Original

Effectiveness of Medical Nutrition Therapy in Improving Prognostic Nutritional Index Scoring among Dietitian Referred Chronic Kidney Patients: A Retrospective Study at Hospital Kuala Lumpur, Malaysia

Jayvikramjit Singh[1], Basmawati Baharom[1], Zamtira Seman[2], Lye Sing Ie[1], Nor Fazlyn Zakaria[1]

[1] *Department of Dietetics and Food Service, Hospital Kuala Lumpur, Malaysia*
[2] *National Institutes of Health, Selangor, Malaysia*

ABSTRACT

Background and purpose: The prognostic nutritional index (PNI) is a simple assessment tool to determine the nutritional status of patients. The purpose of this study was to assess the effectiveness of MNT in improving PNI scoring among chronic kidney patients.

Methods: This retrospective study used data of patients seen by Dietitians in 2022. Descriptive analysis was used to describe patient characteristics, prevalence of CKD patients and PNI scoring. Analysis of PNI towards factor and parameter associated was done using Generalized Estimating Equation (GEE). A *p*-value of < 0.05 was set as the cutoff for statistical significance.

Results: There were significant association ($p<0.05$) for variables such as PNI, hemoglobin, total protein, albumin and urea. There was also positive improvement for PNI scoring, hemoglobin, total protein, albumin. There was also reduction in urea, potassium, phosphate, uric acid, fasting blood sugar and total cholesterol among referred patients to dietitian. Significant association of PNI with hypercholesterolemia ($p=0.017$), albumin ($p=0.003$), total protein ($p=0.003$), creatinine ($p=0.01$), phosphate ($p<0.001$), uric acid ($p=0.043$) and eGFR ($p=0.013$) among patients referred to dietitian. No significant association was noted between BMI and PNI.

Conclusion: Results of current study suggests that medical nutrition therapy is an important aspect of management for chronic kidney patients. Patients with improved PNI scoring which were seen by dietitian showed better nutritional status compared to those patients who did not receive dietary consultations from dietitians. Further study with large coverage may give a concrete or better results in future

Keywords: Prognostic Nutritional Index, Chronic Kidney Disease, End Stage Kidney Disease, Low Protein Diet, Medical Nutrition Therapy

INTRODUCTION

The prognostic nutritional index (PNI) is a simple assessment tool to determine the nutritional status of patients (1). It is calculated by combining serum albumin levels and total lymphocyte counts, which are two indicators of nutritional status or malnutrition and immune function (2). PNI has been shown to be a useful tool in predicting mortality among many populations, including end stage renal patients on dialysis (3).

A study published in the Journal of Renal Nutrition in 2021 investigated the prognostic value of PNI in predicting mortality in 671 hemodialysis patients with CKD (4). The study found that lower PNI values were associated with higher mortality rates, even after adjusting for other factors such as age, sex, and comorbidities (4). Similarly, a study published in the Journal of Cachexia, Sarcopenia and Muscle in 2020 found that PNI was a significant predictor of mortality among Chronic Kidney Disease (CKD) patients undergoing hemodialysis (5). The study also found that PNI was more accurate than other nutritional indices such as the geriatric nutritional risk index and the controlling nutritional status score (5).

PNI has also been also researched among peritoneal dialysis patients. A study conducted by Sijia et al concluded that low PNI levels were independently associated with the first occurrence of pneumonia in PD patients (6-8). PNI was an independent predictor of new-onset pneumonia in PD patients (6-8).

PNI has been also used as a prognostic tool among diabetic nephropathy patients. This study aimed at the long-term effects of prognostic nutritional index (PNI) on renal outcomes in patients with diabetic nephropathy (DN) and type 2 diabetes mellitus (9-10).

*To whom correspondence should be addressed: jayvikramjit@yahoo.co.uk

Results from this study proved that PNI correlated with eGFR and glomerular injury and was an independent predictor for DN progression in patients with T2DM (9-10).

