Original Article

Dialysis Malnutrition and Malnutrition Inflammation Scores: screening tools for prediction of dialysis – related protein-energy wasting in Malaysia

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Background and Objectives: Malnutrition is highly prevalent in Malaysian dialysis patients and there is a need for a valid screening tool for early identification and management. This cross-sectional study aims to examine the sensitivity of the Dialysis Malnutrition Score (DMS) and Malnutrition Inflammation Score (MIS) tools in predicting protein-energy wasting (PEW) among Malaysian dialysis patients. **Methods and Study Design:** A total of 155 haemodialysis (HD) and 90 peritoneal dialysis (PD) patients were screened for risk of malnutrition using DMS and MIS and comparisons were made with established guidelines by International Society of Renal Nutrition and Metabolism (ISRNM) for PEW. **Results:** MIS cut-off score of ≥5 indicated presence of malnutrition in all patients. A total of 59% of HD and 83% of PD patients had PEW by ISRNM criteria. Based on DMS, 73% of HD and 71% of PD patients exhibited moderate malnutrition, whilst using MIS, 88% and 90%, respectively were malnourished. DMS and MIS correlated significantly in HD (r^2=0.552, p<0.001) and PD (r^2=0.466, p<0.001) patients. DMS and MIS had higher sensitivity values in PD (81% and 82%, respectively) compared to HD (59% and 60%, respectively) patients. **Conclusions:** The MIS cut-off scores for malnutrition classification were established (score ≥5) for use amongst Malaysian dialysis patients. Both DMS and MIS are valid tools to be used for nutrition screening of dialysis patients especially those undergoing peritoneal dialysis. The DMS may be a more practical and simpler tool to be utilized in the Malaysian dialysis settings as it does not require laboratory markers.

Key Words: protein-energy malnutrition, nutritional assessment, dialysis, Dialysis Malnutrition Score, Malnutrition Inflammation Score

INTRODUCTION

Protein-energy malnutrition is very prevalent in Malaysian haemodialysis (HD) and peritoneal dialysis (PD) patients varying between 57-90% based on serum albumin of less than 40 g/L and body mass index (BMI) of less than 25 kg/m².[1] Several epidemiological studies have consistently shown strong association between clinical outcomes and measures of both malnutrition,[2,3] and inflammation,[4] in dialysis patients. Moreover, these two conditions tend to occur concurrently and coexist in individuals with end-stage renal disease and lead to adverse consequences such as death.

Diagnosis of protein-energy malnutrition, recently known as protein-energy wasting (PEW) was proposed by the International Society of Renal Nutrition and Metabolism (ISRNM). According to ISRNM, PEW is defined by presence of low levels of serum proteins, reduced body or fat mass or weight loss with reduced dietary protein and energy intake, and reduced muscle mass and muscle wasting.[5] Routine screening of PEW patients is seldom carried out in dialysis centres in Malaysia beyond monitoring of serum albumin levels. Therefore, a simple and reliable tool would be beneficial for early identification and management of poor nutritional status in Malaysian dialysis

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settings.

The Subjective Global Assessment (SGA) was evaluated in different studies as an adequate tool for the assessment of nutritional status in dialysis patients.[6,7] However, its subjective evaluation and semi-quantitative scale consisting of only three discrete severity levels has been suggested to restrict its reliability and precision. Therefore, in later years, Kalantar-Zadeh et al developed another version of SGA, initially called the modified quantitative SGA and subsequently known as the Dialysis Malnutrition Score (DMS).[8] The DMS consisted of 7 variables: weight change, dietary intake, gastrointestinal symptoms, functional capacity, comorbidity, subcutaneous fat and signs of muscle wasting. Each component was assigned a score from 1 (normal) to 5 (very severe). This tool was reported to be more reliable than the conventional SGA in several studies.[8,9] The DMS was reported to correlate with age, years of dialysis therapy, and the combination of mid-arm muscle circumference (MAMC), BMI, serum albumin concentration, and total iron-binding capacity (TIBC) which were markers of malnutrition and inflammation.[8]

