ORIGINAL ARTICLE

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Association of Dialysis Malnutrition Score with Hypoglycemia and Quality of Life among Patients with Diabetes on Maintenance Hemodialysis

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Abstract

Objective. To determine the association between Dialysis Malnutrition Score (DMS), hypoglycemia and quality of life among patients with Diabetes on Maintenance Hemodialysis (MHD).

Methodology. Ninety-two diabetic patients on maintenance hemodialysis were assessed using a standardized data collection tool, Dialysis Malnutrition Score, WHOQoL-BREF questionnaire, anthropometric measurements and hourly blood sugar monitoring during the dialysis session. Association among DMS, hypoglycemia and quality of life were assessed along with other associated variables.

Results. Based on the DMS, 62% of patients were malnourished. Those with malnutrition were significantly older (p=0.0006) and female (p=0.013). Only 6.5% of the participants developed hypoglycemia during dialysis. Those with poor nourishment in the DMS showed a significant trend of decrease in the quality of life (physical (p<0.001), psychological (p<0.001) and social (p=0.004) and is associated with the occurrence of hypoglycemia (p<0.001).

Conclusion. Malnutrition is prevalent in diabetic patients on MHD using DMS. A higher DMS score is highly correlated with increased risk of hypoglycemia and decreased quality of life hence detection of malnutrition is important to prevent further nutritional depletion, hypoglycemia and poor patient outcomes by implementing preventive measures such as nutritional counselling and psychosocial interventions.

Key words: malnutrition, Dialysis Malnutrition Score, hypoglycemia, quality of life, dialysis

INTRODUCTION

According to the International Diabetes Federation, in 2017, 425 million adults are currently estimated to have diabetes and the Philippines is one of the world's emerging diabetes hotspots with 3.7 million Filipinos diagnosed with the disease.[1] The increasing prevalence of diabetes has also led to an increase in the number of complications such as diabetic kidney disease (DKD). DKD, which occurs in 20-40% of all diabetics,[2] is the single strongest predictor of mortality in patients with diabetes and remains to be the most common reason for progressing to end stage renal disease (ESRD) requiring maintenance hemodialysis (MHD).[3,4] DKD predisposes patients to protein energy wasting (PEW), with a 40-70% prevalence among patients on MHD.[5-7] PEW is associated with deterioration of disease condition, impaired wound healing, predisposition to hypoglycemia, depression, increased morbidity, mortality, hospitalization rate and susceptibility to infection which results in poor quality of life.[8-11] Routine screening of PEW in dialysis patients is seldom done because of difficulty of an accurate determination of the nutritional status which requires procedures such as anthropometric, body composition and biochemical measurements; and functional, dietary and subjective assessments which are time consuming, not cost effective and inconvenient to most dialysis centers.[12-13]

There are different tools used to detect PEW in patients with MHD and these were proven to be correlated with dietary intake, anthropometric measurements and laboratory assessments related to nutrition.[7,10,13-15] Previously, the Subjective Global Assessment (SGA) was the most commonly used method but is only semi-quantitative which has restricted reliability and precision.[16] Subsequently, a fully quantitative nutritional scoring system, the Modified Subjective Global Assessment or Dialysis Malnutrition Score (DMS) and Malnutrition Inflammation Score (MIS), were developed which incorporated the advantages of SGA and extended its reliability and precision.

DMS consists of 7 variables such as weight change, dietary intake, gastrointestinal symptoms, functional capacity, co-morbidity, decreased fat stores and signs of muscle wasting. MIS, on the other hand, includes the 7 components of the DMS plus 3 new components: BMI, serum albumin and TIBC. Both the DMS and MIS correlated significantly

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in MHD patients and are valid tools to be used for nutrition screening, it also has advantage that it can detect small changes in nutrition status overtime which can guide the physician for the assessment of nutrition intervention.[16] DMS and MIS has a sensitivity of 94% and 87% and specificity of 88% and 96%, respectively in comparison with SGA.[17] With these tools, detection of malnutrition can be easily done within minutes. DMS is a more sensitive, practical and simpler tool to detect malnutrition in routine hospital assessments.[14]

There are very limited local studies regarding the nutritional status of dialysis patients and the use of such tools to detect malnutrition reliably and conveniently. DMS can be used in all dialysis centers; it can anticipate early nutritional depletion, help the physician prevent any health deterioration, morbidity and mortality by implementing preventive measures such as nutritional counselling and psychosocial interventions which can reduce the risk of complications and can be valuable towards improving quality of life and patients' outcomes.

