Article

Factors Associated with the Prevalence of Malnutrition among Adult Haemodialytic Patients: A Two-Centre Study in Jeddah Region, Saudi Arabia

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Abstract: Background: Chronic kidney disease, one of the most common diseases in the world, is characterized by irreversible impairment of the kidney's metabolic, excretory, and endocrine functions. During end-stage renal disease, patients require renal replacement therapy, such as hemodialysis (HD). Protein-energy wasting is a common health problem among HD patients. However, this study aims to assess the nutritional status of HD patients at two HD centers in Jeddah, Saudi Arabia, and to determine its associated factors. **Methods:** A cross-sectional study was conducted at two different Dialysis Centers in Jeddah, Saudi Arabia; 211 female and male HD patients. Malnutrition was recognized using the Modified-SGA (M-SGA) comprising two parts: medical history and physical examination. Sociodemographic and health status for all patients were also determined. Patients were classified based on their M-SGA score into two groups: normal and malnourished. **Results:** Overall, 54.5% of the participants showed malnutrition. Unemployment, low muscle strength and mass, high level of medication use, and high dialysis vintage were positively ($P<0.05$) associated with malnutrition. **Conclusion**: The M-SGA score indicates a high prevalence of malnutrition among HD patients. These results show the importance of regular assessment and follow-ups for HD patients ensuring better health and nutritional status.

Keywords: Chronic Kidney Disease; Protein-Energy Wasting; Modified-Subjective Global Assessment

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1. Introduction

Chronic kidney disease is a worldwide public health concern that is defined as the irreversible impairment of kidney functioning, which may promote end-stage renal disease and require renal replacement therapy [1]. Renal replacement therapies, which include peritoneal dialysis, hemodialysis (HD), and kidney transplants, were globally established in the 1960s [2]. In the year 2018, the total number of chronic HD patients in Saudi Arabia was 19,033 cases, including 6,419 patients in the Western region, an increase of 58.6% from the number of cases in the year 2011 (around 12 thousand cases). Saudi Arabia had 271 HD centers, most working under the supervision of the Saudi Ministry of Health (MOH), except several government non-MOH hospitals [3].

Protein-energy wasting (PEW) is a common problem among HD patients and one for which there are many causes, including increased nutrient requirements, anorexia, altered taste sensation, emotional distress, gastrointestinal (GI) symptoms, catabolic metabolism, and nutrient loss during HD sessions. A ratio of glucose, amino acids (approximately 4-12 grams) and water-soluble vitamins, are lost while crossing the dialyzer membrane. The last PEW pathway is associated with inflammation and co-morbidity, such as infections, sepsis, and cardiovascular disease [4].

The consequent malnutrition of HD negatively affects patient quality of life. For example, it can cause osteoporosis, which promotes fractures, frequent falls, and muscle loss. Furthermore, malnutrition may increase hospitalization period, morbidity, and mortality rate [4, 5].

Using nutrition assessments to measure nutrition status involves anthropometric, biochemical, clinical, and dietary data. These data are collected by nutrition specialists, with Subjective Global Assessment (SGA) being one of the most important tools used by healthcare providers. This tool assesses nutrition status and support to predict the nutritional-associated clinical outcomes [6]. This tool is based on medical history and physical examination. Medical history includes functional capacity, gastrointestinal symptoms, weight loss, co-morbidities, and dietary intake. Physical examinations concern muscle loss and subcutaneous fat. Meanwhile, biochemical evaluation measured hemoglobin, albumin, and the normalized protein catabolic rate (nPCR) to provide valid measurements for PEW detection. Albumin is the most common malnutrition indicator because its synthesis decreases during malnutrition, and it is affected by food intake. Thus, albumin is a good indicator of nutrition status among HD patients. Furthermore, albumin is significantly related to the nPCR [2, 7]. Finally, bioelectrical impedance analysis is a non-invasive and inexpensive method for assessing body composition in clinical conditions in terms of lean body mass, fat percent, and fluid volume. Different factors can affect bioelectrical impedance measurements, including age, sex, and race [8].

