Original Research Article

Study of Nutritional Status in Patients with Chronic Kidney Disease in North East India: A Hospital Based Cross Sectional Study

H. R. Bharath[1], Sawjib Borphukan[2], Ajit Kumar Pegu[3]

[1]Senior Resident, Department of Medicine, Assam Medical College and Hospital, Dibrugarh, Assam, India.
[2]Associate Professor, Department of Nephrology, Assam Medical College and Hospital, Dibrugarh, Assam, India.
[3]Professor, Department of Medicine, Assam Medical College and Hospital, Dibrugarh, Assam, India.

Abstract

Background: Chronic kidney disease (CKD) is a progressive irreversible loss of renal function over a period of months or years. Malnutrition is an important cause of morbidity and mortality in CKD. Malnutrition occurs in varying degrees with respect to the stages of CKD. Nutritional assessment in patients with CKD should be a multidisciplinary approach which has been tried to analyse in the present study. Our study aims to find out the proportion of under nutrition in patients with CKD and also aims to correlate the degree of under nutrition with stages of CKD.

Methods: The study was a Hospital based observational study conducted in Assam medical college, Dibrugarh. Study was done in patients with chronic kidney disease, aged more than 13 years, during one year duration between June 1st 2019 and May 30th 2020. Every patient was subjected to clinical examination, anthropometrical assessment, Handgrip strength testing and few biochemical parameters were also tested. Mean ± standard deviation was used to express continuous variables. Frequency and percentage were used to express categorical variables. Test of significance for qualitative data was assessed by Chi square test (for 2 x 2 tables). P value less than 0.05 was taken as statistically significant.

Results: The mean age of patients with CKD was 46.39±12.50 years, The commonest symptoms at presentation were swelling of lower limbs and other parts of the body (64.29%). Most of the cases belonged to CKD stage 5 (69.29%), followed by CKD stage 4 (24.29%) and CKD stage 3 (6.43%). Based on BMI estimation 17.14% of the patient's had undernutrition. According to Triceps Skin Fold Thickness, mid arm circumference and Hand Grip Strength measurements, undernutrition was detected in 38.57%, 60.71% and 68.57% of the cases respectively. About 44.29 % and 45% of the patients had undernutrition according to Subjective Global Assessment (SGA) form and Mini nutrition assessment scale (MNA) respectively. On estimation of biochemical markers of nutrition, anemia was found in 92.14%, hypoalbuminemia in 31.43%, hypocholesterolemia in 22.14% and Lymphocytopenia in 57.86% cases respectively. However statistical significance was attained for all the above parameters with undernutrition (P<0.05), except for hypocholesterolemia with undernutrition. The proportion of undernutrition detected by using different nutrition assessment tools in the study was found to be significantly high with an increase in severity of chronic kidney disease, CKD stage 3 to CKD stage 5 respectively (P< 0.05). However statistical significance

was not seen for hypocholesterolemia for undernutrition with severity of CKD.

Conclusion: A multimodal approach using clinical, anthropmetry and laboratory parameters to assess undernutrition in patients with CKD showed undernutrition in almost all parameters of varying degree. Undernutrition increases with its increase in severity of CKD i.e from stage 3 to 5 which were statistically significant except for hypocholestrolemia. These parameters can be used which are cost-effective, feasible in day to day clinical practice, so that early nutritional intervention can be done in patients with CKD.

Keywords: Chronic Kidney Disease, Undernutrition, Nutritional Assessment, Body Mass Index, Triceps Skin Fold Thickness, Mid Arm Circumference, Hand Grip Strength.

Background:

Chronic kidney disease (CKD) is a progressive irreversible loss of renal function over a period of months or years. CKD is defined as abnormalities of kidney structure or function, present for > 3months according to the KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease [1]. The adjusted incidence rate of ESRD is recently estimated to be 229 per million population [2], and more than 1lakh new patients enter renal replacement. Nutrition is an important factor in catabolic states such as CKD. Malnutrition is an important cause of morbidity and mortality in CKD. Malnutrition includes both undernutrition and overnutrition. In the context of catabolic state such as CKD, undernutrition is more common entity and is of prime importance. As undernutrition is a modifiable condition, nutritional assessment, therefore is crucial in chronic kidney disease patients. Undernutrition if identified early and appropriate intervention and dietary counselling leads to improved outcomes.