This study might help to strengthen the PNI as tool to determine as a strong prognostic tool for CKD patients. PNI is a simple tool that can be used to determine nutritional status of CKD patients. Since it is easy to use and only requires two variables (albumin and lymphocytes level) to calculate malnutrition status of CKD patients, it will enable clinicians to better diagnose malnutrition among CKD patients.

Medical nutrition therapy (MNT) has been proven in effectively improving CKD patients' nutritional status (11). However, research on effectiveness of MNT improving patients PNI scoring among CKD patients has not done before in Malaysia. We hope the results of this study will help dietitians and other healthcare personnel to use PNI as a diagnostic tool for better patient outcome in terms of improving nutritional status and patient care.

Objective

General Objective

To assess the effectiveness of MNT in improving PNI scoring among CKD patients

Specific Objectives

To determine the effectiveness of Medical Nutrition Therapy (MNT) in improving patients' nutritional status

To determine the association between Prognostic Nutritional Index (PNI) and clinical outcomes (nutritional status and renal function) in patients with Chronic Kidney Disease (CKD) receiving dietary counselling.

MATERIALS AND METHODS

Study Type and Design

This was a retrospective study that was conducted at Hospital Kuala Lumpur. This study used Malaysian Dietetics Care Notes (DCN) which is the standard documentation form used by Dietitians. Sample size targeted for this study was 352 patients. Chronic Kidney Disease patients at Nephrology outpatient clinic referred to Dietitian and patients not referred to Dietitian from 1st January 2022 until 31st December 2022 were included in this study. A minimum of at least two follow up by dietitian was required for analysis purposes. The end point of the study was the accuracy of PNI in determining nutritional status of CKD patients. Flow chart of this study is explained as below.