Studies regarding malnutrition in HD in Saudi Arabia are scarce. A cross-sectional study, conducted in 2012 [7], showed that 48.7% HD patients in Jeddah were moderately malnourished and 6.3% were severely malnourished. Most of these malnourished patients were females and older age. The limitations of the study included using a single dialysis center and featuring limited patient socioeconomic diversity. Therefore, its results cannot be generalized to all HD patients in Saudi Arabia [7]. It is worth mentioning that no recent data is available regarding the prevalence of malnutrition of HD patients in the Western region of Saudi Arabia. Therefore, our study aims to assess the nutrition status among HD patients at two HD centers in Jeddah, Saudi Arabia, and to determine the associated factors related to malnutrition.

2. Materials and Methods

2.1. Study design and settings

This cross-sectional study was conducted at two branches of Diaverum HD in Jeddah, Saudi Arabia: the Prince Abdulmajeed Dialysis Center, the largest dialysis center in

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Saudi Arabia, and the North Jeddah Dialysis Center. The data were collected during the period between August and September 2020.

2.2. Subjects

There were 6,419 HD patients in the Western region of Saudi Arabia in the year 2018, according to reports issued by the Saudi Center for Organ Transplantation and MOH, [3]. The Epi Info™ software was used (https://www.cdc.gov/epiinfo/index.html), fulfilling the minimum sample size requirement of 161 participants, specified to achieve study power of 80%. The total number of patients in both dialysis centers was 612.

Patient inclusion criteria were: i) adults aged between 18 and 65 years old, ii) undergoing HD three times per week for at least 3 hours per session, iii) hemodialyzed for at least six months, iv) absence of nutritional support (enteral and parenteral feeding), and v) ability to stand. Excluded criteria were: i) any physical, mental, or psychiatric disease(s), ii) amputation patients, iii) presence of infectious diseases, specifically HIV and hepatitis, and iv) communication disability (4). Based on these criteria, 211 HD patients were recruited, and **Figure 1** displays the flow chart for the selection of eligible participants.

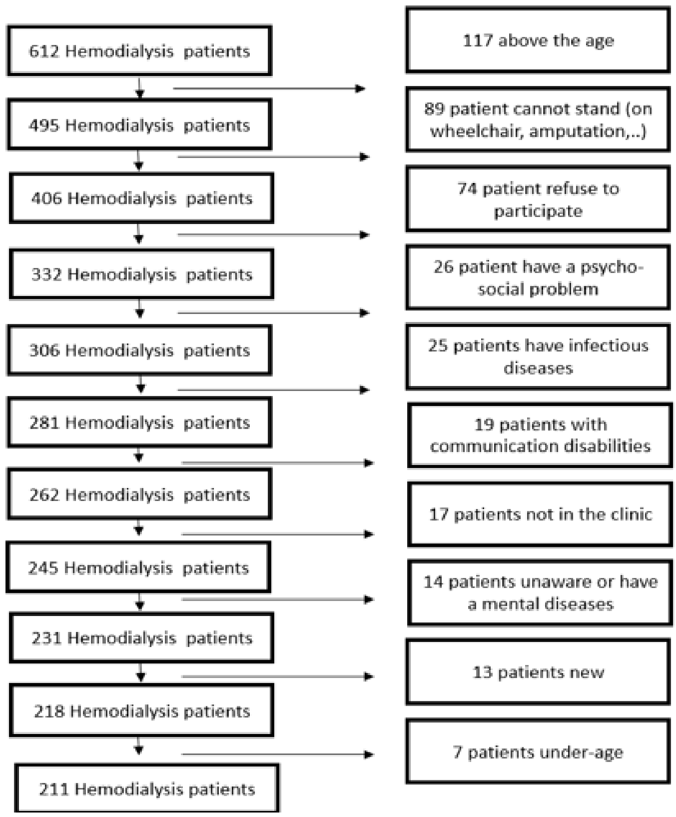

Figure 1. Recruitment of participants.