Nutrition screening and assessment are being infrequently performed in CKD patients. The reasons for this are multifactorial which includes the absence of a validated gold standard screening tool, multiple definitions that constitute undernutrition and difficulties with interpretation of the body composition and laboratory results in the background of volume overload and kidney dysfunction. Nutrition assessment in patients with CKD should be a multidisciplinary approach. It should ideally include measuring energy balance, anthropometry, body composition and tissue function. Many nutrition assessment methods have been developed in recent years and are used in clinical practice. Some of the tools commonly used are anthropometry, Subjective Global Assessment (SGA), Mini nutrition assessment scale (MNA), Malnutrition inflammation score (MIS), Functional assessment by handgrip strength (HGS), biochemical parameters, imaging studies, physical examination, detailed dietary history. No single measurement is highly sensitive and/or specific for identifying undernutrition. Hence multidisciplinary approach is required. At present, there are limited data on nutritional status of patients with CKD from North East India, Hence we planned to take up the study with the aim to find out the proportion of undernutrition in patients with CKD and to correlate the degree of undernutrition with stages of CKD.

Methods

This is a cross-sectional study, which was carried out in the Department of Medicine at Assam Medical College and Hospital, Dibrugarh, in North East India. We enrolled patients from outpatient and inpatient setting in this study. A total of

140 patients with CKD, were enrolled in the study, between June 1st 2019 and May 30th 2020.

Nutritional evaluation was done with a multimodal modal approach including anthropometry parameters like BMI, TSF, MAC, HGS measurement using Hand dyanamometer. Scoring systems like SGA and MNA. Laboratory parmeters like Hb%, S. Albumin, S. Cholestrol and Total lymphocyte count. Staging of CKD was done by calculating e GFR based on the Modification of Diet in Renal Disease study equation (MDRD) [3].

Inclusion Criteria: Patients with CKD with age more than 13 years and giving informed consent.

Exclusion Criteria: Patients suffering from any form of cancer, Haemodynamically unstable patients, Patients suffering from chronic diseases like Cirrhosis of Liver, HIV, Tuberculosis, Chronic obstructive pulmonary disease, Chronic Pancreatitis, Chronic Diarrhoea, Hyperthyroidism, with history of Past abdominal surgeries were excluded.

Ethics: The study was approved by the Ethics Committee of Assam Medical College and Hospital, Dibrugarh. We obtained a written informed consent from all study participants before enrolling them in the study.

Statistical Analysis

Data was entered into computer Microsoft Excel and exported to SPSS version 20 for analysis. Continuous variables were expressed as mean ± standard deviation. Categorical variables were expressed as frequency and percentage. Chi-square test (for 2 x 2 tables) was used as test of significance for qualitative data. P value was considered statistically significant when it was less than 0.05.

Results

The study population comprised of 140 patients with CKD aged more than 13 years. The mean age of patients in our study group was 46.39±12.50 years. There was male preponderance in our study with male to female ratio of 1.19: 1. The commonest symptoms at presentation were swelling of lower limbs and other parts of the body (64.29%) , decreased urine output (61.43%), fatigue (50.71%), breathlessness (48.57%), anorexia (47.14%). On assessing the severity of the chronic kidney disease by staging of CKD based on eGFR, most of the cases belongs to CKD stage 5 (69.29%), followed by CKD stage 4 (24.29%) and CKD stage 3 (6.43%).

On the measurement of BMI underweight is detected in 17.14%, normal BMI in 37.14%, overweight in 30% and obesity in 15.71% respectively; Mean±S.D. of BMI is 22.09±2.81 Kg/m².

On measuring triceps Skin Fold Thickness (TSF), mid arm circumference (MAC) and Hand Grip Strength measurements, undernutrition was detected in 38.57%, 60.71% and 68.57% of the cases respectively. The mean value of TSF, MAC, Handgrip strength was 7.60± 2.80cm, 21.33±4.7 cm and 21.5±9.1.9 kg respectively.