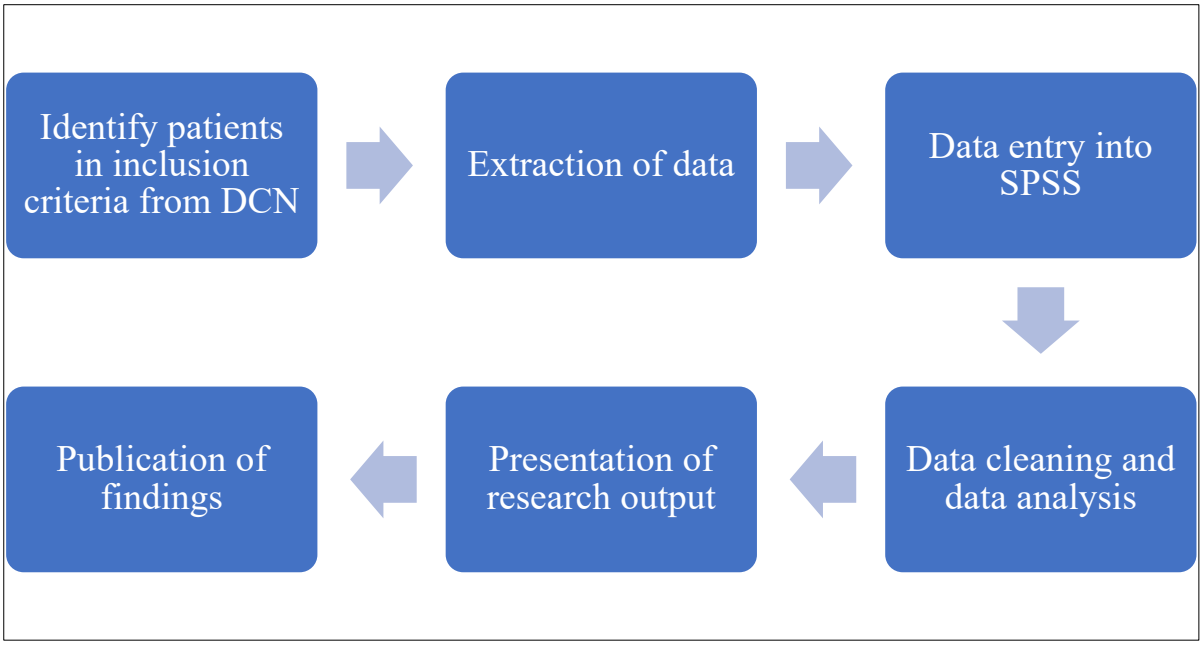

Figure 1: Flow chart for data collection

Study Tool

This study used PNI scoring as a nutritional tool. The PNI was calculated by 5×lymphocyte count (109 /L) +serum albumin (g/L) in this study. Scoring for PNI was determined by low (<40), moderate (40-45), high >45. Clinical information of patients was collected from DCN. Laboratory test results was obtained from Lab Information System (LIS) at Nephrology Clinic, Hospital Kuala Lumpur, Malaysia. All information included demographic data such as age, gender, ethnicity, medical history such as hypertension, diabetes, heart disease, examination data such as

weight, height, blood pressure, laboratory data such as serum creatinine, blood urea nitrogen, total serum uric acid, total cholesterol, HbA1c, fasting blood sugar, proteinuria.

Medical nutrition therapy based on The National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) Guidelines 2020 was given to patients that were referred to dietitian (12). Patients were given a diet comprised of 1) dietary protein intake of 0.6 to 0.8 g/kg/day from 50% plant-based sources, 2) fiber intake of 25 g/day, 3) low-sodium intake of less than 5 g/d and 4) adequate caloric intake of 30 to 35 kcal/kg/day. If patient has a co-morbidity of diabetes and other form of non-communicable diseases, the MNT shall be individualized according to the patient's diseases.

Study Population & Sampling Method

This was a simple random sampling that referred to eligible patients (chronic kidney disease patients) referred and seen by Dietitian as well as patients not referred to Dietitians from 1st January 2022 until 31st December 2022.

Inclusion Criteria

a) All patients referred to dietitian by medical officers/nephrologists
b) Aged 18 years and above
c) Available PNI values (albumin and lymphocytes count)
d) Complete medical records
e) Patients with follow up at least 1 year

Exclusion Criteria

a) Patients with a history of cancer, autoimmune diseases, or chronic infections.
b) Missing data
c) Patients with end stage renal disease at baseline
d) Deaths

Withdrawal Criteria

Not applicable

Sample Size

We used G*Power version 3.1.9.4 to determine the required sample size for detecting an improvement in PNI scoring with a medium effect size of 0.3, a significance level of 5%, and a power of 80%, this study required sample 176 per arm. The two arms were referring to patients referred to dietitians and patients not referred to dietitians. Total patients for both required arms were 352 patients. As no information on effect size was available for this particular factor, we chose to use Cohen's guidelines for effect size interpretation to determine the target effect size.

Study Duration and Timeline

- Stage 1, proposal development - 1 month
- Stage 2, data collection and data analysis - 2 months
- Stage 3, presentation and publication - 2 months

Study Visits and Procedures

The data of concern involved outpatient patients seen by Dietitian and not seen by Dietitian at Outpatient Nephrology Clinic from 1st January 2022 until 31st December 2022. These data were retrieved from copies of Dietetic Care Notes (DCN) which was stored at Dietetic Clinical Store Office. The days of referral and follow ups were within the stipulated time of 1st January 2022 until 31st December 2022. Dietitians of Hospital Kuala Lumpur retrieved the data from Dietetic Clinical Store Office and Lab Information System (LIS) and entered the variables of concern into SPSS for further analysis. These data collection period commenced from 1st January 2024 until 31st January 2024.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS, IBM, Chicago, IL) version 26 was utilized for data analysis. Continuous variables were assessed for normality using the Kolmogorov-Smirnov test. Normally distributed variables were presented as mean ± standard deviation and compared using t-tests or one-way analysis of variance (ANOVA). Non-parametric variables were presented as median (interquartile range) and compared using the Mann-Whitney or Kruskal-Wallis test. In cases where significant differences were observed in ANOVA or Kruskal-Wallis test, post-hoc Tukey comparison or Bonferroni correction was employed.

