Association of Handgrip Strength With Malnutrition-Inflammation Score as an Assessment of Nutritional Status in Hemodialysis Patients

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Introduction. Protein-energy wasting (PEW) is very common in patients with chronic kidney disease and those undergoing maintenance dialysis. Reduced handgrip strength is associated with PEW and considered as a reliable nutritional parameter that reflects loss of muscle mass. This study aimed to evaluate the handgrip strength and its relationship with the Malnutrition-Inflammation Score (MIS) among Iranian dialysis patients.
Materials and Methods. The study population consisted of 83 randomly selected hemodialysis patients from the dialysis centers in Kerman, Iran. Handgrip strength was measured using a dynamometer according to the recommendations of the American Society of Hand Therapists. All the patients were interviewed and the MIS of the patients were recorded.
Results. The PEW was prevalent in Kerman hemodialysis patients, with 83% and 17% having mild and moderate PEW based on MIS, respectively. Handgrip strength was significantly associated with age, sex, height, weight, and diabetes mellitus. After adjustment for age, handgrip strength was significantly associated with nutritional assessment markers on the basis of the MIS.
Conclusions. Handgrip strength can be incorporated as a reliable tool for assessing nutrition status in clinical practice. However, further research is needed to determine the reference values and cutoff points both in healthy people and in hemodialysis patients to classify muscle wasting.

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INTRODUCTION

Protein-energy wasting (PEW) is common in patients with end-stage renal disease on maintenance dialysis and is associated with increased morbidity and mortality.[1] The prevalence of PEW in hemodialysis patients varies from approximately 23% to 76%.[1] This may be a consequence of various factors, including disorders in protein and energy metabolism, hormonal disturbances, infections, and other superimposed illnesses such as cardiovascular disease and diabetes mellitus, as well as reduced food intake due to anorexia, nausea and vomiting, and taste change, caused by uremic toxicity.[1] Considering the high prevalence of PEW and its association with morbidity and mortality, distinguishing nutritional problems requires special attention in this group.

We still lack a reliable single method to detect the nutritional status in these patients; it has been recommended to use multiple markers.[2] There are several clinical, nutritional, and biochemical markers that may be indicative of PEW in hemodialysis patients, including serum albumin, subjective global assessment (SGA), malnutrition-inflammation score (MIS), dietary intake assessment, handgrip strength (HGS), and anthropometry assessment.[3] The SGA is a clinical nutritional assessment method developed by Detsky and colleagues,[4] which is comprised of subjective and objective aspects of nutritional status, including components of medical history and clinical examination.[2] It is considered a simple, inexpensive, and practical technique, and provides important nutritional information.[5] However, the SGA is basically subjective and its sensitivity, accuracy, and reproducibility may be insufficient to detect the presence of PEW or small variations in nutritional status over time in hemodialysis patients.[6]

Kalantar-Zadeh and coworkers proposed a new combined method called malnutrition inflammation score (MIS), which was composed of the SGA method and the other markers.[2] The MIS has a total of 10 components, 70% of the indexes are common with the SGA questionnaire and the remainder 30% are serum albumin, total iron binding capacity (TIBC), and body mass index.[2] Among currently available tools, the MIS appears the most reliable for grading PEW in hemodialysis patients.[6]

Handgrip strength, a measurement of the maximal voluntary force of the hand and arm, is a simple easily performed bedside test.[7,8] It is a useful marker of nutritional status in hemodialysis. It can independently predict nutrition status variations.[9] Therefore, this study was carried out to assess nutritional status by incorporating handgrip strength and compare it against the MIS in hemodialysis patients for the first time in Iran.

MATERIALS AND METHODS

Participants

In this cross-sectional study, 90 hemodialysis patients were randomly selected from among 175 hemodialysis patients in Kerman hemodialysis centers. The required sample was 81 patients for this study. However, due to the reluctance of some patients to participate in this study, sample size was considered 10% more than calculated sample. The inclusion criteria for eligibility were age of 18 to 70 years and undergoing hemodialysis for at least 2 months before starting the study. Patients with an acute disease, malignancies, liver cirrhosis, any abnormalities of the upper extremities, acquired immunodeficiency syndrome, cancer, amputation, progressive disease, isolation, osteoarthritis, and pregnancy were excluded, as well as those who were hospitalized during the study or recently had undergone surgery.