2.3. Data collection

The data were collected using a questionnaire form that included four different sections. The first section considered sociodemographic and health status information. The second section was the SGA. The third section included data about biochemical parameters. All of these data were obtained from computerized documentation or by face-to-face interviews. The final section was the bioelectrical impedance analysis, which evaluated body composition. The four sections of the used questionnaire were as follows:

a) Sociodemographic and health status

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This component produced data about each patient's age, gender, education level, employment status, marital status, residency, household income, living status, HD vintage, HD duration, HD time per week, tobacco use, body mass index (BMI), medications, and co-morbidities [1, 9].

b) Subjective Global Assessment

Patients were screened using a Modified-SGA (M-SGA) [6]. This M-SGA was divided into two sections: medical history and physical examination. Medical history included five parameters, with each measured on the five-point scale. The first measurement was anthropometric assessment (weight change over the previous six months). The second measurement was dietary intake. Gastrointestinal symptoms, the third evaluative measurement, were divided into no symptoms, nausea, vomiting, diarrhea, and severe anorexia. Functional capacity, which is only related to nutrition, evaluated the patient's activity level. The final parameter considered co-morbidity, which was measured by estimating and evaluating HD vintage and co-morbidity levels. Co-morbidity levels included the number of comorbid diseases and the number of medications being taken. The physical examination section of the SGA is comprised of two parts. Results of each part were divided into three levels. First, it estimated fat stores using bioimpedance and clinical examination. Second, it evaluated muscle wasting using a Handgrip instrument (GRIPX Digital Hand Dynamometer Grip Strength Measurement, Shanghai, *China*) [6, 10]. The final handgrip results were recorded as an average of three readings from the same instrument. The M-SGA is composed of 7 components, as mentioned earlier, and was conducted by the researchers, who are certificated by the Saudi Commission of Health Specialties and have experience with HD patients. At each component of the M-SGA, there was a rate from 1 (normal) to 5 (severe malnutrition). For each patient, the values for all components were summed with a potential overall range from 7 to 35, and each HD patient was considered as well-nourished when the total value was 7, and a patient was defined as malnourished if the summation of all components was more than 7.

c) Biochemical assessment

The biochemical assessment measured hemoglobin, albumin, and nPCR. These measurements were conducted pre-dialysis for patients through blood drawing at the beginning of each month. The values were obtained from participants' electronic documentation and compared with the normal ranges [2].

d) Bioimpedance analysis

The bioimpedance machine (Tanita, BC 418, Japan) was used 15-60 min after the dialysis session for each participant to evaluate their lean body mass, fat mass, and body water content. The patient had to remove their shoes and any metallic accessories and stand on the machine in the correct right position to enable the machine to produce these measurements. Among the study population, twenty-nine patients refused to participate in this analysis, whereas 182 HD patients completed the body composition measurements. The body composition analyses for HD patients were performed within 15 to 120 minutes post dialysis, which in turn reflect their dry weight and minimize the potential impact of fluid retention.

2.4. Statistical analysis

Statistical analysis was conducted using IBM-SPSS statistics (Statistic Package for Social Sciences; Armonk, New York, USA) version 23, with P-values <0.05 considered statistically significant. Continuous variables were expressed as mean ± standard deviation. The frequencies of categorical variables were compared using a Chi-squared test. The *Mann-Whitney-U* test was used to compare between means of two groups with non-normal distribution. To assess risk factors related to moderate and severe malnutrition, the odds ratio (OR), 95% confidence intervals (95% CI), and β-coefficient were determined using binary logistic regression.

