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Assessment of nutritional status, dietary intake and adherence to dietary recommendations in hemodialysis patients

Moustakim Rachida [1], Mziwira Mohamed [1, 2], El Ayachi Mohammed[1] and Belahsen Rekia[1, *]

[1]*Chouaib Doukkali University, Training & Research Unit on Nutrition and Food Sciences Faculty of Sciences, El Jadida, Morocco.*
[2]*Ecole Normale Supérieure, Sciences de la vie, Université Hassan II, Casablanca, Morocco.*

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Abstract

Assessing dietary habits and nutritional status in patients with end stage kidney disease (ESKD) treated with maintenance hemodialysis (HD) plays a crucial role in the prevention of protein energy malnutrition. The aim of this study was, on one hand, to assess nutritional status and dietary intake of HD patients in comparison with the guidelines recommendations and, on the other hand, to determine the characteristics of those who didn't meet their nutritional needs. In a sample of 156 HD patients (70 women and 86 men), clinical data, anthropometric measurements and two 24 hour dietary recalls were collected to evaluate the nutritional status and dietary intake. The results showed that based on the Body Mass Index (BMI), appropriate nutritional status was reported for only 60.6% of the patients. The mean energy intake was 1904.98 ±592.50 kcal per day, only 16.8% of participants were found compliant regarding the recommended intake of energy density; about 33 % met the recommended minimum of 1.2g/kg of protein per day and only 36.5% have adequate fiber consumption. The protein and energy density were negatively correlated with age, BMI and waist circumference. No patients achieved the recommendations concerning the saturated fat intake. In conclusion, the study data report that a high proportion of dialysis patients did not meet current renal specific dietary requirements and that the diet quality is considered poor. These results call the attention to individual dietetic counseling and promotion of a global dietary approach in hemodialysis patients in order to improve clinical outcomes and the quality of life of chronic kidney patients.

Keywords: Nutritional status; Hemodialysis patients; Protein energy malnutrition; Calorie density, Protein density; Diet

1. Introduction

Chronic kidney disease (CKD) is recognized as a public health problem in both developed and developing countries with a prevalence of approximately 8 to 16% in adult population [1]. The disease progresses to an end-stage kidney disease (ESKD), which is a critical and costly health problem [1]. Numerous studies have shown a strong association between the occurrence of metabolic disorders, such as diabetes and hypertension, and the development of kidney diseases [2,3].

In recent years, an increasing incidence of chronic kidney disease has been observed worldwide and the number of patients requiring renal replacement therapy is growing [2]. In Morocco, the first annual report of the Magredial Registry estimated the gross prevalence of the ESKD as 267.1 per million population (pmp) in four regions of Morocco while the incidence was between 100 and 150 pmp in 2010 [4]. The MAREMAR (Maladie Rénale Chronique au Maroc) study (2011) was recognized as a screening and prevention program of CKD involving the adult population of 25 to 70 years old and provided data on the cross-sectional baseline observations on CKD, hypertension, diabetes, and obesity in Morocco with the adjusted prevalence's of 5.1%, 16.7%, 13.4%, and 23.2% respectively [5].

* Corresponding author: Belahsen Rekia

Diet and nutrition are an important part of living well with kidney disease. Hence, chronic kidney disease is associated with numerous alterations that can lead to a catabolic state and poor nutritional status which promote the loss of protein body stores and energy [6]. According to the International Society of Renal Nutrition and Metabolism panel, "Protein-Energy Wasting (PEW)" is the preferred terminology in comparison to malnutrition in kidney dysfunction [7-10]. PEW is considered as one of the most serious complications of chronic kidney disease especially for patients undergoing hemodialysis treatment. Several studies assessing nutritional status in hemodialysis patients emphasize a high prevalence of PEW ranging from 18% to 75% [6,11,12]. Indeed, low intake of protein and energy is the main factor for malnutrition in CKD [13].

Furthermore, PEW is a predictor of morbidity and mortality and low quality of life in hemodialysis patients. It can have also a negative impact on health economics [11,14]. The key components of malnutrition are 2 factors: metabolic acidosis and inadequate nutrient intake.

The existing current specialized dietary guidelines for the care of patients with CKD are mainly based on the quality of energy and nutrients and the monitoring of elevated electrolytes (Sodium, Potassium and Phosphorus) [15]. As there are no guidelines available for the Moroccan CKD patients, in this current study, dietary intake was assessed in comparison with international guidelines: K/DOQI (Kidney Disease Outcomes Quality Initiative) Clinical Practice Guidelines for Nutrition in Chronic Renal Failure and the European Best Practice Guideline on Nutrition and Chronic Kidney Disease [16].