All of the participants signed an informed consent. A researcher was trained for ensuring the reliability of the nutritional status assessment and data collection. The MIS and HGS measurements were assessed in all of the participants. Blood samples were taken to analyze biochemical measurements, including serum albumin and TIBC from the patients after an overnight fast. The hemodialysis patients were investigated on a mid-week, before the dialysis session.

Clinical and demographic data of the patients were obtained from their hospital records. The other indexes such as age, sex, family history of kidney disease, cause of end-stage renal disease, duration of dialysis, number of dialysis sessions per week, and time of dialysis session were collected through an interview with the patient. Height and dry weight (end-dialysis body weight) were measured. Dry weight measurement (with little clothing as possible) was assessed within 10 to 20 minutes after dialysis session using a Seca scale (Germany) with an accuracy of ± 100 g.

The study protocol was approved by review panels and ethics committees of the Deputy of Research in Kerman Medical University (Reference number, K/92/399).

Malnutrition-Inflammation Score

The MIS questionnaire is a quantitative tool that is based on the original SGA components, plus 3 additional parameters of assessment (body mass index, serum albumin and TIBC).[2] Each MIS component has 4 levels of severity from zero (normal) to 3 (very severe). The sum of all the 10 MIS components ranges from zero to 30, denoting the increasing degree of severity.[10] The patients were considered mild wasting, moderate wasting, and severe wasting if the MIS score were between zero and 10, 11 and 20, and 21 and 30, respectively. Blood samples were collected on the morning of nutritional assessment to measure serum albumin and TIBC. These samples were centrifuged for 5 minutes at 3000 rpm and stored at -21°C until analysis. Serum albumin and TIBC were measured using a Pars Azmun Kit (Tehran, Iran) with the use of an automated analyzer (Selektra XL, ELITech Group, Puteaux, France).

Body mass index was calculated as the end-dialysis body weight in kilograms divided by the square of height in meters (kg/m^2). Finally, the MIS was calculated for all patients.

Handgrip Strength

Handgrip strength was measured on the nonfistula side before dialysis session using a Jamar hydraulic dynamometer (Sammons Preston Rolyan, USA) with a precision of 0.5 kg and a range of zero to 90 kg. The American Society of Hand Therapists' recommendations were followed to measure HGS. This society suggested a standard testing protocol for HGS in which the participant is seated with the shoulder adducted and neutrally rotated, the elbow flexed at 90 degrees, the forearm in neutral, and the wrist between zero and 30 degrees extension and between 0 and 15 degrees ulnar deviation.[11] In addition to the standardization, dynamometer handle was adjusted for all of the patients in the second position. A pretest was done allowing the participant to become familiar with the instrument and procedure. Three trials were performed with a rest period of at least 1 minute between trials and the highest HGS value was used in the analysis.

Statistical Analyses

Results were expressed as mean ± standard deviation, median (minimum to maximum), or percentage of change, as applicable. The 1-way analysis of variance and the *t* test were used to examine the difference between the mean values. The Pearson correlation coefficient was calculated to examine the relationship between the variables. A linear regression model was used to predict the score of one of the variables, given the score of the other. Significance was assumed at a *P* value less than .05. The statistical analyses were conducted using the SPSS software (Statistical Package for the Social Sciences, version 22.0, SPSS Inc, Chicago, Ill, USA).

RESULT

Eighty-three patients from among a total of 90 hemodialysis patients participated in the study. Fifty of the patients (60.2%) were men. The causes of end-stage renal disease were hypertensive nephrosclerosis in 24 patients (28.9%), diabetic nephropathy in 9 (10.8%), polycystic kidney disease in 6 (7.3%), diabetic and hypertensive nephropathy in 37 (44.6%), urologic and obstructive problems in 3 (3.6%), glomerulonephritis in 1 (1.2%), and not identified in 3. Forty-one men (82%) and 31 women (93.9%) had hemodialysis session 3 times per week. Also, in both men and women, hemodialysis sessions would take 4 hours on average.