OBJECTIVES

This study aims to determine the association between Dialysis Malnutrition Score (DMS), hypoglycemia and quality of life among patients with Diabetes on Maintenance Hemodialysis (MHD) in Chinese General Hospital and Medical Center. It also aimed to determine the following: the prevalence of malnutrition among patients with Diabetes on MHD using DMS, the prevalence of hypoglycemia among patients with DKD on MHD, the quality of life of patients with DKD on MHD using WHOQoL-BREF questionnaire, the correlation between DMS and WHOQoL-BREF in diabetic patients on MHD and the association between the occurrence of hypoglycemia and DMS in diabetic patients on MHD.

METHODOLOGY

This is a cross-sectional study conducted between August to November 2017 at the Hemodialysis Unit of Chinese General Hospital and Medical Center, Manila, Philippines. All adult patients, at least 18 years of age with Diabetes Mellitus on maintenance hemodialysis for at least 3 months were included. The exclusion criteria were as follows: kidney transplant patients, acute infection or sepsis, multi-organ failure, coma, hospitalization in the last 3 months, ongoing oral or parenteral nutritional supplementation, use of steroidal, anti-inflammatory or immunosuppressive agents, receiving protein supplementation including amino acids or any nutritional supplements except for folic acid within 3 months prior to enrollment, history of psychological disorder such as schizophrenia and patients participating in other studies involving nutrition.

Data collection tools and methods

Patient's data

Written informed consent was obtained from a total of 92 participants. A standardized data collection tool was prepared for each subject and data was collected prospectively through interview, review of medical records and laboratory data from the dialysis charts. The questionnaire included the patient's age, gender, occupation, civil status, educational background, financial status, hemodialysis schedule, hemodialysis duration, diabetes duration, creatinine, serum albumin, comorbid conditions and medications (Appendix 1).

Dialysis Malnutrition Score (DMS)

A validated Modified Subjective Global Assessment or Dialysis Malnutrition Score (DMS) (Boado J et al., Nutritional Assessment of patients on maintenance hemodialysis using Dialysis Malnutrition Score) consists of 7 features: weight change, dietary intake, GI symptoms, functional capacity, co-morbidity, subcutaneous fat and signs of muscle wasting (Appendix 2). Patients were interviewed and charts reviewed to gather the pertinent medical history. For weight change, the overall change in the post dialysis dry weight was obtained. The lowest score of one was given if there was no weight change or if patient had gained weight. Score of two was given for minor weight loss (<5%), score of three for weight loss of >10%, score of four for weight loss of 10-15% and score of five for any weight loss over 15% in the last 6 months. Dietary intake was scored one if it was considered as a regular solid intake with no recent change in the amount or quality of the meals, two for sub-optimal solid diet, three for full liquid diet or any moderate overall decrease, four for hypocaloric liquid and five for starvation. Gastrointestinal (GI) symptoms were scored one if there was no symptom, two for nausea, three for vomiting or any moderate GI symptoms, four for diarrhea and five for severe anorexia. Functional capacity was scored one for normal functional capacity and/or any considerable improvement in the level of previous functional impairment, two for any mild to moderate difficulty with ambulation, three for difficulty with normal activity, four for difficulty with light activity and five for bed/chair-ridden state. The co-morbidity was scored one if there was no medical problems and if the patient has been on MHD for less than one year; two if there was mild co-morbidity or if the patient has been on MHD for one to two years; three if there was moderate co-morbidity or if the patient had been dialyzed for two to four years, or if the patient was >75 years of age; four if there was severe co-morbidity or if the patient had been dialyzed for over four years; and five if there were very severe, multiple co-morbidities. Subcutaneous fat was scored by assessing subcutaneous fat deposition in four body areas: below the eyes, triceps, biceps and chest. Signs of muscle wasting were obtained by examining the temple, clavicle, scapula, ribs and quadriceps. Each component was assigned a score from 1 (normal), 2 to 4 (moderate malnutrition) and 5 (severe malnutrition). A lower score (7-10) denotes tendency towards a normal nutritional status while a higher score (>10) is considered to be an indicator of the severity of malnutrition.

Anthropometric measurement

Body dry weight, height and skin-fold measurements were performed immediately after termination of dialysis session. Triceps skin–fold (TSF) in millimeters was measured using skin–fold caliper and Mid-arm circumference (MAC) in centimeters was measured using a tape measure. Body mass index was calculated using the formula kg/m^2. All the above measurements were performed two times on the non-access arm of each dialysis patient and the average result of the two measurements were registered as the final result.

Blood glucose measurement

During one session of the participant's dialysis, the serum glucose levels were measured immediately before starting hemodialysis and hourly until the end of the session using One Touch Select glucose meter and glucose meter strips manufactured by Johnson and Johnson. Values less than 70 mg/dL were considered as hypoglycemia with or without symptoms.