The problem of poor nutritional status of patients with CKD is even considered as the leading cause of poor clinical outcomes and quality of life and mortality [6,7]. Several studies assessing the nutritional status of patients with CKD, using methods such as anthropometric assessments and biochemical evaluation, have shown a positive correlation with mortality [17-19].

Assessment and monitoring the diet and nutritional status of the patients are very important and might potentially help to emphasize the irregularities and enable correcting them, and therefore would contribute to improve health and quality of life during the treatment.

This study was carried out to analyze nutritional status and to assess the daily diet quality, as well as the subsequent adherence to dietary recommendations in HD patients with ESKD undergoing maintenance hemodialysis.

2. Subjects and Methods

2.1. Study sample

A cross sectional study was conducted in two dialysis units. The study was performed between January 2017 and January 2018 and involved 156 patients with ESKD aged 17 years or older. All the participant patients were dialyzed two or three times a week (each session lasting 3 - 5 hours). All subjects were informed about the purpose of the questionnaire and gave their informed consent for the participation in the study.

2.2. Data collection

Information was gathered using structured questionnaires to collect data on demographics characteristics (age, sex, area of residence, level of education), socio-economic status (SES) (monthly income, profession, etc.), physical activity, personal and family history with regard to hypertension, diabetes, chronic kidney disease and treatment. Blood pressure and anthropometric parameters (weight, height, waist and hip circumference) were likewise carefully measured.

2.3. Anthropometric measurements

Weight was measured in light clothing and without shoes to the nearest 0.1 kg on a mechanical scale and height to the nearest 0.1cm with a stadiometer with the subjects in a standing position, not wearing shoes and shoulders in a normal position. BMI (Body Mass Index) was calculated by dividing weight (kg) by the square of height (m^2), according to the World Health Organization (WHO) criteria, underweight was defined as BMI<18 Kg/m^2, normal weight as 18≤BMI≤24.9 Kg/m^2, overweight as 25≤BMI≤29.9 Kg/m^2 and overall obesity was defined as BMI≥30 Kg/m^2. Waist Circumferences (WC) was measured at midway between the lowest rib and the iliac crest and the hip circumference (HC) at the level of the greater trochanter using a flexible tape and expressed in (cm)and the waist to hip ratio (WHR) (WC divided by hip circumference in cm) was calculated. WC is a marker of body fat distribution, according to the NCEP-ATP III reference values WC larger than 88 cm for females and 102 for males are considered to be high. All anthropometric measurements were performed after dialysis sessions and were taken by the same trained person in order to reduce subjective errors.

2.4. Blood pressure measurement

Systolic and Diastolic blood pressure were measured twice in a sitting position after a 10 min resting period, using an electronic radial tensiometer type OMRON M2, and the average of two separate measurements was considered as the final patient's blood pressure. Hypertension was defined according to WHO criteria as blood pressure equal to or greater than 140 mmHg (systolic)/90 mmHg (diastolic), or current use of antihypertensive medications.

2.5. Exercise assessment

Routine exercise participation was assessed from self-reported number of exercise sessions, of any type, participants engaged in per week. This was then multiplied by the number of minutes per session and used as an indicator of routine exercise quantity [20].

2.6. Laboratory Measurements

Blood samples were collected by venipuncture after an overnight fast of at least 12 hours. The samples analysis was performed using a semi-automatic spectrophotometer type BTS 350. All analyses were made on the day of blood collection. Fasting plasma glucose (FPG) was measured using an enzymatic method with glucose oxidase. Triglycerides (TG) and total cholesterol (TC) were measured using enzymatic method with glycerol phosphate oxidase and cholesterol esterase and cholesterol oxidase respectively. Serum creatinine was measured according to the standard colorimetric Jaffe-Kinetic reaction method, while urea was measured by an enzymatic colorimetric method with urease glutamate dehydrogenase (GLDH).

2.7. Nutritional status and dietary assessments

The patient's nutritional status was evaluated using the calculation of the body mass index and biochemistry parameters.

