 0.026).The prevalence of malnutrition based on the triceps skin-fold thickness (TSF) alone was 45.7%, 85.7%,73 and 95% in the control, all CKD, pre-dialysis and MHD groups respectively.

Conclusion: This study confirms that malnutrition is common in CKD patients especially in the hemodialysis group.Clinicians should make concerted efforts to optimise the nutritional care of patients with CKD.

INTRODUCTION

Malnutrition is defined as an imbalance between nutrient requirement and intake resulting in cumulative deficits of energy, protein or micronutrients that may affect relevant outcomes[1]. Malnutrition used synonymously with Protein Energy Malnutrition (PEM) is common among patients with chronic kidney disease more especially in the advanced stages (CKD stages 4 and 5) [2-5]. The prevalence of PEM varies with studies and may depend on the study population and the criteria used in assessing the nutritional status. Amongst dialysis patients, prevalence ranges between 23–76% for those on haemodialysis (HD) and 18–50% for peritoneal dialysis (PD) patients[6,7]. CKD patients indeveloping countries are especially predisposed to PEM, reports from Nigeria showed a high prevalence in CKD patientsranging from (18-86%) based on different criteria[8-11]. The causes of PEM in CKD patients are multi-factorial and include inadequate intake of nutrients, dietary restrictions, loss

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of nutrients into the dialysate in the case of patients on dialysis, and hyper catabolism caused by comor bid conditions. Chronic inflammation also has been found to have a strong relationship with malnutrition in CKD patients and contributes to the high morbidity and mortality observed in malnourished CKD patients[12-14]. The presence of PEM especially at the initiation of dialysis therapy presents high risks of morbidity and mortality[15,16]. Hypoalbuminaemia which may depict malnutrition is an important predictor of mortality in CKD patients, and it is associated with cardiac disease in HD patients[13-16].

There are several techniques and methods developed for the assessment of nutritional status, no single measure provides a comprehensive evaluation, so a combination of different clinical, laboratory parameters, and technical examinations are recommended[17-19]. Some of the methods available for these assessments are too technical, expensive and not readilyavailable for routine use in developing countries.Of all the methods recommended to screen CKD patients for PEM anthropometric tests such as the body mass index (BMI), skinfold thickness (TSF), mid-arm muscle circumference (MAMC) are the methods that are routinely available for us in developing country. These methods are simple, inexpensive, non-invasive and they are highly sensitive for clinical uses in developing countries[19-21]. The reliability of anthropometric methods compared favorably with clinical and biochemical indicators in various studies[19-21]. Thus this study employed these methods to assess the PEM in our CKD patients. We therefore set out to assess the prevalence and severity of malnutrition among patients with CKD who were attending the Renal clinic of a tertiary health facility in southern Nigeria, using these simple, inexpensive, and readily available methods, and also highlighting the importance of nutritional assessments in accordance with the international society for renal nutrition so as to identify malnutrition[22].

METHODS

The study was a cross-sectional study involving 35 patients with stages 4 and 5 CKD who attended the renal clinic of a large centerin southern Nigeria.Thirty-fiveage and sex matched apparently healthy patients with no CKD were also recruited as a comparison from the general outpatient department. The subjects recruited were stable pre-dialysis patients in CKD stages 4 and 5 and patients who had been on regular maintenance haemodialysis (MHD) for at least two months. Patients with diabetes mellitus, intercurrent illnesses, history of malignancy, thyrotoxicosis, severe gastrointestinal diseases, advanced heart failure, nephrotic syndrome, severely oedematous patients, and patients with chronic liver disease were excluded. Consecutive patients who fulfilled the inclusion criteria were recruited. Approval for the study was obtained from the institution's Research and Ethics Committee. Informed consent was obtained from all participants in the study before recruitment.

Demographic and clinical data were obtained from subjects and validated with the physician record. Anthropometric indices such as body mass index (BMI), triceps skinfold thickness (TSF), mid-arm muscle circumference (MAMC). Blood was obtained forbiochemical parameters such as serum albumin,creatinine and haemoglobin. The blood sampling for dialysis patients was done mid-week and before dialysis.Triceps skinfold thickness was measured using Happendales skin fold callipers (Baty International UK). A simple measuring non-stretchable tape was used to measure the mid-upper arm circumference (MUAC). Mid arm muscle circumference (MAMC) was calculated as follows: MAMC = MUAC – (TSF X 0.314cm). The values of the TSF and MAMC obtained were compared to the reference standards and recorded as the percent of the standard[20]. The weight was obtained using a standard weighing scale and the height was obtained using a stadiometer. For the patients on dialysis, the post-dialysis dry weight was used in calculating the BMI. The mean of three measurements of BMI taken was used.