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3. Results

3.1. Sociodemographic and anthropometric characteristics for HD patients

Table 1 describes the sociodemographic and anthropometric characteristics as predictors for malnutrition in HD patients. The mean age was 46.4 years ± 11.6. Most of the participants were between 30-49 years (46.4%), and 44.5% of the participants were 50 years and more. Out of the total number of participants, 122 were males (57.8%), and the remainder were females. Only 7.1% of the participants were living alone, with 92.9% living with family. The mean number of family members in the household was 5.1 ± 2.9. Around 30% (n=64) of patients had three or fewer family members at home, 45.5% (n=96) had between four and six, and 24.2% (n=51) had more than six. About 60% of the patients were married, with the remaining being single (24.6%), divorced (10%), or widowed (4.7%). Regarding monthly income, 19% of participants received ≤3000 SR (~ 810 US Dollar), approximately 23% received between 3001 and 5000 SR (~ 1350 US Dollar), approximately 33% received between 5001 and 10000 SR (~ 2700 US Dollar), and 25.1% received more than 10000 SR. Regarding education level, most patients had secondary education (37.9%), 29.4% had university education. The approximate percentages of employed (34.6%) and unemployed (39.3%) participants were similar, while the remainder of participants (26.1%) were retired. The result showed a significant difference (P= 0.038) in employment status between well-nutrition and malnutrition participants. The mean BMI was 28.5 kg/m^2 ± 6.8, indicating that 11 participants (5.2%) were underweight, 57 were normal weight (27%), 68 were overweight (32.2%), and 75 were obese (35.5%). The mean handgrip score was 19.8 ± 12.2. Mean handgrip results indicated a significant association (P = 0.011), with the degree of malnutrition with well-nourished patients were producing the highest handgrip scores and those with severe malnutrition were recording the lowest scores. Overall, the Tanita device showed that the mean fat-free mass, body fat percent, fat weight, and total body water weight were 47.6 kg ± 10.8, 32.1% ± 10.8, 24.5 kg ± 13, and 35.1 kg ± 7.9, respectively. The average fat-free mass demonstrated a significant difference (P= 0.018) between both categories: well-nourished and malnourished participants, while other Tanita device measurements did not exert any significant differences (P>0.05) between both groups. The Table also presents the potentially sociodemographic and anthropometric predictors related to malnutrition in HD patients. Following previous results, significant (P<0.05) effects were observed for unemployment (OR= 2.257, 95% CI= 1.184-4.302), handgrip (OR=0.978, 95% CI= 0.955-0.998), and fat free mass (OR= 0.969, 95% CI= 0.942-0.996).

Table 1. Sociodemographic and anthropometric characteristics as predictors for malnutrition in HD patients.

Variable	Frequency (%) or Mean ± SD			P-value	OR (95% CI)
	Total	Malnutrition			
		No (n=96)	Yes (n=115)		
Age	46.4 ± 11.6	45.7 ± 11.8	47.1 ± 11.6	0.394	NS
Age category (n= 211)					
18–29	19 (9.1%)	11 (11.5%)	8 (7%)	0.52	NS
30–49	98 (46.4%)	43 (44.8%)	55 (47.8%)		
50–65	94 (44.5%)	42 (43.8%)	52 (45.2%)		
Gender (n= 211)					
Male	122 (57.8%)	59 (61.5%)	63 (54.8%)	0.201	NS