For the dietary assessment, each patient completed two separate non-consecutive 24 hour dietary recalls including one dialysis and one non-dialysis days. Portion sizes of the consumed foods are reported in household measures and converted to grams. The dietary intakes were then analyzed using the software BILNUT 2.01. (S.C.D.A. NUTRISOFT-BILNUT), the mean of the two 24 hour diet recalls taken to reflect usual intake for each nutrient.

The guidelines of K/DOQI (Kidney Disease Outcomes Quality Initiative) Clinical Practice Guidelines for Nutrition in Chronic Renal Failure recommended that the optimal target of dietary protein intake in hemodialysis patient as ≥ 1.2g/kg/day. Patients that consumed less than this cut-off point were classified with inadequate dietary protein intake.

2.8. Statistical Analysis

Data analyses were performed using SPSS statistics program version 24.0. Continuous variables were expressed as mean±SD and categorical variables by frequencies and percentages. Student's test was used to compare differences in means, and Chi-square test was used to compare differences in proportions. In all statistical analysis, P-value less than 0.05 is considered statistically significant.

3. Results

3.1. Characteristics of the population

The study was carried out on a sample of 156 hemodialysis patients, with a mean age of 49.25 ± 15.00 years, 55.1% of whom were male, there was no significant difference between male and females age (p=0.09). The main characteristics of the study patients are shown in Table 1. Overally, 65.4% of the participants were married, 62.2% lived within nuclear families, 70.5% were from rural areas and 48.1% were below basic literacy levels.

Table 1 Sociodemographic data of the study population

Characteristics	N	%
Gender		
Female	70	44.9
Male	86	55.1
Age categories		
17 – 39	40	25.6
40 – 59	71	45.5
≥60	45	28.8
Civil status		
Married	102	65.4
Single	25	16.0
Widower	13	8.3
Divorced	16	10.3
Area of residence		
Urban	46	29.5
Rural	110	70.5
Type of family		
Nuclear family	97	62.2
Extended family	59	37.8
SES		
Low	81	51.9
Medium	57	36.5
High	18	11.5
Education level		
Unable to read/write	75	48.1
Koranic	14	9.0
Primary school	33	21.2
Secondary school	28	17.9
University	6	3.8

SD: Standard deviation; SES: Socio Economic Status.

The main anthropometric and clinical characteristics of the study subjects are shown in Table 2.

3.2. Comparison of different characteristics between the two genders

There was a globally significant difference between males and females concerning the anthropometric characteristics and the etiology of chronic kidney failure. However, the systolic and diastolic blood pressure, family history of ESKD, frequency and duration of dialysis session, co-morbidities and the use of alternative medication were not significantly different between both genders.

Regarding the biochemical parameters, there was a statistically significant difference in the levels of creatinin and total cholesterol between men and women. However no significant difference was found in both sexes concerning the levels of fasting plasma glucose, urea and triglycerides.

Table 2 Anthropometrical and clinical characteristics of the participants stratified by gender