Defining features of malnutrition

We defined nutritional status in this study as any or a combination of the following:

Anthropometric measurements: The TSF, and MAMC measurements, were considered normal if within 10% of the ideal standard:mild deficit was defined as 80 to less than 90% of ideal, moderate deficit was 60 to<80%, and severe deficit was <60% of ideal.[23] The normal BMI (Weight/Height²) was 18.5-25kg/m²,mild underweight was BMI 17.5 - 18.4kg/m², moderate underweight was BMI 17.4-16.5 kg/m² and severely underweight was BMI less than 16.5kg/m².[3] Serum albumin was regarded as normal

if it wase" 3.5g/dl. Mild deficiency of albumin was 3.0-3.4g/dl, Moderate deficiency was 2.5-2.9g/dl and severe deficiency was < 2.5g/dl[3].

We allocated a score of 2 pointsfor each nutritional index (TSF, BMI, MAMC, and serum albumin) that had above normal value, 3 points for normal values, 4 points for mild range deficiency, 5 points for moderate range deficiency, and 6 points for severe deficiency. We computedtotal scores as shown in the table below.

Table 1: Malnutrition scores

INDEX	TOTALPOINTS
Normal	≤ 12 points
Mildly malnourished	13-16 points
Moderately malnourished	17-20 points
Severely malnourished	≥ 20 points

Statistical analysis: Data collected was imputed into Excel version 16.43.1 and analysed using Stata (16.1 StataCorp LLC, College Station, TX). Categorical variables were summarized as proportions and percentages (%). Continuous variables were summarized as means and standard deviations (SD) independent t-test was used to assess differences between continuous variables in 2 groups while between categorical variables, differenceswere established by Chi-square test or Fischer's exact test (with any cell frequency of less than 5). A *P*-value of ≤ 0.05 was considered significant.

RESULTS

Thirty-five patients with CKD and 35 apparently healthy adult patientswith no CKD (GFR> 60mls/min) were recruitedas the comparison group. There were 49 males and 21 females. Among the CKD patients, 20 were on haemodialysis (HD) and 15 were pre-dialysis. The mean age was 41.03 ± 13.40 years in the CKD and was 42.46± 14.93 in the comparison group p = 0.675.The mean GFR was 15.50±8.63ml/min/1.73m^{2}in the CKD patientsand for the comparison group, it was 94.38±28.74 ml/min/1.73m^{2}p < 0.0001. The mean duration of illness from the time of diagnosis of CKD was 15.18±11.19 months. In the pre-dialysis patients, the duration was shorter (9.73 ±4.73 months), while in the MHD patients the duration was 19.28±12.91 months. The dialysis patients had been undergoing hemodialysis for an average of 15.01±10.48 months. The frequency of HD was 2-3 times/week. All patients were on a standard dialysis regimenand used biocompatible polysulphone membranes.

Figure 1 displays the causes of CKD in the patients. The commonest causes were glomerulonephritis and hypertension.

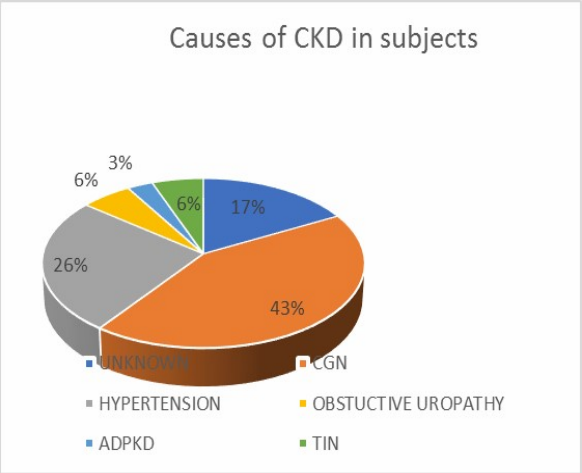

Figure 1: *Causes of CKD in subjects*

CGN – Chronic glomerulonephritis, ADPKD – Autosomal dominant polycystic kidney disease, TIN – Tubulointerstitial nephritis

Tables 2 shows a comparison of the clinical characteristics and nutritional indices of the subjects and the controlgroup. The CKD patients exhibited statistically significant differences in all the parameters except for serum albumin when compared with the control group. However, the mean total serum protein was significantly higher among the control group compared with the CKD group (7.17 ± 0.59 vs 6.83 ± 0.67 p = 0.028).