The characteristics of the studied patients and their PEW classification based on the MIS are shown in Table 1. There was a significant difference in the prevalence of PEW between the men and the women.

There was a significant negative correlation between age and HGS. There also a significant positive correlation between height and weight and HGS (Table 2). The HGS values of the men were significantly higher than those of the women ($P < .001$). The lowest HGS values were observed in the patients with diabetes mellitus as compared

Table 1. Characteristics of the Studied Patients

Characteristic	Women (n = 33)	Men (n = 50)	Total (n = 83)	*P*
Mean age, y	11.17 ± 59.27	13.42 ± 56.8	12.56 ± 57.8	.39
Duration of dialysis, mo	21.8 ± 25	26.7 ± 33	25.06 ± 29.8	.16
Family history of kidney disease, %	27.3	14.0	19.3	.13
Body weight, kg	15.6 ± 65.2	14.3 ± 71.2	15.04 ± 68.8	.07
Body height, cm	6.67 ± 154.3	6.43 ± 165.9	8.6 ± 161.2	< .001
Body mass index, kg/m^2	6.2 ± 27.3	4.9 ± 25.92	5.47 ± 26.48	.13
Serum albumin, g/dL	0.38 ± 3.78	0.52 ± 3.77	0.47 ± 3.77	.87
Malnutrition-inflammation score, %				
Mildly wasted	72.7	90.0	83.1	
Moderately wasted	27.3	10.0	16.9	0.04
Handgrip strength, kg	4.93 ± 13.96	8.26 ± 26.76	9.48 ± 21.67	< .001

Table 2. Correlation Between Handgrip Strength and Patients' Parameter

	Handgrip strength and Patients' Parameters					
	Women		Men		All	
Parameter	r	*P*	R	*P*	r	*P*
Weight	0.213	.23	0.125	.39	0.238	.03
Height	0.441	< .001	0.499	< .001	0.701	< .001
Age	-0.625	.01	-0.625	< .001	-0.524	< .001

Table 3. Malnutrition-Inflammation Score by Handgrip Strength and Sex

	Malnutrition-Inflammation Score		
Patients	Mildly Malnourished	Moderately Malnourished	*P*
Women	4.9 ± 13.99	5.3 ± 13.9	.97
Men	8.3 ± 27.27	6.9 ± 22.23	.20
All	9.6 ± 22.6	7.04 ± 16.9	.04

Table 4. Partial Correlation Analysis Between Handgrip Strength and Malnutrition-Inflammation Score (MIS)

	Handgrip Strength and MIS	
Adjusted Variables	R	*P*
Age	-0.247	.03
Diabetes	-0.218	.04
Age and diabetes	-0.238	.03

to the nondiabetics (17.7 ± 7.4 kg versus 26.6 ± 9.6 kg, *P* < .001).

The HGS values of the patients identified as mildly and moderately malnourished according to the MIS were 22.6 ± 9.6 kg and 16.9 ± 7.04 kg, respectively, which were significantly different (*P* = .04), but not significant when stratified by sex (Table 3). The HGS total score was significantly associated with the score of MIS (independent variable) in the univariable analysis (Table 4). However, results from the partial correlation analysis indicated that there was no correlation between HGS and MIS after adjustment for age, diabetes mellitus, body weight, and height. After adjusting for age and diabetes mellitus, the mean HGS was greater in patients with mild malnourishment than those in patients with moderate malnourishment (beta coefficient, -262, *P* = .01).

DISCUSSION

In the present study, based on the standard criteria of MIS, about 83% and 17% of patients had mild and moderate PEW, respectively. Tabibi and colleagues reported lower rates among 291 hemodialysis patients admitted to hospitals in Tehran (about 54% mild to moderate and 1% severe malnutrition).[12] Jahromi and colleagues indicated that 67.8% of their 112 hemodialysis patients were malnourished, according to the Dialysis Malnutrition Score and anthropometric and biochemical indexes.[13] Also, in Janardhan and coworkers' study on 66 hemodialysis patients in India, 91% of patients were mildly to moderately malnourished.[14] Overall, these results are somewhat in line with our results.