Variables	Total (n=156)	Males (n=86)	Femeles (n=70)	P – value
Weight, Kg (mean ±SD)	62.32±12.83	66.09 ±12.00	57.74 ±12.37	0.000
Height, cm (mean±SD)	162.79±9.12	168.34 ±7.13	156.06 ±6.32	0.000
BMI, Kg/m^2 (mean±SD)	23.46 ±4.19	23.23 ±3.41	23.73 ±4.98	0.465
BMI, Kg/m^2 n (%)				0.004
Underweight	14 (9.0)	3 (3.5)	11 (15.7)	
Normal weight	94 (60.6)	60 (70.6)	34 (48.6)	
Overweight	33 (21.3)	18 (21.2)	15 (21.4)	
Obesity	14 (9.0)	4 (4.7)	10 (14.3)	
WC, cm (mean±SD)	86.94 ±13.60	88.06 ±11.78	85.57 ±15.52	0.257
HC, cm (mean±SD)	93.83±8.73	93.48 ±7.05	94.26 ±10.47	0.581
WHR (mean±SD)	0.92±0.09	0.94±0.08	0.90±0.09	0.013
SBP, mmHg (mean±SD)	134.1 ±22.84	135.99 ±23.84	131.94 ±21.52	0.273
DBP ,mmHg (mean±SD)	78.78 ±12.61	79.48 ±12.25	77.93 ±13.08	0.448
FPG (g/l) (mean±SD)	1.06 ±0.57	1.11 ±0.63	1.00 ±0.50	0.259
Serumcreatinin,mg/l (mean±SD)	100.98 ±37.71	108.91±40.63	90.95 ±31.23	0.007
Serum urea, g/l(mean±SD)	1.50 ±0.57	1.50 ±0.52	1.49 ±0.62	0.923
Totalcholesterol,g/l(mean±SD)	1.60 ±0.41	1.52 ±0.40	1.70 ±0.40	0.011
Triglycerides,g/l (mean±SD)	1.50 ±0.70	1.48 ±0.77	1.53 ±0.60	0.740
Family antecedent of ESRD, n (%)	25(16.0)	15(17.4)	10(14.3)	0.593
Frequency of dialysis, n (%)				
1 time per week	1 (0.6)	1 (1.2)	0(0,0)	0.078
2 times per week	141 (90.4)	81 (94.2)	60(85.7)	
3 times per week	14 (9.0)	4(4.7)	10(14.3)	
Duration of hemodialysis session, hours (mean±SD)	4.28 ±0.49	4.31 ±0.46	4.24 ±0.54	0.397
Use of alternative medication, n (%)				
Never	94(60.2)	46(53.5)	48(68.6)	0.194
Actuel	31(19.9)	22(25.6)	9(12.8)	
Former	31(19.9)	18(20.9)	13(18.6)	
Etiology, n (%)				0.026
Unknown	112 (71.8)	63(73.3)	49(70.0)	
Hypertensive nephropathy	12 (7.7)	3 (3.5)	9(12.9)	
Diabetic nephropathy	15(9.6)	7(8.1)	8(11.4)	
Kidney Polykystosis	8 (5.1)	6 (7.0)	2(2.9)	
Others	9 (5.8)	7 (8.2)	2(2.9)	
Comorbidities, n (%)				
Diabetestype2	6(3.8)	5(5.8)	1(1.4)	0.157
Diabetestype1	24 (15.4)	11(12.8)	13(18.6)	0.320
Hypertension	75(48.1)	41(47.7)	34(48.6)	0.911

BMI, Body Mass Index; DBP, Diastolic Blood Pressure; ESKD, End Stage Renal Disease; HC, Hip Circumference; SBP, Systolic Blood Pressure; FPG: Fasting plasma glucose, SD, Standard Deviation; WC, Waist Circumference; WHC, Waist Hip Circumference.

3.3. Daily intake of macronutrients and micronutrients

Table 3 shows the mean dietary intake and the number (%) of participants who are adherent to the recommended intakes for all nutrients assessed. Mean ± SD sodium intake was 1971.42 ±1082.15 mg/day (2185.95 mg/day for men and 1707.86 mg/day for women, p=0.006). About 11% of the participants met the recommended level of sodium intake of 2000–2300 mg/day while 39.1% exceeded the recommended sodium intake range.

The energy intake average was 1904.98± 592.50 kcal/day. According to K/DOQI Clinical Practice Guidelines for Nutrition in Chronic Renal Failure, only 16.8% of the participants met the recommended calorie density of 30–35 kcal/kg. For protein density, about 33% of participants consumed the recommended minimum of 1.2 g/kg of protein per day. Protein intake contributed around 13% of the total energy. Saturated fat intake contributed in a mean of 36% to the total energy intake, markedly higher than recommended. The mean carbohydrate intake accounted for 64 % of the total energy (at the higher end of recommendations). On the other hand, about two thirds of the participants consumed inadequate fiber and potassium; 50% had excess intake of phosphorus, about 77% had less than the recommended minimum of 500 mg of dietary calcium daily intake and 15% of the participants consumed more potassium than recommended.

Dietary sodium intake was statistically significantly correlated with energy intake ($r = 0.47$, $p < 0.001$) and with potassium intake ($r = 0.49$, $p < 0.001$).

Table 3 Daily intake of macronutrients and micronutrients and proportion of individuals within recommended targets