According to SGA, 55.71% of the patients were well-nourished, 35.71% were moderate undernourished and 8.57% were severely undernourished. According to MNA, 55% of the patients were well nourished, 30.71% had risk of malnutrition and 14.29% were poorly nourished.

On assessing Hb%, severe anaemia in 44.29%, moderate anemia in 30%, mild anemia in 17.86% and normal Hb% in 7.86% of the cases were seen. Overall of 92.27% of the study group had anaemia. Mean hemoglobin of the study group is 6.96± 2.25g/dl.

On assessing serum albumin, 31.43% of the study subjects had hypoalbumenia. The mean value of the albumin was 3.42 ± 0.35gm/dl. On assessing serum cholesterol level, 22.14%. Of the study group had

hypocholestrolemia. The mean value of serum cholesterol was 147.16 ± 25.36 mg/dl. On assessing serum Total lymphocyte count, 57.86% of the study group had Lymphocytopenia. The mean total lymphocyte count was 1462.49±466.16 cells/microliter.

Almost all the parameters mentioned above showed that undernutrition increases with increasing severity of the CKD i.e., from stage 3 to 5 and showed statistical significance (p<0.05), except for hypocolestrolemia (p=0.0875).

Table 1: Distribution of Cases According to Nutritional Status by Various Methods

Methods	Normal n (%)		Under nutrition n (%)		Obesity n (%)	
	N	%	n	%	n	%
Subjective Global Assessment (SGA)	78	55.71	62	44.29		
Mini Nutrition Assessment Scale (MNA)	77	55.00	63	45.00		
Body Mass index (BMI)	52	37.14	24	17.14	22	15.71
Triceps Skinfold Thickness (TSF)	86	61.42	54	38.57		
Mid Arm Circumference (MAC)	55	39.28	85	60.71		
Waist Circumference	39	27.85			101	72.14
Waist To Hip Ratio	23	16.42			117	83.57
Hand Grip Strength	44	31.42	96	68.57		
Haemoglobin (Hb%)	11	7.85	129	92.14		
Serum Albumin	98	68.57	44	31.43		
Serum Cholesterol	109	77.86	31	22.14		
Total lymphocyte count	59	42.14	81	57.86		

Table 2: Distribution of Cases According to Nutritional Status with Severity of CKD

Methods	Interpretation	CKD III (n = 9) n (%)		CKD IV (n = 34) n (%)		CKD V (n = 97) n (%)		p value
Subjective Global Assessment	Moderate Undernutrition SGA (B) (n = 50)	1	11.11	8	23.52	41	42.26	0.0025
	Severe Undernutrition SGA (C) (n =12)	0	0	0	0	12	35.29	0.002
Mini Nutrition Assessment Scale	Risk of Malnutrition (n=43)	1	11.11	7	20.58	35	36.08	0.004
	Malnourished (n=20)	0	0	2	5.88	18	18.55	0.01
Body Mass Index	Under Nutrition (n = 24)	0	0	3	8.82	21	27.27	0.0021
Mid arm circumference	Undernutrition(n=85)	1	11.11	17	50	67	69.07	0.0010
Triceps Skin fold Thickness	Moderate Undernutrition (n = 9)	0	0	1	2.94	8	8.24	0.0041
	Severe Undernutrition (n = 45)	1	11.11	7	20.58	37	38.14	0.004
Hand Grip Strength	Undernutrition (n = 96)	2	22.22	16	47.05	78	80.41	<0.001
Haemoglobin (gm %)	Mild Anemia (n = 25)	1	11.11	5	14.70	19	19.58	0.005
	Moderate Anemia (n = 42)	1	11.11	7	20.58	34	35.05	0.0047
	Severe Anemia (n = 62)	0	0	11	32.35	51	52.57	0.0236
Serum Albumin (mg/dl)	Hypoalbuminemia (n =44)	1	11.11	7	20.58	36	37.11	0.0408
Serum Cholesterol	Hypocholesterolemia (n = 31)	0	0	5	14.70	26	26.80	0.0875
Total Lymphocyte Count	Lymphocytopenia(n=81)	2	22.22	16	47.05	63	64.94	0.0157

Discussion

Our cross sectional study aimed to find out the proportion of under nutrition in patients with CKD and to correlate the degree of under nutrition with stages of CKD in patients age more than or equal to 13 years.