In our study, sex, height, weight, and predisposing disorder such as diabetes mellitus influenced the results of HGS assessment. Similar to the general population, HGS values for hemodialysis patients are associated with age.[15,16] Qureshi and colleagues revealed a negative correlation between age and HGS (r = -0.54). However, mean HGS values were significantly higher in patients under 65 years of age (70.2 ± 24.5%), when compared with those over 65 (45.2 ± 23%).[17] Moreover, it has been confirmed by other studies that age was negatively correlated with HGS.[8,18] We indicated that men had HGS mean values higher than women, similar to healthy samples,[19,20] and as documented in patients on hemodialysis.[8,21] The results of our study were consistent with the results in healthy subjects[15] and dialysis patients[18]; hence, the findings of these studies showed a positive association between height and weight with HGS. On the other hand, in the study of Wang and colleagues, similar to the present study, HGS was significantly associated with diabetes mellitus.[18]

Results from the association between the HGS values and MIS scores, before adjusting for age, height, and weight, showed no correlation between these indexes in men and women; nonetheless, the lower HGS values were shown with higher

MIS scores in hemodialysis men. However, results indicated that there was an association in the total sample. The correlation of HGS with MIS after adjustment for age revealed that there was a significant negative correlation between these indexes. It means that the patients who had mild PEW had more HGS values. Amparo and colleagues[22] found that MIS, as a nutritional scoring system, has a strong negative correlation with HGS. Silva and colleagues, in a study on 276 men and 162 women on hemodialysis,[21] reported that lower HGS values were independently associated with higher MIS scores. This inverse correlation was observed among both men and women after adjusting for age, race, duration of dialysis, and KT/V. These associations remained significant after more extensive adjustments. This study suggested that HGS was a valid instrument for screening malnutrition and inflammation in hemodialysis patients.

There are still few studies in this field. Most studies evaluated the association between HGS and SGA. Flood and colleagues[9] reported that HGS values in hospitalized patients were significantly correlated with SGA score and SGA categories. Their results suggested that HGS could independently predict nutritional status. Nutritional status defined by SGA score and SGA categories can alter the HGS. In contrast with their results, Garcia and coworkers[5] showed no association between HGS and the SGA in hospitalized patients. Gowhar and colleagues[7] revealed that HGS directly correlated with SGA score and HGS was a complementary tool for screening malnutrition in patients on maintenance hemodialysis. Wang and colleagues showed that HGS significantly correlated with SGA in 2 separate studies.[18,23]

Antioxidants might have a protective role against malnutrition and inflammation in hemodialysis patients via anti-oxidative and anti-inflammatory properties. Therefore, antioxidant supplementation may diminish MIS and augment HGS values in these patients. It has been shown that supplementation with vitamin E with and without alpha-lipoic acid significantly reduces interleukin-6 concentration.[24] A nonsignificant decrease is reported in the high-sensitivity C-Reactive protein and malondialdehyde levels. However, the authors have concluded that antioxidant supplementation might improve inflammation and malnutrition status.

One of the limitations of our study was the lack of measuring free triiodothyronine and the Charlson Comorbidity Index. Relationship these variables of malnutrition and inflammation was demonstrated in hemodialysis patients. The results of one of the studies indicated that free triiodothyronine is negatively correlated with inflammatory markers, namely C-reactive protein, and it is independently related with MIS in hemodialysis patients.[25]

CONCLUSIONS

Handgrip strength can be incorporated as a useful and reliable tool for evaluating the systematic and continuous muscle mass in relation to nutritional status in dialysis patients. However, the main obstacle to the general adoption of HGS as a tool for nutritional evaluation lies in the fact that there are still few studies proposing reference values based on representative samples of the population and the cutoff point to classify muscle wasting has not yet been defined. However, these studies have been conducted outside the country and no study in this field has been performed in Iran. Therefore, more research is needed to determine reference values and cutoff points both in healthy people and in patients to classify muscle wasting.

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CONFLICT OF INTEREST

None declared.

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