Female	89 (42.2%)	37 (38.5%)	52 (45.2%)		
Living arrangements (n= 211)					
Alone	15 (7.1%)	7 (7.3%)	9 (7%)	0.566	NS
With family	196 (92.9%)	89 (92.7%)	107 (93%)		
Number of Family members (n= 211)	5.1 ± 2.9	5.1 ± 2.9	5.1 ±2.9	0.819	NS
≤ 3	64 (30.3%)	27 (28.1%)	37 (32.2%)	0.816	NS
4-6	96 (45.5%)	45 (46.9%)	51 (44.3%)		
> 6	51 (24.2%)	24 (25%)	27 (23.5%)		
Marital status (n= 211)					
Single	52 (24.6%)	25 (26%)	27 (23.5%)	0.956	NS
Married	128 (60.7%)	58 (60.4%)	70 (60.9%)		
Divorced	21 (10%)	9 (9.4%)	12 (10.4%)		
Widow	10 (4.7%)	4 (4.2%)	6 (5.2%)		
Income category (SR*; n= 211)					
≤ 3000	40 (19%)	13 (13.5%)	27 (23.5%)	0.267	NS
3001-5000	48 (22.7%)	22 (22.9%)	26 (22.6%)		
5001-10000	70 (33.2%)	33 (34.4%)	37 (32.2%)		
>10000	53 (25.1%)	28 (29.2%)	25 (21.7%)		
Education level (n= 211)					
Illiterate	16 (7.6%)	8 (8.3%)	8 (7%)	0.382	NS
Primary	20 (9.5%)	8 (8.3%)	12 (10.4%)		
Intermediate	28 (13.3%)	9 (9.4%)	19 (16.5%)		
Secondary	80 (37.9%)	34 (35.4%)	46 (40%)		
University	62 (29.4%)	34 (35.4%)	28 (24.3%)		
Higher education	5 (2.4%)	3 (3.1%)	2 (1.7%)		
Employment status (n= 211)					
Employment	73 (34.6%)	40 (41.7%)	33 (28.7%)	**0.038**	1
Unemployment	83 (39.3%)	29 (30.2%)	54 (47%)		**2.257 (1.184-4.302)**
Retired	55 (26.1%)	27 (28.1%)	28 (24.3%)		1.257 (0.623-2.535)
Weight (kg; n= 211)	74.2 ± 20.9	76.3 ± 17	72.5 ± 23.6	0.075	NS
Height (cm; n= 211)	161.3 ± 9.2	162.2 ± 7.5	160.5 ± 10.3	0.318	NS
BMI (kg/m²; n= 211)	28.5 ± 6.8	29 ± 6.1	28.1 ± 7.3	0.199	NS
BMI category					
Underweight	11 (5.2%)	1 (1%)	10 (8.7%)	0.94	NS
Normal weight	57 (27%)	26 (27.1%)	31 (27%)		
Overweight	68 (32.2%)	32 (33.3%)	36 (31.3%)		
Obese	75 (35.5%)	37 (38.5%)	38 (33%)		
Handgrip (n= 211)	19.8 ± 12.2	21.5 ± 11.9	18.3 ± 12.3	**0.011**	**0.978 (0.955-0.998)**
Fat free mass (kg; n=182)	47.6 ± 10.8	49.5 ± 10.5	45.9 ± 10.8	**0.018**	**0.969 (0.942-0.996)**
Body fat % (n=182)	32.1 ± 10.8	32.1 ± 10.8	32.1 ± 10.9	0.975	NS
Fat weight (kg; n=182)	24.5 ± 13	25 ± 12.1	24.1 ± 13.7	0.395	NS
Total body water (kg; n=182)	35.1 ± 7.9	36.5 ± 7.7	34 ± 7.9	0.12	NS

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- P-values were determined by Chi-squared (χ^2) test for categorical variables and by Mann-Whitney-U-Test for continuous variables.
- Bold values denote significant results; * SR: Saudi Riyals; 1 SR equals 0.27 American Dollar.