Categorical variables were presented as counts and percentages and analyzed using Pearson's chi-squared test or Fisher's exact test. The strength of the relationship between variables was assessed using Pearson's bi variate correlation. Kaplan-Meier and Cox-regression was used to estimate disease progression. A significance level of $p < 0.05$ was used to determine statistical significance.

Risk and benefit to study participants

There were no risk and benefit to the participants as this was a retrospective study which did not involve direct contact with any patient.

Risk Benefit Assessment

Assessment using PNI should be considered to treat malnutrition which might lead to significant improvement in relation to treating and improving nutritional status of CKD patients. The results of this study may help clinicians identify patients with low PNI scores and improve their clinical outcome. Clinicians will be able to accurately identify the impact of PNI scoring on patient nutritional outcome. Results from this study will enable Dietitians to further strengthen the usage of PNI as a prognostic tool for treating malnutrition.

Ethics of Study

Ethical approval was needed from the Medical Research and Ethics Committee, Ministry of Health Malaysia. This research was registered with National Medical Research Register (NMRR), Malaysia under the registration identification number of NMRR ID-23-03077-3ZW.

Ethical approval was obtained from other relevant approvals prior to the start of any study related activities. The study was performed in compliance with the principles of the Declaration of Helsinki, in accordance with the International Conference of Harmonization Guideline for Good Clinical Practice, and in accordance with applicable regulatory requirements.

Informed Consent/Assent Process

Waiver of consent was requested and was granted by Medical Research and Ethics Committee (MREC) in view of retrospective study and no patient/participant contacts.

Privacy and Confidentiality

Subject's names were kept on a password-protected database and were linked only with a study identification number for this research. The identification number instead of patient identifiers was used on subject data sheets. All data were entered into a computer that was password protected. On completion of study, data in the computer was copied to thumb drives and the data in the computer erased. Thumb drives and any hard copy data were stored in a locked office of the investigators and maintained for a minimum of three years after the completion of the study. The thumb drives and data will be destroyed after that period of storage. Study will not be shared with any third party.

Termination of Study

Not applicable

RESULTS

Table 1: Patient characteristics stratified by Dietitian Referred (N=300)

Variable	Dietitian Referred			p-value
	Yes	No	Total	
Gender				
Female	73 (50)	73 (50)	146	>0.999[a]
Male	77 (50)	77 (50)	154	
Ethnicity				
Malay	93 (48.7)	98 (51.3)	191	0.393[b]
Chinese	34 (51.5)	32 (48.5)	66	
Indian	21 (51.2)	20 (48.8)	41	
Others	2 (100)	0 (0)	2	
Diabetes mellitus				
Yes	108 (56.5)	83 (43.5)	191	0.003[a]
No	42 (38.5)	67 (61.5)	109	
Hypertension				
Yes	131 (51.6)	123 (48.4)	254	0.200[a]
No	19 (41.3)	27 (58.7)	46	
Hypercholesterolemia				
Yes	81 (48.5)	86 (51.5)	167	0.561[a]
No	69 (51.9)	64 (48.1)	133	
Heart Disease				
Yes	25 (52.1)	23 (47.9)	48	0.753[a]
No	125 (49.6)	127 (50.4)	252	
BMI category				
Underweight	7 (70)	3 (30)	10	0.092[a]
Normal	41 (53.2)	36 (46.8)	77	
Overweight	47 (50.5)	46 (49.5)	93	
Obese	46 (68.7)	21 (31.3)	67	

[a]Chi Square, [b]Exacts

Table 2: Parameter changes for overall patients and stratified by dietitian referred.