In the CKD patients, the BMI, %TSF thickness, and %MAMC were significantly lower among the HD patientscompared with the pre-dialysis patients (Table 3). Although the mean serum albumin levels were lower in the HD patients compared with the pre-dialysis patients 3.52±0.6 vs 3.91 ± 0.65, the difference was not statistically significant. (*P*=0.075)

Table 2: Characteristics of all subjects

Parameter	All CKD (n=35)	No CKD (n=35)	Test statistics	P value
Sex				
Male	25 (71.4%)	24(68.6%)	0.07*	0.794*
Female	10 (28.6%)	11(31.4%)		
Mean serum urea (mg/dl)	79.96±25.04	34.05±8.66	10.25	<0.001
Mean serum creatinine (mg/dl)	6.31±3.12	1.05±0.27	9.93	<0.001
PCV%	27.31±4.22	39.86±3.40	-13.70	<0.001
Protein excretion g/24hrs	1.69±0.56	0.52±0.3	10.89	<0.001
Nutritional indices				
BMI (kg/m^2)	20.3±3.74	25.95±3.74	-6.32	<0.001
%TSF	62.36±25.10	104.23±25.15	-6.97	<0.001
%MAMC	89.24±11.33	100.57±10.83	-4.28	<0.001
Mean Total protein g/dl	6.83±0.67	7.17±0.59	-2.25	0.028
Mean albumin g/dl	3.68±0.64	3.91±0.48	-1.70	0.094

*PCV-packed cell volume, BMI-Body mass index, RBW-Relative body weight, %TSF- Triceps skinfold thickness, %MAMC- mid-arm muscle circumference.*chi-square.*

Table 3: Characteristics of pre-dialysis and maintenance hemodialysis patients

Parameter	Pre-dialysis(n=15)	MHD (n=20)	Test statistic	P value
Sex				
Male	11(73.3%)	14 (70%)		0.567*
Female	4(26.7%)	6 (30%)		
Mean serum urea (mg/dl)	85.58±27.37	74±22.57	1.37	0.179
Mean serumcreatinine(mg/dl)	5.87±3.06	6.65±3.21	-0.73	0.473
PCV%	27.6±5.36	27.1±3.24	0.34	0.734
Protein excretion g/24hrs	1.63±0.57	1.3±0.41	1.99	0.054
Nutritional indices				
BMI (kg/m^2)	23.88 ± 3.54	20.64 ± 3.32	2.78	0.009
%TSF	74.33 ± 25.91	53.39± 20.86	2.65	0.012
%MAMC	95.64 ± 9	84.44± 10.66	3.28	0.002
Mean Total protein g/dl	6.9 ± 0.64	6.77 ± 0.7	0.56	0.577
Mean albumin g/dl	3.91 ± 0.65	3.52 ± 0.6	1.84	0.075

*PCV-packed cell volume, BMI-Body mass index, RBW-Relative body weight, %TSF- Triceps skinfold thickness, %MAMC- mid-arm muscle circumference. *fishers exact*

Tables 4 shows the prevalence of malnutrition by combining the various methods among the study subjects. Overall, 31(88.6%) of the patients with CKD had one form of malnutrition or the other while 15 (43%) of the control group had mild malnutrition($P < 0.001$).

The MHD patients were significantly more malnourished than the pre-dialysis patients (Fishers exact P=0.026). All the patients on MHD were malnourished.