Quality of life

All subjects were provided with a validated WHOQOL-BREF questionnaire in Filipino (Dela Vega, S. Improving the quality of life of Filipinos) for the assessment of quality of life for patients on Hemodialysis. WHOQOL-BREF Questionnaire was developed by the WHOQOL Group with fifteen internal field centers, simultaneously in an attempt to develop a quality of life assessment. It has 4 major domains: physical health, psychological, social relationships and environment with two individually scored items about individual's overall perception of quality of life and health. The four domain scores are scaled in a positive direction with higher scores indicating a higher quality of life. The 4 domains are then scored, labeled and transformed to a 0-100 scale using the transformation scale score.

Statistical analysis

We computed a sample size requirement of 91 subjects, based on 90% power and 5% level of significance to detect a correlation coefficient of 0.334 from the reference article by Sohrabi Z.[11] Descriptive statistics were used to summarize the clinical characteristics of the patients. Frequency and proportion were used for nominal variables, median and range for ordinal variables, and mean and SD for interval/ratio variables. Spearman's rank correlation was used to determine the correlation between DMS and QoL scores. Logistic regression was initially planned to determine predictors of malnutrition in diabetic ESRD patients on maintenance hemodialysis, but it was impractical due to a very low number of patients with hypoglycemia in our study. All valid data were included in the analysis. Missing variables were neither replaced nor estimated. The null hypothesis was rejected at 0.05 α-level of significance. STATA 15.0 was used for data analysis.

Ethical considerations

This study was conducted in accordance to the ethical principles based on the Declaration of Helsinki and the National Guidelines for Biomedical Research of the National Ethics Committee (NEC) of the Philippines. This study was approved by the Research and Ethics Review Board (RERB). All patients provided written informed consent.

RESULTS

Among the 180 patients on maintenance hemodialysis, there were 101 patients with diabetes. Five were excluded due to hospitalization because of acute infection, 4 were on enteral feeding, hence, a total of 92 patients were included in the analysis. Of the 92 patients, there were 35 (38%) patients who were classified as well-nourished by DMS scoring, 53 (57.6%) who were moderately malnourished, and four (4.35%) severely malnourished. Overall, they had a median age of 69 years, median duration of diabetes of 10 years, and 48.91% were female, less than 10% were working, and the majority were able to finish college (49%).

Their baseline socio-demographics and anthropometrics are presented in Table 1.

Table 1. Distribution of participants according to socio-demographic profile and clinical characteristics (N=92)

	Frequency (%); Mean±SD; Median (Range)
Age (years)	69 (30 – 98)
Male	47 (51.09)
Female	45 (48.91)
Employed	9 (9.78)
With at least tertiary education	51 (55.43)
Civil status	
Single	14 (15.38)
Married	49 (53.26)
Widowed	29 (31.87)
Comorbidities	
Hypertension	66 (71.74)
Coronary artery disease	29 (31.52)
CVA (infarct/hemorrhage)	25 (27.17)
Goiter	5 (5.43)
COPD/TB	3 (3.26)
Bronchial asthma	1 (1.09)
Seizure disorder	1 (1.09)
Liver disease	1 (1.09)
Medications	
Anti-diabetic	
Oral hypoglycemic	39 (42.39)
Insulin or both	24 (26.09)
None	17 (18.48)
Both	12 (13.04)
Erythropoietin	91 (98.91)
Iron supplement	77 (83.70)
Antihypertensive	67 (72.83)
Antiplatelet	31 (33.70)
Duration of diabetes (year)	10 (1 – 40)
Hemodialysis Schedule	
Twice a week	24 (26.09)
Thrice a week	68 (73.91)
Duration of dialysis (year)	2 (0.25-10)
Triceps skin fold (mm)	19 (8 – 210)
Mid-arm circumference (cm)	29.5 (17 – 58)
Dry weight (kg)	60.24±14.31
BMI (kg/m^2)	22.75±4.46
Underweight	14 (15.22)
Normal	32 (34.78)
Overweight	33 (35.87)
Obese	13 (14.13)
Serum albumin (g/L)	
<30	16 (17.39)
30 – 34	19 (20.65)
35 – 39	22 (23.91)
≥40	35 (38.04)

A greater proportion among those with malnutrition were older (71 years versus 63 years, p<0.001), were female (57.89% versus 34.29%, p=0.028), and were widowed (42.11% versus 14.29%, p=0.014). We had insufficient evidence to demonstrate a difference between groups in terms of employment, education, and duration of dialysis (Table 2).

Of 92 patients, there were six patients (6.52%) who had hypoglycemia, four of whom were moderately malnourished and two who were severely malnourished. WHOQoL-BREF scores are presented on Table 3.