Mean age of the patients in our study was 46.39 ± 12.50 years. In this study males accounted for 54.29% and females accounted for 45.71% of the cases in a ratio of 1.19:1. This was comparable to the study done by Singh et al.[4] in 2013, who found a mean age of 45.22 ±15.2 years. Majority of the patients, that is 38 cases (27.14%) were in age group 51-60 years.

The most common presenting complain in the study group was swelling of lower limbs and other parts of the body (64.29%) followed by decreased urine output (61.43%), fatigue (50.71%), breathlessness (48.57%), anorexia (47.14%), nausea and vomiting (25%), altered sensorium (10.71%) and seizures (3.57%). This was comparable with Sharma et al.[5] in 2016. In their study too most common symptom was swelling of legs (80%).

On measurement of BMI as a parameter of undernutrition, underweight is detected in 17.14%, normal BMI in 37.14%, overweight in 30% and obesity in 15.71% respectively; Mean±S.D. of BMI is 22.09±2.81 Kg/m^2. Hence 17.14% patients had undernutrition according BMI. Study conducted by Nagabhushan et al.[6], Y.Hyun et al.[7], Windhal et al.[8] showed that according to BMI undernutrition was seen in 17%, 33.2%, 20% respectively. Our study was comparable to the above following studies.

According to SGA, SGA-A: well-nourished in 55.71%, SGA-B: moderate undernourished in 35.71%, followed by SGA-C: severe undernourished in 8.57% of the study subjects was seen. Overall undernutrition was seen in 44.29% of the study population. In the study done by Agboton et al.[9] following distribution according to SGA is seen, Normal in 63.76%, Overall malnutrition in 36.24%, Moderate malnutrition in 36.24% and Severe malnutrition in O% cases. In the study done by Windahl et al.[8] in 2017, showed that 26% of cases had moderate malnutrition, 26% had normal nutritional status and less than 1% severe malnutrition. The above finding goes in hand with our study. However the minor difference of the results could be attributable to variation in demographic, culture characteristics; eating habits which are specific to each country and ethnic group. In India we have mostly have high-calorie and low-protein diets.

According to MNA, our study shows well nourished (satisfactory) in 55%, followed by Risk of malnutrition in 30.71% and severe undernourished (poor) in 14.29% of the study subjects. In the study done by Agboton et al.[9], according to MNA, 57.05% had normal nutritional status, 31.54% had risk of malnutrition and 11.41% had severe malnutrition. In the study done by Lukasz R et al.[10] in 2017 showed that according to MNA scale, 70.21% had normal nutritional status, 27.65% had risk of malnutrition and 2.127% had severe malnutrition. In the present study as maximum of the patients have presenting complain swelling of lower limbs and other parts of the body (64.29%) including ascites, so mean waist circumference is found to be higher. Also the geographical difference in the study population may also be a contributable factor for this; hence our result may have some differences as compared to above studies mentioned.

On measurement of TSF, our study shows 9.21% of male and 3.125% female had moderate undernutrition; and severe undernutrition was detected in 27.63% of male and 37.5% of female of the study population. Overall malnutrition according to TSF is 38.57%. The finding of our study is comparable with other studies done by Cynthia MP et al.[11] in 2012, showed

31.25% undernutrition by TSF. The mean value in the present study is 7.60±2.80 cm and is comparable to the study done by Arun Sedhain et al.[12] in 2015, which shows a mean of 7.37±2.37 cm.