The Malnutrition Inflammation Score (MIS) was developed with addition of three new components to the DMS which were the BMI, serum albumin, and serum TIBC.[10] The MIS has total score ranging from 0 to 30 with higher scores denoting presence of malnutrition risk. Unlike the DMS, no cut-offs have been proposed for the MIS to classify the severity of malnutrition. The MIS was found to significantly correlate with hospitalisation, mortality, and indices of nutrition, inflammation, and anemia.[10,11]

Currently in Malaysia, the common tools used for rapid assessment of malnutrition include SGA and conventional parameters such as BMI, serum albumin and dietary intake. In this present cross-sectional study, we compared the DMS and MIS nutritional screening tools in predicting PEW among the Malaysian HD and PD patients and the possible cut-off score for defining presence of malnutrition with MIS.

METHODS

Patient eligibility

The study population comprised of 155 HD and 90 PD patients from two major hospitals in Kuala Lumpur, Malaysia. The recruited patients were above 18 years old with no history of hospitalisation or peritonitis for the past 3 months and had undergone dialysis for at least 6 months. Warded dialysis patients and patients on any kind of nutritional support were excluded from this study. The study complied with the provision of the Declaration of Helsinki and ethical approval was obtained from the Joint Committee of Ethics and Research in International Medical University (project identification: IMU 233/ 2011). The study was also approved by the Ethics Committee of the Ministry of Health Malaysia (project identification: NMRR-11-355-9148). Identified patients gave informed consent prior to the study initiation and patients' anonymity was maintained.

Anthropometric measurements

The HD and PD patients were measured for their height and post-dialysis weight using the electronic column scales (SECA 206, Germany). The BMI was then calculated using the Weight (kg) / Height x Height (m²) formula. Mid-arm circumference (MAC) was measured using a flexible, non-stretchable measuring tape while the triceps skinfold (TSF) was measured using the Harpenden skinfold calliper on non-fistula arm for HD patients and on the right arm for PD patients. The MAMC and mid-arm muscle area (MAMA) was then calculated using the following equations,[12]

$$\text{MAMC (cm)} = \text{MAC} - \pi \times \text{TSF}; \quad \text{MAMA} = \text{MAMC}^2/4\pi.$$

The correction for gender for MAMA (cMAMA) was as per the equations,[12]

In men: cMAMA = MAMA – 10;

in women: cMAMA = MAMA − 6.5.

Biochemical measurements

Biochemical measurements were obtained retrospectively from the patients' medical records based on the routine blood tests performed by the in-house hospital laboratories. Patients were required to fast 12 hours prior to blood collection by the trained hospital staff. Biochemical parameters obtained for analysis included the serum urea, serum creatinine, serum albumin, serum cholesterol and serum TIBC.

Dietary intake

Dietary intake was collected for 2 days (weekday and weekend) using the 24-hour recall method by trained dietitians. Household measurements and food albums were used to help the patients estimate food portions consumed. Foods eaten were then converted into weight in grams. Nutrient analysis were carried out using the Nutritionist Pro software (Version 5.1.0, Axxya Systems, LLC, USA), based on the Composition of Malaysian Foods,[13] and other sources such as food labels. Dietary energy intake in PD patients was calculated after taking into consideration the glucose absorbed from the peritoneal dialysate.

Dialysis Malnutrition Score

The DMS, a 5-point scale modified quantitative SGA is comprised of two major components; medical history and physical examination.[8] The DMS was performed on dialysis patients by a trained dietitian through interview and physical evaluation. Each component of the DMS was subjectively rated on a scale from 1 to 5, where 1 is normal nutrition status, 2 to 4 is moderate malnutrition status and 5 is severe malnutrition status. Patients were then classified accordingly based on their degree of malnutrition i.e. normal, moderate (any 3 areas rated as a moderate or severe level), or severe (at least 3 areas at severe level).[14]