Table 2. Clinical characteristics of patients, by DMS category (N= 92)

	Total (n=92)	Well-nourished (n= 35)	Moderate and severe malnutrition (n=57)	p-value
Age (years)	69 (30–98)	63 (31–82)	71 (30–98)	**<0.001***
Female sex	45 (48.91)	12 (34.29)	33 (57.89)	**0.028†**
Employed	9 (9.78)	4 (11.43)	5 (8.77)	0.727‡
With at least tertiary education	51 (55.43)	20 (57.14)	31 (54.39)	0.796†
Civil status				**0.014†**
Single	14 (15.38)	8 (22.86)	6 (10.53)	
Married	49 (53.26)	22 (62.86)	27 (47.37)	
Widowed	29 (31.87)	5 (14.29)	24 (42.11)	
Duration of dialysis (years)	2 (0.25 – 10)	1 (0.25 – 8)	3 (0.25 – 10)	0.110

Numerical data are summarized as either median (range) or mean±standard deviation; categorical data as frequency (%).
Statistical tests used: * - Mann Whitney U test; † - Chi-square Test of Independence; ‡ - Fisher's Exact Test;

Table 3. Dialysis malnutrition scores, hypoglycemia, and quality of life of 92 adult patients with diabetic kidney disease on maintenance hemodialysis

	Total (n=92)	Well (n= 35)	Moderate and severe (n=57)	p-value
Hypoglycemia	6 (6.52)	0	6 (10.53)	0.079‡
WHOQOL-BREF				
Q1 – overall life	49.73±23	55.71±22.76	46.05±22.55	0.050§
Q2 – overall health	40.22±20.95	44.29±21.93	37.72±20.11	0.145§
Physical	45.34±18.28	54.18±16.78	39.91±17.12	**<0.001§**
Psychological	55.43±13.52	62.5±9.26	51.10±13.94	**<0.001§**
Social relationships	56.97±17.04	64.29±17.34	52.49±15.35	**0.001§**
Environment	54.59±13.18	57.68±10.43	52.69±14.37	0.078§

Numerical data are summarized as mean±standard deviation; categorical data as frequency (%).
Statistical tests used: ‡ - Fisher's Exact Test; § - Independent t-test

Table 4. Correlation between Dialysis Malnutrition Scores and WHOQoL-BREF Scores (N = 92)

	Correlation Coefficient (Rho)	Interpretation	p-value
Q1 – overall life	-0.2709	Negative, weak relationship	0.009
Q2 – overall health	-0.1868	Negative, very weak relationship	0.075
Physical	-0.5383	Negative, moderate relationship	<0.001
Psychological	-0.4688	Negative moderate relationship	<0.001
Social relationships	-0.3594	Negative, weak relationship	0.004
Environment	-0.1451	Negative, very weak relationship	0.168

Statistical test used: Spearman's rank correlation.

WHOQoL-BREF scores range from zero to 100, with higher scores indicating better quality of life. The quality of life scores were relatively low, scoring below 60 points overall and across domains. The well-nourished group had significantly higher scores in physical, psychological, and social relationships domains.

We observed statistically significant and negative weak to moderate correlations between DMS and overall life, and on the domains of physical, psychological, and social relationships (Table 4).

DISCUSSION

DMS stratifies patients into well nourished, moderately malnourished and severely malnourished which has an impact on patients' outcome when not detected and properly addressed. In this study, based on the DMS, 58% had moderate malnutrition and 4% were severely malnourished. Using the DMS, in the study of Afshar et al., which included 54 patients on MHD in Iran, 35% had moderate malnutrition and 6% had severe malnutrition[10] while that of Soodeh et al., had 67% malnutrition rate among the 112 chronic hemodialysis Iranian patients.[18]

It appears that the nutritional status of our patients are almost similar with other countries. There was only one study done in the Philippines using DMS for hemodialysis patients done by Boado et al. It included 33 patients on MHD, of which 81% had malnutrition.[12] It had higher rate of malnutrition compared to our study probably because a large proportion of the population (88%) were on twice a week dialysis in contrast to our population wherein majority (74%) were on thrice a week hemodialysis schedule.[12] In the study of Divina et al., the lesser frequency of dialysis showed significant association with the development and severity of malnutrition due to inadequacy of dialysis.[7]

An older age and female sex predispose patients to malnutrition such as in the study of Miguel et al.[21] In the study by Kalantar-Zadeh et al., women also had a stronger tendency to malnutrition but was not significant.[6] Some studies have found that age has an adverse effect on the incidence of malnutrition which can be due to underlying psychological disorders such as depression and economic or physical disability in the preparation and consumption of food.[9] Many changes associated with the process of aging can promote malnutrition and is frequently associated with decreases in taste acuity and smell, deterioration in dental health and decrease in physical activity which may affect nutrient intake.[20] In the study of Boado et al., and Sohrabi et al., dialysis duration was not associated with malnutrition which is the same in this study.[11]