On measurement of MAC, our study shows that 32.14% of male and 28.7% of female study group had undernutrition. Overall undernutrition is 60.71%. Mean±S.D of MAC was 21.33±4.7 cm. Study done by Liman et al [13] in 2015, Agboton et al.[9] in 2017, Cynthia MP et al.[11] in 2012, shows that 48.4%,

42.28%, 31.25% undernutrition respectively, which are comparable to our study. Our study results have some differences compared the above studies according to MAC, as our study was undertaken in a tertiary care centre where the main pool of patients mostly belong to the low socio-economic class, there is a high chance of undernutrition irrespective of the disease, which might be the reason for increased malnutrition as compared to above studies. The Mean±S.D of MAC was 21.33±4.7cm. The study done by Arun Sedhai et al.[12] in 2015 obtained a mean MAC of 22.57±2.56 cm, which is comparable to our study.

On measurement of HGS, Our study shows that undernutrition in 64.47% of male and 73.44% of females. A total of 68.57% of the study group was having undernutrition. The mean of the study group is 21.5±9.1.9 kg. Study done by Wang et al.[14] in 2005, Neeraj B et al.[15] in 2019, Susetyowati et al.[16] in 2017 obtained mean of 19.9±10.6, 20.9±4.1, 17.3±9.3 respectively, which are comparable to our study. Study done by Susetyowati et al in 2017 showed 46% of the study population had undernutrition according HGS, which is less compared to our study. Our study results have differences compared the above studies according to HGS, as the present study was undertaken in a tertiary care centre where the main pool of patients mostly belong to the low socio-economic class,

there is a high chances of undernutrition irrespective of the disease, which might be a contributable factor.

Our study showed, severe anaemia in 44.29%, moderate anemia in 30%, mild anemia in 17.86% and normal Hb% in 7.86% of the study group was seen. Overall anaemia in 92.29% of the study population. Mean hemoglobin of the study group is 6.96± 2.25g/dl. Studies done by Bhatta et al.[17] in 2011 and Neha sundhir et al.[18] 2018, obtained 100% anaemia in CKD patients, which is almost comparable to our study.

Our study, showed hypoalbuminemia in 31.43% of the study subjects on estimation of serum albumin. The mean value of the study group was 3.42 ± 0.35gm/dl. Study done by Cameroon et al.[19] in 2013, Lydia F et al.[20] in 2015, Agboton et al.[9] 2017, showed 31.6%, 31.5% and 29.53% hypoalbumenia respectively, results of our study are comparable to the above studies.

In the present study on estimation of serum cholesterol, detected hypocholesterolemia in 22.14% of the study group. The mean was 147.16 ± 25.36 mg/dl for the whole study group. Study done by Arun Sedhai et al.[12] in 2015 and study done by Y Kim et al.[21] in 2017, obtained mean total cholesterol of 138.65 ±39.13 and 157 ±6.4 mg/dl which is comparable to our study.

In the present study, Lymphocytopenia is seen in 57.86% of the study group. The mean for the whole study group was 1462.49 ± 466.16 cells/ microlitre. Study done by Y Kim et al.[21] in 2017 obtained mean of 1597± 512 cells/microlitre. The finding of the above studies goes in hand with the our study.

Our study showed that CKD stage 5 was detected in 69.29%, followed by CKD stage 4 in 24.29% and CKD stage 3 in 6.43% of the study group respectively and no patients were detected in CKD stage 1 and 2. Study done by Abhishek Bansal et al.[22] in 2015 found that 60% of CKD

patients in Stage 5, 32% in Stage 4 and 5% patients in Stage 3, our study result is comparable to the above studies. The high number of patients in stage 5 is likely due to the fact that, majority of the cases included in the study are the admitted cases admitted in our wards who are usually stage 4 and 5 CKD. Patients of stage 1 and 2 are asymptomatic and only detected by screening programs for high risk cases.

Proportion of undernutrition detected by using different nutrition assessment tools in the study was found to be significantly high with increase in severity of chronic kidney disease, CKD stage 3 to CKD stage 5 respectively. Almost all the above paremters showed statistical significance as listed in the tabular column (p< 0.05), except statistical significance was not seen for hypocholesterolemia for undernutrition with severity of CKD (p=0.0875).