Table 4: Prevalence and severity of malnutrition in subjects

Nutritional status	No CKD(35)	All CKD (35)	Pre-dialysis (15)	MHD (20)
Normal	20(57)	4(11.4%)	4(26.7%)	0
Mild	15(43%)	13 (37%)	6(40%)	7(35%)
Moderate	0	16 (46%)	5(33.3%)	11(55%)
Severe	0	2 (5.7%)	0	2(10%)
Total malnourished	15(42.9%)	31(88.6%) *	11(73.3%)	20(100%) **

Fisher's exact P= <.001*

Fisher's exact P= 0.026**

Table 5 shows the prevalence of malnutrition according to the various indices used for assessment. The highest prevalence observed was with using %TSF thickness across all the groups.

Table 5: Prevalence of malnutrition according to the various nutritional indices in subjects

Nutritional indices	No CKD n=35(%)	All CKD n = 35 (%)	Pre-dialysis n = 15 (%)	Haemodialysis n =20 (%)
%TSF	16 (45.7)	30 (85.7)	11 (73)	19 (95)
Albumin	9 (25.7)	15 (42.9)	4 (26.7)	11 (55)
%MAMC	3 (8.6)	12 (34.3)	4 (26.7)	8 (40)
BMI	1(2.9)	11 (31.4)	3 (20)	8 (40)

DISCUSSION

In this study,using our theorised instrument, malnutrition was commoner among CKD patients, especially among those on MHDcompared to normal controls. (100% in MHD patients and 73% in the pre-dialysis patients). Several reportsinliterature demonstrate a high prevalence of malnutrition in CKD patients[8-11]. For instance, the prevalence of malnutrition in Nigerian reports varied from (18-86%) using various assessment methods[8-11]. Oluseyi et al observed a prevalence of 46.7% in pre-dialysis CKD patients as against 27.5% among controls (P=0.033) and also remarked that the prevalence increased significantly across CKD stages (P=0.020) [10]. In there study like our study the instrument used in evaluating patients for malnutrition include BMI, hypoalbuminaemia and hypocholesterolemia and these are combination of clinical and laboratory parameters while we looked at those with advanced CKD that is stages 4 and 5, both pre-dialysis and hemodialysis patients using both clinical and laboratory parameters. Our study unlike Oluseyi et al study also employed a more sensitive anthropometric instrument, TSF and with this we are able to detect more PEM in CKD patients.

In the study of Liman et al malnutrition in CKD patients was 54.8% based on subjective global assessment (SGA) criteria and this under estimates

the true prevalence of PEM in CKD patients[8]. In the same study using single parameters like BMI, MUAC, TSF and albumin the prevalence of malnutrition ranged between 24,2% to 85.5% and when two parameters were combined the prevalence of malnutrition was 69.4%.The parameter out of all the parameters that suggested high level of PEM in this study was TSF (85.5% vs albumin 24.2%), however, there was no sensitivity and specificity test done.In our study, the TSF yielded higher results compared with other techniques, and this was similar to the study by Liman et al who reported aprevalence of 85.5% using TSF[8]. The prevalence of malnutrition in this study based on albumin alone was highest in the MHD patients(55%). Agaba et al reported a similarly high prevalence as defined by serum albumin < 29 g/Lin their CKD patients (43.2%)[11]. However, Agaba's patients were pre-dialysis patients. The prevalence in our pre-dialysis patients was 33%. The high prevalence of malnutrition observed in our predialysis patients highlights the fact that malnutrition is also apparent in CKD patients before commencement of MHD[11].

CONCLUSION

In conclusion, this study showed that the features of physical and biochemical malnutrition were common in CKD patients, in both pre-dialysis and MHD patients. The findings have several important implications for the nutritional care of CKD patients. Given that malnutrition is associated with increased risk of cardiovascular disease, which is a major cause of mortality in CKD patients, it is imperative to assess and to incorporate nutritional assessment as critical components in the wholistic care of all CKD patients[13,16]. Among the several methods of assessing the nutritional status of CKD patients, there is no single one that is perfect however a combination of these methods usually yields better results. We therefore recommend the combined use of the assessment methods described abovein addition to SGA in the routine evaluation of malnutrition among CKD patients in Nigeria as they are are most practical,simple to use, readily available and inexpensive.

LIMITATION

Our study is limited by the small sample size and being cross-sectional, patients were not followed up to determine if there would be an improvement in their nutritional status or other outcomes. We did not employ SGA tools, or bioelectrical impedance for assessing body composition in CKD.We also did not assess inflammation which is considered an important component of malnutrition and wasting in CKD patients.

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