3.2. Health status for HD patients

Table 2 presents health status as a predictor of malnutrition in HD patients. Regarding tobacco use, 122 patients (57.8%) were non-smokers, 42 were smokers (19.9%), and 47 were previously smokers (22.3%). Most patients (n=176; 83.4%) had not received a kidney transplant; 35 had received a kidney transplant. The mean HD duration was 5.8 years ± 5.5. The results demonstrated a highly significant difference (P < 0.001) in the HD duration between well-nourished participants and malnutrition (3.4 years vs 7.9 years, respectively). Also, there was a highly significant difference (P < 0.001) in nutritional status between participants with less than four years of HD and participants with HD 4 years and more. The average number of chronic diseases was 2.1 ± 1.1, and the average number of medications for chronic diseases was 4.3 ± 2.8. The average number of medications for chronic disease was significantly (P=0.001) associated with nutritional status. Furthermore, well-nutrition and malnutrition groups were significantly correlated (P < 0.001) with the number of medications for chronic disease (less than 4 medications or 4 medications and more). Most patients recorded normal hemoglobin (94.3%), albumin (99.5%), and nPCR levels (60.7%). The averages of hemoglobin serum level, albumin serum level, and nPCR were not significant (P>0.05) between both groups. Furthermore, Table 2 displays potentially health status predictors that were related to malnutrition, with HD vintage (continuous results; OR= 1.299, 95% CI= 1.176-1.435, discontinuous results; OR= 11.36, 95% CI= 5.958-21.661) and the number of medications (continuous results; OR= 1.203, 95% CI= 1.067-1.355; discontinuous results; OR=3.063, 95% CI=1.732-5.417) showing the only significant (P<0.05) results.

Table 2. Health status as predictors for malnutrition in HD patients (n= 211).

Variable	Frequency (%) or Mean ± SD			P-value	OR (95% CI)
	Total (n= 211)	Malnutrition No (n=96)	Malnutrition Yes (n=115)		
Tobacco use					
Yes	42 (19.9%)	22 (22.9%)	20 (17.4%)	0.6	NS
Ex-smoker	47 (22.3%)	21 (21.9%)	26 (22.6%)		
No	122 (57.8%)	53 (55.2%)	69 (60%)		
Kidney transplant					
Yes	35 (16.6%)	13 (13.5%)	22 (19.1%)	0.184	NS
No	176 (83.4%)	83 (86.5%)	93 (80.9%)		
Duration of dialysis per year	5.8 ± 5.5	3.4 ± 3.5	7.9 ± 6	**<0.001**	**1.299 (1.176-1.435)**
< 4 years	117 (55.5%)	25 (26%)	92 (80%)	**<0.001**	1
≥ 4 years	94 (44.5%)	71 (74%)	23 (20%)		**11.36 (5.958-21.661)**
Number of chronic diseases	2.1 ± 1.1	2.1 ± 1.1	2.1 ± 1.1	0.753	NS
< 3 chronic diseases	138 (65.4%)	62 (64.6%)	76 (66.1%)	0.466	NS
≥ 3 chronic diseases	73 (34.6%)	34 (35.4%)	39 (33.9%)		

Number of medications for chronic diseases	4.3 ± 2.8	3.7 ± 2.6	4.9 ± 2.8	**0.001**	**1.203 (1.067-1.355)**
< 4 medications	125 (59.2%)	43 (44.8%)	52 (71.3%)	**<0.001**	1
≥ 4 medications	86 (40.8%)	53 (55.2%)	33 (28.7%)		**3.063 (1.732-5.417)**
Hemoglobin (g/dl)	11.3 ± 0.9	11.4 ± 0.8	11.2 ± 1	0.258	NS
Deficient	12 (5.7)	5 (5.2%)	7 (6.1%)	0.923	NS
Normal	199 (94.3%)	91 (94.8%)	108 (93.9%)		
Albumin (g/l)	38.6 ± 2.8	38.7 ± 2.7	38.5 ± 2.8	0.881	NS
Deficient	1 (0.5%)	0	1 (0.9%)	0.545	NS
Normal	210 (99.5%)	96 (100%)	114 (99.1%)		
nPCR (g/kg/day)	1.1 ± 0.3	1.1 ± 0.3	1.1 ± 0.3	0.503	NS
Deficient	83 (39.3%)	37 (38.5%)	46 (40%)	0.471	NS
Normal	128 (60.7%)	59 (61.5%)	69 (60%)		

- P-values were determined by Chi-squared (χ^2) test for categorical variables and by Mann-Whitney-U-Test for continuous variables.
- Bold values denote significant results
- Normal biochemical serum level: Hemoglobin: 10–12 g/dl; Albumin: ≥ 35 g/l; nPCR: ≥ 1.0 g/kg/day.
- NS: Not significant