In our study, overall life and health status appeared to be lower with poorer state of nutrition. The trends of the physical domain scores (pain and discomfort, energy, sleep), psychological health (positive feelings, memory and concentration, self esteem, bodily image and appearance, negative feelings) and social relationships (personal and social support, sexual activity) of the malnourished group were notably lower as compared to the well-nourished group. In the study of Rambod et al., negative correlations were found between nutritional status and quality of life aspects,[21] Bilgic et al., also found a significant association between MIS and poor quality of life[22] and Spiegel et al., showed that nutritional biomarkers were correlated with quality of life[23] which are all consistent with this study. Quality of life is a predictor of survival in HD patients[24] hence correlation between nutritional status using the DMS and quality of life focuses on the effects of malnutrition status on patients' survival. The decrease in quality of life is an important determinant of hospitalization and death in patients on MHD. Our study is also similar to the study of Sathvik et al., which used the WHOQOL-BREF in 75 hemodialysis patients from India, the evidence did not support a significant difference in mean environment (safety and security, home and physical environment) score across groups because most of the patients revealed that they have enough time for recreational activities with their families and they have a decent home or physical environment. They were also satisfied with their access to health services in the hospital.[25]

Screening for malnutrition using DMS is of utmost importance not only because it is the first step to correct malnutrition but also because it can prompt a reduction of unnecessary anti-hyperglycemic therapy preventing hypoglycemic episodes because hypoglycemia is associated with significant morbidities leading to both physical and cognitive dysfunction and further deterioration of patients' general health.[26-28] In our study, only 6 participants or 6.5% had episode of hypoglycemia without symptoms during dialysis. Four of those who developed hypoglycemia were on sulfonylurea while 2 of the participants were on insulin. Two out of the 6 participants who developed hypoglycemia also had episodes of hypoglycemia at home probably due to a delay in the metabolism and excretion of insulin and oral hypoglycemic agents. This is less than the 15.2% in the study of Cho et al., which included 1685 Asian patients with or without diabetes on hemodialysis and peritoneal dialysis for at least 1 month.[27] This is probably due to the difference in population studied. In Cho et al.'s study, 74% of the patients who had hypoglycemia were diabetics and they also reported that 15.6% of patients with hypoglycemia had clinical malnutrition.[27] Patients with DMS detected malnutrition often have poor appetite, decreased hepatic glycogen stores, reduced availability of gluconeogenic, insulin resistance and glucose intolerance which can lead to decreased weight and hypoglycemia hence evaluation of nutritional status using DMS with optimal dose of dialysis is important to prevent PEW and subsequent hypoglycemia.[28-31]

CONCLUSION

Malnutrition is prevalent in diabetic patients on MHD using DMS which calls for more attention to early identification and management. A higher DMS score is highly correlated with increased risk of hypoglycemia and decreased quality of life hence detection of malnutrition is important to prevent further nutritional depletion, hypoglycemia and poor patient outcomes by implementing preventive measures such as nutritional counselling and psychosocial interventions.

Limitations

There was limited sample size and the adequacy of dialysis (Kt/V) was not determined because of lack of available data and funding. The participants also have different timing of dialysis or shifts which may affect the detection of hypoglycemia. The causality of the association between DMS, hypoglycemia and quality of life cannot be proven, which is an inherent nature of cross-sectional studies.

Recommendations

Further studies with larger sample size, same dialysis shifts and equal number of participants in each classification of DMS are suggested to decrease bias. More longitudinal studies are needed to assess the association of DMS with hypoglycemia, quality of life and related risk factors.