Study done by Lu Dai et al [23] in 2017 in Sweden, showed that prevalence of protein energy wasting (PEW) according to SGA increased with disease severity i.e from 2% in CKD stage 1-2, 16% in CKD stage 3-4 and 31% in CKD stage 5-Non dialyzable patient, and was 44% in dialysis patients. The prevalence of PEW increased with lower %HGS and lower serum albumin was seen. Study done by Oluseyi et al [24] in 2016, showed prevalence of malnutrition increases with decline in eGFR, (p=0.020) however this study used either Hypoalbumenia or Low BMI + Hypocholestrolemia to diagnose malnutrition. Study done by Kopple et al [25] in 2000, named as MDRD study, shows the prevalence of malnutrition increases with decline of eGFR. However this study divided patients into three categories according to eGFR(ml/kg/1.73m^2) into, eGFR <21, 21-37, >37 and used multiple parameters to assess malnutrition with reference to gender as well, However serum albumin (p<0.01) and TSF (p<0.01) showed decreasing trend with decrease in eGFR.

The findings of above studies showed similar trend in increasing/decreasing of various parameters with severity of disease as found in the present study. However there are only few studies of undernutrition in correlation with disease severity (CKD stages) and the majority of the studies of undernutrition are done in patients with ESRD (stage 5 CKD). However our study included patients of predialysis group as well, hence correlation of undernutrition by various parameters with CKD stages is done as stated above.

Conclusion

The present study demonstrated high proportion of undernutrition in patients with chronic kidney disease which is variable from 17.14% to 92.14%. by using various nutrition assessment tools. Undernutrition was detected in 92.14% of the study population by measurement of Hemoglobin (Anaemia) whereas it was found to be low in 17.14% of the study population by BMI estimation. SGA and MNA were easy and cost-effective methods of assessing nutritional status by scoring system. Nutritional status assessment is a multimodal modal approach including clinical paramters, anthropometry, scoring systems, HGS and laboratory parmeters. The proportion of undernutrition by different nutrition assessment tools increased significantly with severity of chronic kidney disease based on CKD staging except for hypocholestrolemia. Based on our study results it can be suggested to utilize which are cost-effective and easily available nutrition assessment tools for every case of CKD. And hence early nutritional status assessment and early intervention can be done.

Data sharing statement provided by the authors is available with the full text of this article at Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this