Parameter	Referred (n=150)			Not-Referred (n=150)		
	Mean (SD)			Mean (SD)		
	Before	After	Mean diff (95%CI)	Before	After	Mean diff (95%CI)
Prognostic Nutritional Index	46.79 (5.31)	47.72 (4.87)	0.93 (0.32, 1.54)**	46.92 (5.27)	46.55 (4.72)	-0.37 (-0.94, 0.2)
Hemoglobin	11.93 (1.84)	12.1 (1.92)	0.17 (0.04, 0.31)*	11.87 (2.04)	11.96 (1.87)	0.09 (-0.11, 0.28)
Total Protein	76.11 (5.67)	76.97 (5.92)	0.86 (0.15, 1.57)*	71.97 (6.77)	72.07 (6.23)	0.1 (-0.58, 0.78)
Albumin	35 (4.06)	35.4 (3.73)	0.4 (0.01, 0.79)*	35.35 (3.6)	35.63 (3.32)	0.28 (-0.17, 0.73)
Urea	11.39 (7.22)	10.25 (3.94)	-1.14 (-2.18, -0.1)*	7.58 (3.39)	7.86 (3.41)	0.28 (0, 0.56)
Creatinine	198.12 (89.22)	202.41 (87.73)	4.29 (-0.99, 9.58)	153.8 (82.86)	155.44 (84.71)	1.64 (-4.57, 7.85)
Potassium	4.62 (0.73)	4.55 (0.67)	-0.07 (-0.18, 0.04)	4.7 (0.69)	4.73 (0.68)	0.03 (-0.09, 0.15)
Phosphate	1.24 (0.21)	1.22 (0.21)	-0.02 (-0.05, 0.01)	1.25 (0.34)	1.29 (0.44)	0.04 (-0.01, 0.08)
Uric acid	471.26 (113.1)	464.36 (105.49)	-6.9 (-20.86, 7.06)	461.33 (101.22)	464.53 (91.05)	3.21 (-8.65, 15.06)
Fasting Blood Sugar	7.28 (3.43)	7.11 (3.64)	-0.17 (-0.71, 0.37)	6.14 (1.95)	6.39 (2.32)	0.25 (-0.02, 0.53)
HBA1C	7.64 (1.36)[a]	7.49 (1.76)[a]	-0.16 (-1.56, 1.24)	8 (0)[b]	8.3 (0)[b]	-
EGFR	33.44 (19.31)	32.8 (19.35)	-0.64 (-1.5, 0.23)	44.13 (17.07)	42.87 (17.34)	-1.26 (-2.04, -0.49)**
Total Cholesterol	4.7 (1.36)	4.53 (1.31)	-0.17 (-0.36, 0.01)	4.46 (1.09)	4.44 (1.17)	-0.02 (-0.19, 0.14)

*p<0.05, **p<0.05, ***p<0.001, [a]n=7, [b]n=1, [c]N=8

Table 3: Analysis of PNI towards factor and parameter associated using Generalized Estimating Equation (GEE)