4. Discussion

The study aimed to assess the nutritional status and factors related to malnutrition in HD patients in Jeddah, Saudi Arabia, where only one outdated study discussed the prevalence of malnutrition among such patients [7]. The current study used the SGA, handgrip, and body composition analysis tools to assess patient nutrition status. The SGA is an inexpensive and rapid assessment tool that has been recommended for HD patients by the National Kidney Foundation's Kidney Disease/Dialysis Outcomes and Quality Initiative. The five-point scale parameters (M-SGA) chosen, which included medical history (weight change, dietary intake, GI symptoms, functional capacity, and co-morbidities) and physical examination, which included measuring fat stores, subcutaneous fat, and muscle status. The body composition analysis tool was used to support the results derived from the M-SGA [6]. Results of this study indicated that factors significantly ($P<0.05$) related to malnutrition were unemployment, handgrip, fat-free mass, medication consumption, and the number of years of HD.

The worldwide prevalence of malnutrition among HD patients is different. Comparable results for the prevalence of malnutrition among HD patients have been found in Lithuania (42.4%) [11], Australia (46%), and Brazil (47%) [12]. A higher percentage (54.4%) was observed in Malaysia [13], while the lowest percentage (27.3%) was observed in Iran [14]. In the Arab region, a recent cross-sectional study in Palestine focused on evaluating the nutrition status of 174 HD patients using inexpensive nutritional assessment equipment. That study showed that most HD patients (65%) experienced moderate malnutrition. However, the study featured some limitations, including its study design, which limited its capacity to define a causative relationship between variables, and its sample collection method, with patients deriving from a single HD center, precluding the results from being generalized to all Palestinian HD patients. Additionally, the study used the malnutrition inflammation score, a subjective measurement, to evaluate patient nutrition status, meaning it mostly depended on the examiner's assessment and clinical judgment. Finally, the presence of some clinical factors that can influence patients' nutritional status was not considered by the study, such as residual renal functioning and total weekly dialysis hours [1].

Concretely, 45.5% of this study's participants were well-nourished, 51.7% demonstrated moderate malnutrition, and 2.8% showed severe malnutrition. These results are similar to those of the previous Jeddah study (well-nourished participants: 45.7%; moderately malnourished participants: 48.7%; severely malnourished participants: 5.6%) [7]. These similar results can be explained by the fact of the patients of both studies were living in the same region.

Meanwhile, the proportion of moderately malnourished patients in the present study was smaller than that reported by the Palestine study (65%). In contrast, there were more severely malnourished patients in our study than in the Palestine study [1]. Lower levels of moderate malnutrition were reported by studies conducted in Iran (18.8%) and Australia (40%), but levels of severe malnutrition were higher in both countries (10.9% and 6%, respectively) [12, 15]. The differences between our study and other studies could be because of different risk factors, different socioeconomic levels, variations in facilities, and different population factors. Furthermore, malnutrition in HD patients could be shown in different degrees by changing some physiological factors, including reduced appetite, diminished taste sensitivity, chewing and ingestion difficulties, increased co-morbidities, diminished cognitive abilities, and obstacles to purchasing and preparing food [1, 16].

Dialysis vintage also demonstrated a direct relationship with undernutrition. Patients who had experienced 4 years or more of HD were at a higher risk of severe malnutrition than patients with fewer than 4 years of HD. This might be explained by studies that have found that HD duration increases the risk of other diseases and further complications. Moreover, increased HD duration can promote weight loss [17]. Additionally, HD is a highly catabolic process, leading patients to lose essential nutrients, such as proteins, amino acids, glucose, and vitamins. It has been reported that patients undergoing dialysis three times a week may lose 2 kg of lean body mass every year [1]. However, some studies have indicated that there is no significant link between HD duration and malnutrition [7, 12], potentially because some patients were on a path toward transplant surgery or death [17].