article at

References

1. Kidney Disease Improving Global Outcomes (KDIGO) CKD work group. KDIGO 2012 Clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int suppl; 2013;3(1): s19-62.
2. Modi GK, Jha V. The incidence of end-stage renal disease in India: a population-based study. Kidney Int. 2006;70(12):2131-3.
3. Matsushita K, Tonelli M, Lloyd A, Levey AS, Coresh J, Hemmelgarn BR. Clinical risk implications of the CKD epidemiology collaboration (CKD-EPI) equation compared with the modification of diet in renal disease (MDRD) study equation for estimated GFR. Am J Kidney Dis. 2012;60(2):241-9.
4. Singh AK, Farag YMK, Mittal B V, Subramanian KK, Reddy SRK, Acharya VN, et al. Epidemiology and risk factors of chronic kidney disease in India - results from the SEEK (Screening and Early Evaluation of Kidney Disease) study. BMC Nephrol. 2013;14(1):114.
5. Sharma M, Baruah S K, Teron M, Das H J. Chronic kidney disease with special reference to dyslipidemia. Int J Heal Res Med Leg Pract. 2016;2(2): 18-23.
6. S Nagabhushana ,M Ranganatha, GK Ranjith Kumar, Virupakshappa . Evaluation of nutritional status in chronic kidney disease patients undergoing hemodialysis. Int J Adv Med. 2017;4(4):907.
7. Hyun YY, Lee KB, Han SH, Kim YH, Kim YS, Lee SW, et al. Nutritional status in adults with predialysis chronic kidney disease: KNOW-CKD study. J Korean Med Sci. 2017;32(2):257-63.
8. Windahl K, Faxen Irving G, Almquist T, Liden MK, van de Luijtgaarden M, Chesnaye NC, et al. Prevalence and risk of protein-energy wasting assessed by subjective global assessment in older adults with advanced chronic kidney disease. J Ren Nutr. 2018;28(3):165-74.
9. Agboton BL, Agueh VD, Vigan J, Sourou BA, Ahoui S, Agboton CG et al. Assessing the nutritional status of hemodialysis patients in a sub-saharan country. J Kidney. 2017;03(02):1-5.
10. Rogowski L, Kusztal M, Gol^biowski T, Bulinska K, Zembron-Lacny A, Wyka J, et al. Nutritional assessment of patients with end-stage renal disease using the MNA scale. Adv Clin Exp Med. 2018;27(8):1117-23.
11. Piratelli CM, Telarolli R, Ii J. Nutritional evaluation of stage 5 chronic kidney disease patients on dialysis. Sao paulo med J. 2012;130(6): 392-399.
12. Sedhain A, Hada R, Agrawal RK, Bhattarai GR, Baral A. Assessment of nutritional status of nepalese hemodialysis patients by anthropometric examinations and modified quantitative subjective global assessment. Nutr Metab Insights. 2015; 8: 21-7.
13. Liman H, Anteyi E, Oviasu E. Prevalence of malnutrition in chronic kidney disease: a study of patients in a tertiary Hospital in Nigeria. Sahel Med J. 2015;18(5):8.
14. Wang AYM, Sea MMM, Ho ZSY, Lui SF, Li PKT, Woo J. Evaluation of handgrip strength as a nutritional marker and prognostic indicator in peritoneal dialysis patients. Am J Clin Nutr. 2005;81(1):79-86.
15. Birajdar N, Anandh U, Premlatha S, Rajeshwari G. Hand grip strength in patients on maintenance hemodialysis: An observational cohort study from India. Indian J Nephrol. 2019; 29(6): 393.
16. Susetyowati, Alfitri KN, Faza F. Validation of handgrip strength as a nutritional assessment tool for hemodialysis patients in dr. sardjito hospital, Indonesia. Pakistan J Nutr.

2017;16(10):763-9.

17. Bhatta S, Aryal G, Kafle R. Anemia in chronic kidney disease patients in predialysis and postdialysis stages. J Pathol Nepal. 1970;1(1):26-9.

18. Sundhir N, Joshi S, Adya CM, Sharma R, Garg H. Profile of anemia in chronic kidney disease patients at a rural tertiary care centre: a prospective observational study. Int J contemp med res. 2018;5(5):2454-7379.

19. Halle MP, Zebaze PN, Mbofung CM, Kaze F, Mbiatat H, Ashuntantang G, et al. Nutritional status of patients on maintenance hemodialysis in urban sub-Saharan Africa: evidence from Cameroon. J Nephrol. 2014;27(5):545-53.

20. Foucan L, Merault H, Velayoudom FL, Larifla L, Cosmin A, Ducros J. Impact of protein energy wasting status on survival among afro-Caribbean hemodialysis patients: a 3-year prospective study. Springerplus. 2015; 4(1):452-8.

21. Kim YN, Shin HS. Relationships of total lymphocyte count and subpopulation lymphocyte counts with the nutritional status in patients undergoing hemodialysis/peritoneal dialysis. Kosin Med J. 2017;32(1):58.

22. Bansal A, Kakrani AL, Gokhale VS, Harale M, Bale C. Study of endoscopic findings in CKD patients with dyspepsia. Indian J Basic Appl Med Res. 2015;5(01):591-6.

23. Dai L, Mukai H, Lindholm B, Heimburger O, Barany P, Stenvinkel P, et al. Clinical global assessment of nutritional status as predictor of mortality in chronic kidney disease patients. PLoS One. 2017;12(12):e01 86659.

24. Oluseyi A, Enajite O. Malnutrition in pre-dialysis chronic kidney disease patients in a teaching Hospital in Southern Nigeria. Afri Heal Sci. 2016; 16(1):234-41.

25. Kopple JD, Greene T, Chumlea WC, Hollinger D, Maroni BJ, Merrill D, et al. Relationship between nutritional status and the glomerular filtration rate: results from the MDRD study. Kidney Int. 2000;57(4):1688-703.