Variable	Overall		Referred		Not-Referred	
	β (95%CI)	p-value	β (95%CI)	p-value	β (95%CI)	p-value
Dietitian						
Referred	0.52 (-0.54, 1.58)	0.336				
Not referred	1					
Gender						
Female	-1.01 (-2.07, 0.05)	0.061	-0.74 (-2.24, 0.76)	0.334	-1.28 (-2.77, 0.20)	0.090
Male	1		1		1	
Ethnicity						
Malay	0.53 (-0.70, 1.75)	0.398	-0.47 (-2.31, 1.38)	0.620	1.11 (-2.30, 4.52)	0.523
Indian	0.59 (-1.39, 2.57)	0.561	0.10 (-1.93, 2.13)	0.924	-	
Others	1.78 (0.56, 3.01)	0.004	0.83 (-0.83, 2.50)	0.328	1.58 (0.05, 3.11)	0.043
Chinese	1		1		1	
Diabetes mellitus						
Yes	-1.00 (-2.07, 0.07)	0.068	-1.00 (-2.67, 0.68)	0.243	-1.23 (-2.69, 0.23)	0.099
No	1		1		1	
Hypertension						
Yes	-1.49 (-3.12, 0.14)	0.074	-2.45 (-5.49, 0.59)	0.115	-0.88 (-2.62, 0.86)	0.322
No	1		1		1	
Hypercholesterolemia						
Yes	-0.48 (-1.58, 0.63)	0.398	-1.84 (-3.36, -0.32)	0.017	0.95 (-0.62, 2.51)	0.235
No	1		1		1	
Heart disease						
Yes	0.03 (-1.42, 1.47)	0.973	1.03 (-0.96, 3.01)	0.312	-1.07 (-3.05, 0.91)	0.289
No	1		1		1	
Body Mass Index						

Variable	Overall		Referred		Not-Referred	
	β (95%CI)	p-value	β (95%CI)	p-value	β (95%CI)	p-value
Underweight	1.19 (-2.40, 4.77)	0.516	0.05 (-4.52, 4.62)	0.984	3.81 (-0.77, 8.38)	0.103
Normal	0.16 (-1.55, 1.86)	0.858	0.67 (-1.28, 2.62)	0.502	-0.14 (-3.58, 3.29)	0.934
Overweight	0.83 (-0.85, 2.52)	0.333	0.92 (-1.07, 2.92)	0.365	1.06 (-2.33, 4.45)	0.540
Obese	1		1		1	
Age	0.01 (-0.04, 0.06)	0.618	-0.01 (-0.09, 0.07)	0.798	0.02 (-0.04, 0.08)	0.463
Body Mass Index	-0.02 (-0.14, 0.10)	0.751	-0.04 (-0.19, 0.11)	0.611	0 (-0.2, 0.21)	0.970
Total Protein	0.13 (0.06, 0.20)	<0.001	0.17 (0.06, 0.27)	0.003	0.11 (0.02, 0.21)	0.023
Albumin	0.80 (0.69, 0.90)	<0.001	0.80 (0.67, 0.93)	<0.001	0.79 (0.64, 0.95)	<0.001
Urea	-0.09 (-0.22, 0.04)	0.191	-0.09 (-0.25, 0.07)	0.260	-0.16 (-0.30, -0.02)	0.023
Creatinine	-0.01 (-0.01, <-0.001)	0.007	-0.01 (-0.02, <-0.001)	0.010	-0.01 (-0.01, <-0.001)	0.044
Potassium	0.49 (-0.08, 1.06)	0.093	0.24 (-0.58, 1.06)	0.564	0.73 (0.02, 1.43)	0.043
Phosphate	-1.13 (-2.23, -0.02)	0.046	-4.67 (-7.25, -2.08)	<0.001	0.12 (-0.87, 1.12)	0.809
Uric Acid	0.00 (-0.01, 0.00)	0.214	-0.01 (-0.01, <-0.001)	0.043	0.00 (0.00, 0.01)	0.640
Fasting Blood Sugar	-0.12 (-0.26, 0.03)	0.119	-0.05 (-0.18, 0.08)	0.428	-0.36 (-0.82, 0.10)	0.126
HBA1C	0.19 (-0.61, 0.98)	0.644	0.93 (-0.65, 2.51)	0.247	-0.11 (-1.10, 0.89)	0.831
EGFR	0.03 (0.00, 0.06)	0.025	0.05 (0.01, 0.09)	0.013	0.03 (-0.02, 0.08)	0.241
Total Cholesterol	-0.26 (-0.61, 0.10)	0.155	-0.29 (-0.75, 0.17)	0.222	-0.22 (-0.76, 0.32)	0.430

Table 1 showed a total of 300 patients were finally recruited after considering the inclusion and exclusion criteria. There was equal distribution of respondents between gender (50%) with Malay ethnicity being the majority (48.7%). Most respondents had comorbidities such as diabetes (56.5%), hypertension (51.6%) and high cholesterol (48.5%). Most of the respondents were obese (68.7%).