Nutrients	Daily intake baseline (n=156)	n(%) within target values	Recommended levels
Energy, kcal	1904.98 ± 592.50	-	-
Calorie density, kcal/kg	31.37± 10.19	26(16.8%)	30 – 35kcal/kg*
Protein density, g/kg	1.04 ± 0.43	51(32.9%)	≥1.2g/kg*
Protein, %TE	13.37 ± 3.45	-	-
Total fat,% TE	22.79 ± 9.51	39(25%)	25 – 35 % TE†
Saturated fat, %TE	35.79 ± 8.62	0(0%)	<7% TE†
MUFA,%TE	46.52 ± 8.56	156(100%)	>20% TE†
PUFA,%TE	17.46 ± 6.65	141(90.4%)	>10% TE†
Carbohydrates, g	297.43 ± 89.02	151(96.8%)	≥130 g‡
Carbohydrates,%TE	63.85 ± 9.70	36 (23.1%)	50 – 60 %*
Fiber, g	18.68 ± 10.57	57(36.5%)	>20g‡
Sodium, mg	1971.42 ± 1082.15	17(10.9%)	2000 – 2300 mg§
Potassium, mg	2030.97 ± 720.76	50(32.1%)	1950-2730 mg §
Calcium, mg	390.65 ± 199.57	27(17.3%)	500 – 800 mg §
Phosphorus, mg	1038.44 ± 378.31	30(19.2%)	800 – 1000 mg§

MUFA: Monounsaturated Fatty Acids; PUFA: Plyunsaturated Fatty Acids. % TE: Percentage of total energy. Data are expressed as mean ± standard deviation.

*Target values recommended by KDOQI Clinical Practice Guidelines for Nutrition in Chronic Renal Failure †Target values recommended by KDOQI Clinical Practice Guidelines for Management of Dyslipidemia in Patients With Kidney Disease. ‡Target values recommended by Standing Committee on the Scientific Evaluation of Dietary Reference Intakes FaNB. §Target values recommended by European Best Practice Guideline on Nutrition and Chronic Kidney Disease.

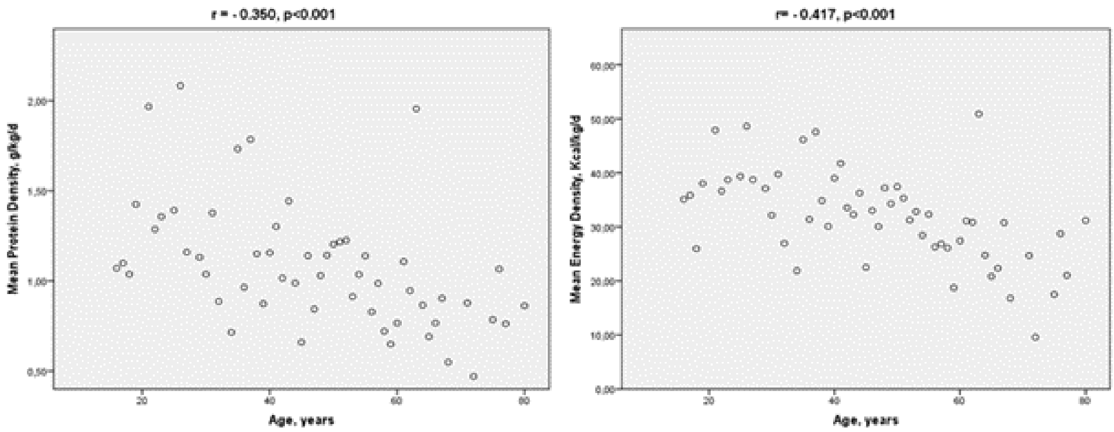

Figure 1 Correlation between age and daily protein and energy density in the studied hemodialysis patients

Normalized energy and protein intake were clearly inversely and significantly correlated with age with ($r = -0.417$, $p<0.001$) and ($r = -0.350$, $p<0.001$) respectively (Figure1).

3.4. General characteristics of patients according to their adherence or not to the K/DOQI guidelines for protein intake

Table 4 shows the comparison of the clinical, anthropometric, physical activity and energy intake in the patients according to their adherence or not to K/DOQI guidelines for protein intake. The patients who adhere to these guidelines were more likely to be younger, not obese, with lower incidence of hypertension, more active, consuming less number of medications and had a high energy and calorie density compared to those who did not adhere to the guidelines.