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References

1. International Diabetes Federation, Diabetes Atlas, 8th edition, 2017.
2. Gheith O, Farouk N, Nampoory N, et al. Diabetic kidney disease: Worldwide difference of prevalence and risk factors. J Nephropharmacol. 2016;5(1):49-56. PMID: 28197499. PMCID: PMC5297507.
3. Toth-Manikowski S, Atta MG. Diabetic kidney disease: Pathophysiology and therapeutic targets. J Diabetes Res V. 2015; 2015:Article ID 697010. https://doi.org/10.1155/2015/697010.
4. Ghaderian SB, Hayati F, Shayanpour S, Beladi Mousavi SS. Diabetes and end-stage renal disease; A review article on new concepts. J Renal Inj Prev. 2015;4(2):28-33. PMID: 26060834. PMCID: PMC4459725. https://doi.org/10.12861/jrip.2015.07.
5. Ikizler T. Optimal nutrition in hemodialysis patients. Adv Chronic Kidney Dis. 2013; 20(2):181-9. PMID: 23439378. PMCID: PMC3582995. https://doi.org/10.1053/j.ackd.2012.12.002.
6. Kalantar-Zadeh K, Kleiner M, Dunne E, Lee GH, Luft FC. A modified quantitative subjective global assessment of nutrition for dialysis patients. Nephrol Dial Transplant 1999;14(7):1732-8. PMID: 10435884.
7. Divina RJ, Felicida FS, Chan RE, Llido LO. Nutritional status of hemodialysis patients in the Philippines: A cross-sectional survey in four out-patient dialysis centers. PhilsPEN. 2010;82-9.
8. Czira M, Lindner AV, Szeifert L, et al. Association between the malnutrition-inflammation score and depressive symptoms in kidney transplanted patients. Gen Hosp Psychiatry. 2011;33(2):157-65. PMID: 21596209. https://doi.org/10.1016/j.genhosppsych.2011.01.012.
9. Ebrahimzadehkor B, Dorri A, Yapan-Gharavi A. Malnutrition-inflammation score in hemodialysis patients. Zahedan J Res Med Sci. 2014;16(8):25-8.
10. Afshar R, Sanavi S, Izadi-Khah A. Assessment of nutritional status in patients undergoing maintenance hemodialysis: A single-center study from Iran. Saudi J Kidney Dis Transpl.2007;18(3):397-404. PMID: 17679753.
11. Sohrabi Z, Eftekhari MH, Eskandari MH, Rezaeianzadeh A, Sagheb MM. Malnutrition-inflammation score and quality of life in hemodialysis patients: Is there any correlation? Nephrourol Mon. 2015;7(3):e27445. PMID: 26034747. PMCID: PMC4450166. https://doi.org/10.5812/numonthly.7(3)2015.27445.
12. Boado JRV, Redondo DC, Flauta-Orio J, et al. Nutrition assessment of patients on maintenance hemodialysis using dialysis malnutrition score (DMS). PhilSPEN 2014;74-88.
13. Yamada K, Furuya R, Takita T, et al. Simplified nutritional screening tools for patients on maintenance hemodialysis. Am J Clin Nutr. 2008;87(1):106-13. PMID: 18175743. https://doi.org/10.1093/ajcn/87.1.106.