Malnutrition Inflammation Score

The MIS, a 4-point scale quantitative nutrition screening tool consists of four main parts: patients' related medical history, physical examination, BMI and laboratory parameters. Score 0 of the MIS in each part denotes normal nutrition status while score 3 denotes severe nutritional deficit.[10] The sum of all components ranges from 0 to 30 where score 0 denotes normal nutrition status and score 30 denotes severe level of malnutrition and inflamma-

tion.[10] The MIS cut-off scores for categorisation of patients into normal nutrition status and malnutrition was obtained by plotting the receiver operating characteristic (ROC) curve using the DMS scores as standard. Number of patients scoring lesser than the obtained cut-off score were classified as normal nutrition status while number of patients scoring higher than the obtained cut-off score was classified as malnourished.

Diagnosing of protein-energy wasting

The ISRNM recommended the diagnosis of PEW involves 4 main categories: biochemical criteria, low body weight, reduced total body fat or weight loss; decrease in muscle mass; and low protein or energy intake.[5] At least 3 of the 4 listed criteria (and at least 1 test result in each of the selected categories) must be satisfied for diagnosis of PEW. The proposed criteria for diagnosis of PEW were adapted from Fouque et al[5] and are as listed in Table 1. Percentage of the studied dialysis patients that fulfilled 3 out of the 4 criteria were computed and identified as malnourished.

Criterion validity

The criterion validity were determined by comparing the score of each of the two tools with the mentioned pre-set criteria for malnutrition based on the ISRNM.[5] The sensitivity, specificity, positive predictive value and negative predictive value were determined. Sensitivity represents the probability (0-100%) that the screening tool correctly identifies moderately and severely malnourished patients. Specificity represents the probability (0-100%) that the screening tool correctly identifies well-nourished patients. Positive predictive value (0-100%) represents the probability that a patient with a screening tool score for moderate or severe malnutrition is indeed malnourished according to the mentioned definition of malnutrition. Negative predictive value (0-100%) represents the probability that a patient with a screening tool score for well nutrition is indeed well-nourished according to the pre-set definition of malnutrition. The cut-off points of the diagnostic values were arbitrarily set as 90-100% excellent; 80-90% good; 70-80% fair; 60-70% insufficient and 50-60% poor. A sensitivity and specificity of 70% was set as a prerequisite for adequate performance of a screening tool.

Statistical analysis

Data was analysed using the SPSS version 19 (SPSS Inc., Chicago, IL, USA). Data was presented as mean±SD (parametric data) and median±interquartile range (non-parametric data) and percentage patients (%). A ROC curve using the DMS scores as standard was plotted to obtain the MIS cut-off score that classifies nutrition status for the dialysis patients. The area under the ROC curve indicated the probability of discriminating nutritional risk while the cut-off nutritional risk score for MIS tool was defined from the highest sensitivity - (1 - specificity) value in the ROC curve. Pearson correlation coefficient 'r' (parametric data) and the Spearman rank correlation coefficient (non-parametric data) was used to assess the strength of associations between various nutritional variables. The sensitivity (ability to identify malnutrition) and specificity (ability to identify non-malnutrition) of the DMS and MIS was computed against patients diagnosed with PEW based on the ISRNM criteria through cross tabulation.

RESULTS

Table 2 shows study population comprised of 56% male and 44% of female dialysis patients with mean age of 52±15 years. Majority of the HD patients (59%) had been on dialysis for less than 10 years while majority of the PD patients (70%) were dialysing for less than 5 years. The major co-morbidities were hypertension (74%), diabetes mellitus (36%) and Hepatitis B or C (29%). The HD and PD patients were adequately dialysed as indicated by mean Kt/V of 1.72±0.38 and 2.29±0.68, respectively. These baseline data are in line with the current demographics reported generally for dialysis patients in Malaysia by the 20th Malaysian Dialysis and Transplant Registry, 2013.

The mean±SD of DMS and MIS scores of HD patients were 13±4 and 9±5, respectively while the mean DMS and MIS scores of PD patients were 12±3 and 8±4, respectively.