Table 4 Baseline participants characteristics stratified according to the categories of daily protein intake based on K/DOQI clinical practice guidelines for nutrition in chronic renal failure

Baseline characteristics	**All (n= 155)**	**Low protein intake <1.2g/kg/day (n=104)**	**Recommended protein intake ≥1.2g/kg/day (n=51)**	**P- value**
Age, mean±SD	49.25±15.00	52.65±14.28	42.16±14.16	0.000
Age categories, n (%)				0.001
17 – 39	40(25.6)	19(47.5)	21(52.5)	
49 – 59	70(45.5)	47(67.1)	23(39.9)	
≥ 60	45(28.8)	38(84.4)	7(15.6)	
SBP, n (%)				0.800
High SBP	63(40.6)	43(41.3)	20(39.2)	
Normal SBP	92(59.4)	61(58.7)	31(60.8)	
DBP, n (%)				0.084
High DBP	33(21.3)	18(17.3)	15(29.4)	
Normal DBP	122(78.7)	86(82.7)	36(70.6)	
Blood Pressure, n (%)				0.631
High BP	65(41.9)	45(43.3)	20(39.2)	
Normal BP	90(58.1)	59(56.7)	31(60.8)	
WC, n (%)				0.000
High WC	32(20.6)	32(30.8)	0(0.0)	
Normal WC	123(79.4)	72(69.2)	51(100.0)	
WHR, n (%)				0.008
High WHR	107(69.0)	79(76.0)	28(54.9)	
Normal WHR	48(31.0)	25(24.0)	23(45.1)	
BMI, n (%)				0.000
Low weight	14(9)	6(5.8)	8(15.7)	
Normal weight	94(60.6)	54(51.9)	40(78.4)	
Overweight	33(21.3)	30(28.8)	3(5.9)	
Obesity	14(9)	14(13.5)	0(0.0)	
Therapy, n (%)				0.027
None	62(40.0)	34(32.7)	28(54.9)	
One drug	69(44.5)	51(49.0)	18(35.3)	
More than one drug	24(15.5)	19(18.3)	5(9.8)	
Physical activity, n (%)				0.047
High PA	99(63.9)	72(69.2)	27(52.9)	
Less PA	56(36.1)	32(30.8)	24(47.1)	
Energy, Kcal/day	1904.98±592.50	1717.75 ± 532.66	2290.96 ± 527.18	0.000
Energy density, n (%)				0.000
Low	73(46.8)	71(68.3)	2(3.9)	
Recommended	26(16.7)	18(17.3)	8(15.7)	
High	56(35.9)	15(14.4)	41(80.4)	

BP, Blood Pressure; DBP, Diastolic Blood Pressure; PA, Physical Activity; SBP, Systolic Blood Pressure; ; SD, Standard Deviation; WC, Waist Circumference; WHR, Waist Hip Circumference

4. Discussion

In this current study, we assessed the daily intake and the dietary quality of the hemodialysis Moroccan patients at the nephrology service to examine whether they adhered to the international current renal specific recommendations. The present study data show that a large proportion of patients did not meet the recommendations for energy and the main macronutrients and micronutrients intakes.

In spite of the substantial improvements in the renal replacement therapy (RRT), the morbidity and mortality of patients with ESKD remain excessively high [8]. Among the many factors that negatively affect patient outcomes, protein-energy malnutrition and cardiovascular diseases are two of the main causes of mortality and morbidity in patients with ESKD [19,21,22] due to poor appetite, inflammation and nutrients loss during dialysis. Indeed, the current recommendations suggest that a minimum energy and protein intake is necessary to assume a balanced protein levels and avoid energy deficit and malnutrition [22,23]. The majority of our study subjects did not achieve those minimal recommendations this finding is consistent with previous studies [16,19] probably because of a reduced consumption of protein in their diet. Accordingly, protein and energy intake were better than that reported by other studies [16,23], but it was not completely satisfactory, because most of the patients did not reach their recommended intake.

In contrast to protein intake, our study indicates an excess of saturated fat consumption in a high proportion of hemodialysis patients as an important source of energy. The levels of saturated fat were markedly higher than the recommended (35% of the total energy intake). This is in agreement with several reports [16,24] and probably owing to an unhealthy eating and the choice of poor quality foods. Nevertheless, the intakes of monounsaturated and polyunsaturated fatty acids were in accordance with the requirements (100% and 90.4% respectively), which is of health benefit as it may reduce cardiovascular disease risk and also will help address issues related to low protein intake.

We found a negative association between energy and protein density intake with age. These finding are in agreement with those previously reported in both healthy and hemodialysis patients [25].

Similarly to previous author'-s' findings, most of our patients consume too little fiber in their diets, probably because of the current dietary advice to limit or exclude fruits and vegetables by the patients from their daily food rations in order to control potassium levels [2,16].

Furthermore, the diet analysis showed an excessive consumption of organic phosphorus, sodium and potassium in 49.7%, 38.7% and 15.5% of the patients respectively and this result is similar to previous studies [16]. A recent study reported difficulties among dialysis patients to adhere to kidney recommendations suggesting that there may be a need to implement nutritional education and individualized counseling in these subjects [16,23,26,27].