Regarding the association between HD patients taking a lower number of medications and avoiding malnutrition, results of this study matched those that were found by the Palestine study [1]. This result could be related to the effect of medications on nutrient absorption, food intake, and appetite, which might, in turn, promote GI symptoms. Moreover, increasing the number of medications has been associated with increased numbers of diseases and catabolic states [1]. In contrast, the Brazil study observed the inverse phenomenon [16].

Meanwhile, the finding of this study indicated a significant association between handgrip and malnutrition, which is consistent with a previous study that showed an inverse relationship between both of them [18]. The handgrip is an inexpensive, simple, fast, and reliable method for evaluating muscle strength and malnutrition, and this measurement was incorporated with anthropometric and laboratory measurements. Additionally, the handgrip results indicates early nutrition status deterioration, which permits starting suitable intervention expeditiously [18]. Our findings showed that the malnourished HD patients recorded lower handgrip values ($P = 0.011$) compared to the well-nourished HD patients (18.3 ± 12 and 21.5 ± 11.9, respectively). This observation could be attributed to potential muscle weakness in response to malnutrition [18]. It is well known that muscle mass, as measured by fat-free mass, is higher in well-nourished HD patients than in malnourished patients [19]. This agrees with our findings, in which the impact of malnutrition yielded comparable results by reducing both muscle mass and handgrip values. Accordingly, it could be assumed that these factors are intercorrelated with each other and could be used as predicting factors for malnutrition.

In the present study, unemployment was the only socioeconomic factor related to malnutrition; hence, unemployed HD patients were about 2.3 times higher odds of malnutrition than employed HD patients. This result could be ascribed to that unemployment might be linked to low income, shortage of food sources, delaying medical treatment, and low healthcare allowance. Furthermore, employed individuals could have better physical and mental status than unemployed ones, because of better movement and contact with others [20]. However, the employment rate for HD patients was low in different countries, and the rate gradually decrease with increased the severity of such patients [21].

Several predictive factors that were significantly associated with malnutrition in previous studies were not significant in our study. For example, a study conducted in Iran in 2020 indicated that the prevalence of malnutrition was significantly greater among female HD patients than male HD patients, and demonstrated a positive relationship between serum albumin and malnutrition, as well as older age and malnutrition [15]. Meanwhile, the previously mentioned Brazil study indicated strong associations between malnutrition in HD patients and low incomes, illiteracy, retirement, the presence of hypertension, hospitalization frequency, and depression [16]. Additionally, in the Omari study, malnutrition was positively associated with patients living alone [1], and the Alharbi study showed strong relationships between nutrition status and gender, albumin, triceps skinfold, and mid-arm muscle circumference, and intradialytic weight [7]. The differences between the present study and these other studies could be due to different sample sizes, different data collection methods, differences in the socioeconomic status of participants, and different facilities and population factors.

The limitations of our study are the use of convenience sampling to recruit participants could affect the results or produce biases in the results, and the authors did not provide measures of dialysis adequacy (%URR or Kt/V). Meanwhile, collecting all data from one city, made it difficult to generalize the results for Saudi Arabia. Finally, inflammatory biomarkers and some biochemical parameters, such as phosphate, and calcium, that could affect the nutritional status assessment were not considered.

5. Conclusions

According to the SGA, malnutrition was highly prevalent among HD patients. The percentage of moderate malnourished patients was 51.7%, severe malnourished was 2.8%, and the remaining patients were well-nourished (45.5%). This high prevalence was significantly associated with unemployment, low muscle strength and muscle mass, increased medications consumption, and HD vintage. These findings indicate the need for healthcare providers to implement regular nutritional assessment, education, counseling, and follow-up consultations with HD patients, as well as being aware of which patients are at risk of malnutrition, enabling nutritional deterioration to be avoided. It is also recommended to conduct further studies in different regions and with larger sample sizes to enable the generalization of the results.

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