Based on the ROC curve (Figure 1) plotted for all patients, area under the curve obtained was 0.957 indicating the probability of MIS in identifying nutritional risk is excellent. The cut-off score derived from the highest sensitivity - (1-specificity) point was 5. This cut-off score was used to classify patients with nutritional risk where

Table 1. Criteria proposed by the International Society of Renal Nutrition and Metabolism (ISRNM) expert panel used for diagnosis of protein-energy wasting (PEW) in the studied dialysis patients

Criteria
Body weight and fat (body mass)
Body mass index <23 kg/m²;
Unintentional weight loss over time: 5% over 3 months or 10% over 6 months.
Muscle mass
Mid-arm muscle circumference: reduction >10% in relation to 50th percentile of reference population;[15]
Reduced muscle mass: 5% over 3 months or 10% over 6 months.
Serum chemistry
Serum albumin <38 g/L;
Serum cholesterol <2.59 mmol/L.
Dietary intake
Unintentional low dietary protein intake <0.8 g/kg/day for 2 months for dialysis patients;
Unintentional low dietary energy intake <25 kcal/kg/day for 2 months.

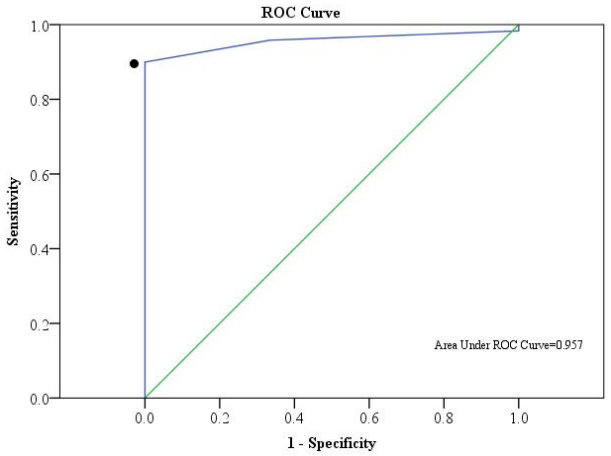

Figure 1. Receiver operating characteristic (ROC) curve of Malnutrition-Inflammation Score in comparison with Dialysis Malnutrition Score for total dialysis patients. The area under the ROC curve (AUC) indicates the probability for discriminating nutritional risk. The cut-off score of nutritional risk (●) for the Malnutrition Inflammation Score is defined by the highest sensitivity - (1- Specificity) value on the ROC area under the curve.

patients with scores <5 were classified as normal nutrition status whilst patients with scores ≥5 were classified as malnourished.

Using the pre-set definition of malnutrition by ISRNM, 59% and 83% of HD and PD patients were identified as malnourished and the remainder 41% and 17%, respectively were well-nourished (Table 3). Based on DMS, 73% of HD and 71% of PD patients exhibited moderate malnutrition. There were no severe cases of malnutrition reported among the HD and PD patients as per the DMS. The MIS cut-off scores (5 and above) that is currently being proposed in this study demonstrated presence of malnutrition in 88% of HD and 90% of PD patients, respectively. Only a small percentage of patients, 12% of HD and 10% of PD patients had normal nutrition status. DMS and MIS identified a higher percentage of malnourished patients in both HD and PD patients compared to ISRNM method.

Table 4 shows Pearson correlation coefficients (r) between the dialysis patients' quantitative nutritional scores and nutritionally relevant parameters. The DMS correlated significantly (p<0.01) with BMI (r=-0.332), TSF (r=-0.266), MAMA (r=-0.303), MAMC (r=-0.288) and serum TIBC (r=-0.175). The MIS on the other hand, not only correlated (p<0.01) well with serum albumin (r=-0.296), serum TIBC (r=-0.175) and BMI (r=-0.428) which were components of the MIS, but it also correlated significantly (p<0.01) with TSF (r=-0.289), MAMA (r=-0.356) and MAMC (r=-0.333). Table 5 shows DMS and MIS had higher sensitivity values in PD (81% and 82%, respectively) compared to HD (59% and 60%, respectively) patients. However, MIS had higher positive predictive values than DMS for both modalities of dialysis. The accuracy of predicting malnutrition for both tools is better in PD than HD patients. As for identifying well-nourished patients, both tools had greater specificity in identifying well-nourished HD patients compared to well-nourished PD patients. The DMS showed better performance in terms of higher negative predictive values than MIS in HD and PD patients.