14. Harvinder GS, Swee WC, Karupaiah T, et al. Dialysis malnutrition and malnutrition inflammation scores: Screening tool for prediction of dialysis related protein-energy wasting in Malaysia. Asia Pac J Clin Nutr 2016;25(1):26-33. PMID: 26965758.
15. As'habi A, Tabibi H, Nozary-Heshmati B, Mahdavi-Mazdeh M, Hedayati M. Comparison of various scoring methods for the diagnosis of protein-energy wasting in hemodialysis patients. Int Urol Nephrol. 2014;46:999-1004.
16. Lim S, Lin XH, Daniels L. Seven-point subjective global assessment is more time sensitive than conventional subjective global assessment in detecting nutrition changes. JPEN J Parenter Enteral Nutr. 2016;40(7):966-72. PMID: 25847315. https://doi.org/10.1177/0148607115579938.
17. Campbell KL, Ash S, Bauer J, Bauer J, Davies PSW. Critical review of nutrition assessment tools to measure malnutrition in chronic kidney disease. Nutrition and Dietetics. 2007;64(1):22-30. https://doi.org/10.1111/j.1747-0080.2007.00116.x.
18. Jahromi SR, Hosseini S, Razeghi E, Meysamie Ap, Sadrzadeh H. Malnutrition predicting factors in hemodialysis patients. Saudi J Kidney Dis Transpl. 2010;21(5):846-51. PMID: 20814118.
19. Miguel LS, Julia ÁH, Mercè P, et al. Prevalence of hospital malnutrition in patients with diabetes mellitus: A sub-analysis of the PREDyCES study. SM J Public Health Epidemiol. 2015;1(4):1018.
20. Hickson M. Malnutrition and ageing. Postgrad Med J. 2006;82(963):2-8. PMID: 16397072. PMCID: PMC2563720. https://doi.org/10.1136/pgmj.2005.037564.
21. Rambod M, Bross R, Zitterkoph J, et al. Association of malnutrition-inflammation score with quality of life and mortality in hemodialysis patients: A 5-year prospective cohort study. Am J Kidney Dis. 2009;53(2):298-309. PMID: 19070949.PMCID: PMC5500250. NIHMSID: NIHMS322402.
22. Bilgic A, Akgul A, Sezer S, Arat et al. Nutritional status and depression, sleep disorder and quality of life in hemodialysis patients. J Ren Nutr 2007;17(6):381-8. PMID: 17971310. https://doi.org/10.1053/j.jrn.2007.08.008.
23. Spiegel BMR, Melmed G, Robbins S, Esrailian E. Biomarkers and health-related quality of life in end-stage renal disease: A systematic review. Clin J Am Soc Neohrol. 2008; 3(6):1759-68. PMID: 18832106. PMCID: PMC2572281.
24. Yusop NBM, Mun CY, Shariff ZM, Huat CH. Factors associated with quality of life among hemodialysis patients in Malaysia. PLoS ONE. 2013;8(12):e84152. https://doi.org/10/1371/journal.pone.0084152.
25. Sathvik BS, Parthasarathi G, Narahari MG, Gurudev KC. An assessment of the quality of life in hemodialysis patients using the WHOQOL-BREF questionnaire. Indian J Nephrol. 2008;18(4):141-9. PMID: 20142925. PMCID: PMC2813538. https://doi.org/10.4103/0971-4065.45288.
26. Chu YW, Lin HM, Wang JJ, Weng SF, Lin CC, Chien CC. Epidemiology and outcomes of hypoglycemia in patients with advanced diabetic kidney disease on dialysis: A national cohort study. PLoS One. 2017;12(3):e0174601. PMID: 28355264. PMCID: PMC5371333. https://doi.org/10.1371/journal.pone.0174601.
27. Cho A, Noh JW, Kim JK, et al. Prevalence and prognosis of hypoglycaemia in patients receiving maintenance dialysis. https://doi.org/10.1002/imj.13230.
28. Abdelhafiz A, Rodriguez-Mañas L, Morley JE, Sinclair A. hypoglycemia in older people - a less well recognized risk factor for frailty. Aging Dis. 2015;6(2):156-67. PMID: 25821643. PMCID: PMC4365959. https://doi.org/10.14336/AD.2014.0330.
29. Jung HS, Kim HI, Kim MJ, et al. Analysis of hemodialysis-associated hypoglycemia in patients with type 2 diabetes using a continuous glucose monitoring system. Diabetes Tech Ther. 2010;12(10):801-7. PMID: 20809681. https://doi.org/10.1089/dia.2010.0067.
30. Abe M, Kalantar-Zadeh K. Hemodialysis-induced hypoglycemia and glycemic disarrays. Nat Rev Nephrol. 2015;11(5):302-12. PMID: 25848881. PMCID: PMC6015632. https://doi.org/10.1038/nrneph.2015.38.
31. Sun CY, Lee CC, Wu MS. Hypoglycemia in diabetic patients undergoing chronic hemodialysis. Ther Apher Dial. 2009;13(2):95-102. PMID: 19379147. https://doi.org/10.1111/j.1744-9987.2009.00662.x.

APPENDIX 1

Data Collection Form

Patient Number: _____ Age: _____ Occupation: _____ Set of HD: _____

Gender:
○ Male ○ Female

Civil Status:
○ Single ○ Married ○ Widowed

Educational Background:
○ Primary ○ Secondary ○ Tertiary ○ Postgraduate

Financial Status:
○ <7,890 pesos/month
○ 7,890 to 15,780 pesos/month
○ 15,780 to 31,560 pesos/month
○ 31,560 to 78,900 pesos/month
○ 78,900 to 118,350 pesos/month
○ 118,350 to 157,800 pesos/month
○ >157,800 pesos/month

HD schedule:
○ 2x/week ○ 3x/week ○ 4x/week

Duration of Dialysis: _____

Pre-HD weight: _____ Post-HD weight: _____ Height: _____ BMI: _____

Albumin: _____ TIBC: _____ URR: _____

Co-morbid condition:
○ Hypertension
○ Coronary Artery Disease
○ Liver Disease
○ Seizure Disorder
○ CVA infarct or hemorrhage
○ Last Hospitalization: _____
○ Thyroid/Goiter
○ Bronchial Asthma
○ COPD/TB
○ Cancer: _____
○ Psychiatric Illness
○ Previous Surgery: _____
○ DM Duration: _____

Medications:
○ Anti DM
  ○ Insulin _____ took prior to HD _____ Y _____ N _____
  ○ OHA _____ took prior to HD _____ Y _____ N _____
○ Erythropoietin _____
○ Multivitamins ○ Iron Supplements ○ Amino acids
○ Steroids _____
○ Others: _____

Food Recall:
1:
2:
Energy kcal/day: _____ CHO _____ CHON _____ Fats _____

CBG: Fasting _____ 1st hour _____ 2nd hour _____ 3rd hour _____ 4th hour _____
Hypoglycemic symptoms: _____