Results from Table 2 showed significant association ($p<0.05$) for variables such as PNI, hemoglobin, total protein, albumin and urea. There was positive improvement for PNI scoring, hemoglobin, total protein, albumin. There was also reduction in urea, potassium, phosphate, uric acid, fasting blood sugar and total cholesterol among referred patients to dietitian.

Results from Table 3 showed significant association of PNI with hypercholesterolemia ($p=0.017$), albumin ($p=0.003$), total protein ($p=0.003$), creatinine ($p=0.01$), phosphate ($p<0.001$), uric acid ($p=0.043$) and eGFR ($p=0.013$) among patients referred to dietitian. No significant association was noted between BMI and PNI.

DISCUSSION

To the best of our knowledge, this is the first study that has been done in Malaysia involving MNT and its effect on improvement of PNI scoring. Besides improvement of PNI scoring, clinical implications of our findings is that delivery of MNT by Dietitians showed improvement in chronic kidney disease and its related parameters such as fasting blood sugar, urea, total cholesterol and albumin.

Improvement of variables such as hemoglobin, albumin, phosphate and total protein was very much relayed to the adequate protein that was provided during dietary counseling (12). A low protein diet helped improved and lower down the urea levels of respondents (13,14). A plant dominant diet generally reduces uremic levels in the body (12,13,14). The low protein diet is beneficial, because they reduce the production of protein-derived waste products, the retention of protein-derived toxins and fixed acids, lower single nephron glomerular hyper filtration and proteinuria, and reduce dietary phosphate load (15). Since albumin levels had increased significantly, this might had contributed to the improved scoring of PNI.

Improvement of fasting blood sugar and total cholesterol in general wad attributed by the adequate fiber intake (13-14). This plant based diet helps to regulate lipids and achieve better glycemic control among diabetic nephropathy patients (13-14). The KDOQI 2020 guidelines also emphasized on interventions using omega 3 and 6 fats for better lipid control (12). A reduction of saturated fatty acids (SFA) and trans-fat intake contributes to a reduction in risk of cardiovascular disease in patient which is part of the KDOQI 2020 guidelines (12).

In CKD clinics, medical nutrition therapy (MNT) should be emphasized and requires the same level of importance as pharmacological treatment (16). In this study, we would like to highlight that MNT should be a cornerstone of the management of CKD as well as of other chronic diseases. Provision of MNT for pre dialysis patients has proven evidence of delaying the need for dialysis (17,18). All patients regardless of stages of chronic kidney disease should be referred to dietitian for better disease management and patient outcome.

Limitations of our study was that it has a small sample size and it was a single center study. A prospective intervention study with larger sample size would yield stronger clinical results. The main strength of our study was that the results were similar and consistent with other studies that indicates the effectiveness of MNT in patients' nutritional status. Future studies on effectiveness of PNI in improvement of patient survival should be considered. A cohort study specially designed to determine whether a high PNI scoring can delay the need for dialysis or delay the progression of kidney disease among Malaysian CKD patients.

Conclusion

Results of current study suggests that medical nutrition therapy is an important aspect of management for chronic kidney patients. Patients with improved PNI scoring showed better nutritional status compared to those patients who did not receive dietary consultations from dietitians. Further study with large coverage may give a concrete or better results in future.

Conflict of Interest

The investigators declared they had no conflict of interest

Publication Policy

No personal information was disclosed when the findings of the survey were published. Manuscript were submitted to National Institutes for Health, Malaysia for Director General's approval prior to any publication and presentation.

ACKNOWLEDGMENT

The authors wish to thank the Director General of Health Malaysia for his permission to publish this study and all the team members for their participation in this study.

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