Table 2. Socioeconomic and medical history of dialysis patients

	Haemodialysis (n=155)	Peritoneal dialysis (n=90)	Total (n=245)
Age (years)†	51±14	54±16	52±15
Gender (%)			
Men	59	51	56
Women	41	49	44
Primary cause of kidney failure (%)			
Unknown	50	41	47
Diabetes mellitus	22	33	26
Hypertension	16	11	14
Others‡	12	14	13
Major co-morbidities (%)			
Hypertension	70	82	74
Hepatitis B or C	41	7	29
Diabetes mellitus	28	49	36
Cardiovascular disease	14	28	19
Others§	17	6	13
Duration on dialysis (years) (%)			
<5 years	32	70	46
5-10 years	27	24	26
>10 years	41	6	28
Dialysis adequacy (Kt/V)†	1.72±0.38	2.29±0.68	1.92±0.57
Normalised protein catabolic rate (g/kg/day)†	0.87±0.37	1.00±1.20	0.91±0.76

All measurements are expressed as percentage patients (%) unless stated otherwise.
†Age, normalised protein catabolic rate and dialysis adequacy for peritoneal dialysis patients (n=82) and overall population (n=237) is expressed as mean±SD.
‡Other causes of kidney failure include acute polycystic kidney disease, glomerulonephritis, kidney stone and systemic lupus erythematous.
§Other co-morbidities include dyslipidaemia, gout nephropathy, and hyperthyroidism.

Table 3. Patients identified as malnourished by protein-energy wasting (PEW) criteria, Dialysis Malnutrition Score (DMS), and Malnutrition Inflammation Score (MIS)

	Haemodialysis (n=155)	Peritoneal dialysis (n=90)	Total (n=245)
PEW (% patients)			
Patients identified as malnourished	59	83	68
Patients identified as well-nourished	41	17	32
DMS (% patients)			
Normal	27	29	27
Moderate (any 3 areas rated as a moderate or severe level)	73	71	73
Severe (at least 3 areas at severe level)	0	0	0
MIS (% patients)			
Patients identified as malnourished (score ≥5)	88	90	89
Patients identified as well-nourished (score <5)	12	10	11

PEW: protein-energy wasting; DMS: Dialysis Malnutrition Score; MIS: Malnutrition Inflammation Score.
Data expressed as percentage patients (%).

Table 4. Relationship of Dialysis Malnutrition Score (DMS) and Malnutrition Inflammation Score (MIS) with anthropometry, biochemical, clinical and dietary parameters in total dialysis population

	DMS scores		MIS scores	
	r	*p*	r	*p*
BMI (kg/m²)	-0.332	<0.001**	-0.428	<0.001**
TSF (mm)	-0.266	<0.001**	-0.289	<0.001**
MAMA (cm²)†	-0.303	<0.001**	-0.356	<0.001**
MAMC (cm)	-0.288	<0.001**	-0.333	<0.001**
Serum albumin (g/L)†	-0.059	0.359	-0.296	<0.001**
Serum TIBC (mmol/L)	-0.175	0.006**	-0.430	<0.001**
Serum cholesterol (mmol/L)	-0.087	0.180	-0.035	0.592
Serum creatinine (μmol/L)	-0.089	0.167	-0.185	0.004**
Serum urea (mmol/L)	-0.005	0.938	-0.127	0.049*
Serum CRP (mg/L)†	-0.001	0.982	-0.053	0.700
Kt/V	-0.007	0.913	-0.018	0.783
nPCR (g/kg/day)†	0.105	0.121	0.128	0.059
DEI (kcal/day)	-0.022	0.731	-0.074	0.251
DPI (g/day)†	-0.041	0.528	-0.048	0.457