APPENDIX 2

Dialysis Malnutrition Score

A. Patients-related medical history:

1. Weight change (overall change in past 6 months)				
1	2	3	4	5
no weight change or gain	minor weight loss (<5%)	weight loss 5 to 10%	weight loss 10 to 15%	weight loss >15%
2. Dietary intake				
1	2	3	4	5
no change	sub-optimal solid diet	full liquid diet or moderate overall decrease	hypo-caloric liquid	starvation
3. Gastrointestinal symptoms				
1	2	3	4	5
no symptoms	nausea	vomiting or moderate GI symptoms	diarrhea	severe anorexia
4. Functional capacity (nutritionally-related functional impairment)				
1	2	3	4	5
none (improved)	difficulty with ambulation	difficulty with normal activity	light activity	bed/chair-ridden with no or little activity
5. Co-morbidity				
1	2	3	4	5
dialysis <12 months and healthy otherwise	dialysis 1-2 years or mild co-morbidity	dialysis 2-4 years or age >75 or moderate co-morbidity	dialysis >4 years or severe co-morbidity	very severe multiple co-morbidity

B. Physical Exam:

1. Decreased fat stores or loss of subcutaneous fat (below eyes, triceps, biceps, chest)				
1	2	3	4	5
no change		moderate		severe
2. Signs of muscle wasting (temple, clavicle, scapula, ribs, quadriceps, knee, interosseous)				
1	2	3	4	5
no change		moderate		severe

C. Malnutrition Score: (sum of all numbers)

APPENDIX 3

Dialysis Malnutrition Score Results

	Total (N = 92)	DMS		
		Well Nourished (N = 35)	Moderate (N = 53)	Severe (N = 4)
% Weight change in past 6 months				
None	44 (47.83)	31 (88.57)	13 (24.53)	0
<5	16 (17.39)	0	16 (30.19)	0
5–10	15 (16.30)	4 (11.43)	10 (18.87)	1 (25)
10–15	4 (4.35)	0	3 (5.66)	1 (25)
>15	13 (14.13)	0	11 (20.75)	2 (50)
Dietary intake				
No change	53 (57.61)	35 (100)	18 (33.96)	0
Sub-optimal solid diet	31 (33.70)	0	30 (56.60)	1 (25)
Full liquid diet or moderate overall decrease	8.70	0	5 (9.43)	3 (75)
Hypo-caloric liquid	0	0	0	0
Starvation	0	0	0	0
Gastrointestinal symptoms				
No symptoms	80 (86.96)	34 (97.14)	43 (81.13)	3 (75)
Nausea	10 (10.87)	1 (2.86)	8 (15.09)	1 (25)
Vomiting or moderate GI symptoms	2 (2.17)	0	2 (3.77)	0
Diarrhea	0	0	0	0
Severe anorexia	0	0	0	0
Functional capacity				
None (improved)	41 (44.57)	31 (88.57)	10 (18.87)	0
Difficulty with ambulation	11 (11.96)	2 (5.71)	9 (16.98)	0
Difficulty with normal activity	12 (13.04)	1 (2.86)	10 (18.87)	1 (25)
Light activity	10 (10.87)	0	9 (16.98)	1 (25)
Bed/chair ridden with little or no activity	18 (19.57)	1 (2.86)	15 (28.30)	2 (50)
Comorbidity				
Dialysis <12 mos and healthy otherwise	28 (30.43)	14 (40)	14 (26.42)	0
Dialysis 1–2 years or mild comorbidity	14 (15.22)	9 (25.71)	5 (9.43)	0
Dialysis 2–4 years or age > 75 or moderate co-morbidity	27 (29.35)	7 (20)	18 (33.96)	2 (50)
Dialysis > 4 years or severe co-morbidity	23 (25)	5 (14.29)	16 (30.19)	2 (50)
Very severe multiple comorbidity	0	0	0	0
Decreased fat stores				
No change	54 (58.70)	35 (100)	19 (35.18)	0
(2)	21 (22.83)	0	21 (39.62)	0
Moderate	14 (15.22)	0	12 (22.64)	2 (50)
(4)	2 (2.17)	0	1 (1.89)	1 (25)
Severe	1 (1.09)	0	0	1 (25)
Signs of muscle wasting				
(1) No change	56 (60.87)	35 (100)	21 (39.62)	0
(2)	17 (18.48)	0	17 (32.08)	0
(3) Moderate	14 (15.22)	0	13 (24.53)	1 (25)
(4)	4 (4.35)	0	2 (3.77)	2 (50)
(5) Severe	1 (1.09)	0	0	1 (25)