DMS: Dialysis Malnutrition Score; MIS: Malnutrition Inflammation Score; BMI: body mass index; TSF: triceps skin folds; MAMA: mid-arm muscle area; MAMC: mid-arm muscle circumference; TIBC: total iron-binding capacity; CRP: C-reactive protein; Kt/V: dialysis adequacy; nPCR: normalised Protein Catabolic Rate; DEI: dietary energy intake; DPI: dietary protein intake.
†Non-parametric correlation of Spearman-Rho, otherwise data expressed as parametric Pearson correlation.
*Significant at $p<0.05$, **Significant at $p<0.01$.

Table 5. Diagnostic values for the nutritional screening tools relative to patients identified with protein-energy wasting

	DMS (Score >7)†		MIS (Score ≥5)†	
	HD (n=155)	PD (n=90)	HD (n=155)	PD (n=87)
Sensitivity (%)	58.8	81.3	59.9	82.1
Specificity (%)	41.5	11.5	50.0	11.1
PPV (%)	73.6	69.3	90.1	88.9
NPV (%)	26.6	20.0	14.1	6.7
Accuracy (%)	54.2	61.1	58.7	74.7

DMS: Dialysis Malnutrition Score; MIS: Malnutrition Inflammation Score; HD: haemodialysis; PD: peritoneal dialysis; PPV: positive predictive value; NPV: negative predictive value.
Data expressed as percentage patients (%).
†Cut-off scores denote patients identified as malnourished.

DISCUSSION

In the present study, we explored the possible cut-off score of defining malnutrition with the MIS. MIS scores of <5 obtained for all patients indicated normal nutrition status whilst scores of ≥5 indicated presence of malnutrition. Previously, Kalantar-Zadeh et al suggested that MIS should be regarded as a continual parameter where every point of reduction confers a similar degree of clinical benefit in terms of better survival and fewer hospitalisations.[10] However, in the Malaysian dialysis settings with the lack of renal dietitians, the distinct classification of malnutrition was necessary to facilitate other health care professionals into correctly classifying the dialysis patients with poor nutritional status. The DMS scores were used as the reference standard instead of serum albumin, which is widely accepted as a nutritional marker, because

serum albumin is frequently affected by the presence of systemic inflammation prevalent in HD and PD patients.[16,17] Furthermore, the DMS has proven its clinical significance as a predictor of malnutrition in several studies among the Asian dialysis populations.[18,19] Although the cut-off scores of the MIS were essentially arbitrary, in clinical practice and research settings, a simple classification of normal nutrition status and malnutrition may be useful in grouping patients than a parameter with linear scale.

The DMS in our study correlated well with nutritional markers to define malnutrition by ISRNM.[5] BMI, TSF, MAMA, MAMC and serum TIBC have been associated with quality of life and survival among the HD and PD patients.[20-22] Likewise, the MIS also strongly correlated with the BMI, TSF, MAMA, MAMC, serum albumin and serum TIBC. The DMS and MIS distinguished a greater number of dialysis patients as malnourished compared to the diagnostic criteria of PEW by ISRNM in this study. This is perhaps due to the DMS and MIS being screening tools confer discriminative screening properties in detecting potentially malnourished dialysis patients which may require urgency of intervention. The diagnostic criteria of PEW on the other hand, may not discriminate presence of early malnutrition among the dialysis patients as it encompasses diagnostic properties which may be best utilised in monitoring long-term improvements in malnutrition.

The DMS and MIS in this study were more sensitive in predicting PEW and performed better when used for PD compared to HD patients. This could be explained by the higher percentage of patients on PD with low serum albumins and poor dietary protein intake in the studied population. Our study showed that the MIS and DMS are useful in identifying malnourished patients as both tools have sensitivity and accuracy well above 50%. One of the factors to consider when using the MIS among the Asian population is the categories of BMI used in the original MIS were designed for Caucasians, who have different standards for healthy weight and obesity from that of the Asian population.[23,24] Nevertheless, in our current study, this factor did not affect the sensitivity of the MIS tool in identifying malnourished patients. Another advantage of the MIS is it reflects internal inflammation, predicts mortality and hospitalisation,[11,24] as well as it is an indicator of Malnutrition-Inflammation Complex Syndrome.[10]

In our study, both DMS and MIS had low specificity and negative predictive values for well-nourished patients, and this could be attributed to the fewer well-nourished patients in the dialysis centers. Nevertheless, dialysis patients should have periodic nutrition screening, consisting of laboratory measures (eg, serum albumin), body weight, food intake and repeated screening for malnutrition every six months.[12]

Our study showed that both DMS and MIS are equally valid in identifying malnourished patients especially those undergoing PD. The DMS may be a more practical tool in the Malaysian dialysis settings due to its ease and short time required to conduct the screening, as it does not require laboratory markers. It also closely resembles the SGA screening tool familiar to dietitians and nurses in the local hospital settings.

There are several limitations in this study. Patients recruited into this study only represented a portion of the spectrum of dialysis patients. Therefore, for further validation of the screening tools, greater subsets of dialysis patients are warranted. However, the baseline demographic characteristics of the recruited patients were similar to those reported in our local Malaysian Dialysis and Transplant Registry, 2013 suggesting that patients in our study are representative of the overall dialysis population.[1] Furthermore, we did not analyse high sensitivity C-reactive protein and other inflammatory markers to quantify the degree of systemic inflammation. Thus, the relationship between the inflammatory parameters with the DMS and MIS could not be obtained.

Conclusion

Both DMS and MIS are valid tools to be used for nutrition screening of dialysis patients especially those undergoing PD where a higher rate of malnutrition is present. The DMS may be a more practical and simpler tool to be utilised in the Malaysian dialysis settings as it does not require laboratory markers.

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AUTHOR DISCLOSURES

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Original Article

Dialysis Malnutrition and Malnutrition Inflammation Scores: screening tools for prediction of dialysis – related protein-energy wasting in Malaysia

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透析营养不良和营养不良炎性评分：在马来西亚预测透析相关的蛋白质-能量消耗的筛选工具

背景与目的：在马来西亚透析患者中，营养不良的发生率很高，需要一种能够早期识别和管理患者的有效的筛查工具。本横断面研究目的是在马来西亚透析患者中探讨透析营养不良评分工具（DMS）和营养不良炎症评分工具（MIS）预测蛋白质能量消耗（PEW）的敏感度。**方法与研究设计**：用 DMS 和 MIS 筛查 155 名血液透析（HD）和 90 名腹膜透析（PD）患者营养不良的风险，并与国际肾脏营养与代谢协会（ISRNM）已经制定的 PEW 指南进行比较。**结果**：MIS 截点得分≥5 表示所有的患者存在营养不良。根据 ISRNM 标准，59%的 HD 和 83%的 PD 患者有 PEW。基于 DMS，73%的 HD 和 71%的 PD 患者存在中度营养不良，而使用 MIS，分别有 88%和 90%的患者为营养不良。在 HD（R^2 =0.552，p<0.001）和 PD（R^2=0.466，p<0.001）患者中，DMS 和 MIS 显著相关。与 HD 患者相比（分别为 59%和 60%），PD 患者对 DMS 和 MIS 有较高的灵敏度值（分别为 81%和 82%）。**结论**：在马来西亚透析患者中，确定了 MIS 区分营养不良的截点值（得分≥5）。对于透析患者，尤其是接受腹膜透析的患者，DMS 和 MIS 是有效的营养筛查工具。DMS 可能是用在马来西亚透析装置中更实用更简单的工具，因为它不需要实验室指标。

关键词：蛋白质-能量营养不良、营养评估、透析、透析营养不良评分、营养不良炎症评分