Overall, the data on the nutrients intakes reported by our patients suggests that the quality of their diet is poor. These findings are in accordance with other investigations on HD patients [16,19,23].

Underweight is prevalent in 9.0% of this study HD patients. Compared to the literature, this prevalence is slightly higher than in previous findings [28,29] and lower than in others [14]. On the other hand, 21,3% of HD patients were overweight or even obese (9%). Other studies have reported a similar [14] or high prevalence of overweight in the HD population [28].

The present study analyzed also the comparison of the characteristics of the patients who were in compliance with the protein intake as recommended by K/DOQI Clinical Practice Guidelines, using Target values level for protein intake in hemodialysis patients of ≥1.2g/kg/day, to those who don't meet this recommendation with regard to age, blood pressure, overall obesity, abdominal obesity, physical activity, medication, energy and calorie density. In agreement with previous studies, the analysis showed an association of a higher physical activity level with more adequate protein intake in the patients indicating that patients with malnutrition are less physically active. Furthermore, several studies have reported also that hemodialyzed patients are generally less physically active than healthy people [30].

Concerning the number of medications, we found that patients with adequate protein intake consumed less medications and had less complications linked to the ESKD compared to those with inadequate protein intake. This may be explained by their adherence to the dietary guidelines that may provide a best quality of life with less complication for these chronic patients. In addition, we found a high proportion of the patients with high systolic blood pressure in the group with inadequate protein intake compared to the other group although the difference was not statistically significant.

Also as previously reported by other study [23], there is evident linear association between intakes of energy and calorie density and category of protein intake.

Obesity has been well recognized as independent risk factor of both chronic kidney disease and other risk factor of kidney dysfunction such as diabetes and hypertension. Indeed, it is well established that nutritional factors are the leading determinant of emerging prevalence of chronic diseases including CKD in both developed and developing countries. Morocco is going through the third phase of its epidemiological transition characterized by considerable changes in healthy lifestyle including low physical activity and adoption of western dietary habits with a rising consumption of fast food rich in fat and sugar [31]. Despite the fact that obesity could induce the initiation and progression of kidney dysfunction, many studies have consistently reported a controversial role of obesity in the end stage of kidney failure and hemodialysis. In fact, contrary to the normal population, obesity has preventable effects on decreasing mortality and improvement of survival in hemodialysis patients. This phenomenon is called «obesity paradox » or « reverse epidemiology »[7,25]. However, these literature findings are not in line with what we found here [32]. Our study data indicated, in fact, that overall and abdominal obesity as well as low physical activity have a significant effect on protein intake; hence, participants who didn't adhere to the guidelines of protein intake were with higher values of BMI and WC. Thus, the precise mechanisms of obesity paradox are complicated and are not well known [33], this finding may suggest that we should take into account other factors like the duration of the kidney failure, its antecedents and its complications. In conclusion, obese patients with hemodialysis in the present study have significant low protein and energy intakes compared to the normal weight patients which indicate that obesity might not necessarily mediate protective effects in hemodialysis.

To the best of our knowledge, this is the first study that investigated the daily nutrient intakes in patients suffering from ESKD in comparison with the daily international recommendations and the study that characterizes HD patients in compliance with these guidelines. Nevertheless, there are some considerations worth noting. First of all, our investigation was carried out on a population from a low socioeconomic area in Morocco which might not reflect the diet of other hemodialysis patients from other centers or regions in Morocco. Nonetheless, these findings are strongly in line with reports from other parts of the world. Second, we performed only a 2-day food records which is subjected to the inherent errors of dietary assessment and can be affected by under- or over-reporting. However, we tried to minimize this by our concise interview with patients to determine more accurately the amount of ingested food portions. Finally, the study population may not have been representative of the Moroccan hemodialysis population due to the eligibility criteria.

5. Conclusion

In summary, our finding indicates that except for monounsaturated and polyunsaturated fatty acids, there is poor dietary quality and poor adherence to the current renal specific dietary recommendations in the study population. Consequently, these results recall for a continued effort to intensify dietary intervention in hemodialysis patients by limiting the intake of processed, restaurant, and convenience foods that are almost universally high in sodium, inorganic phosphorus, and added potassium, enhancing patient's self-efficacy on reading food labels and promoting a whole diet approach. The particular challenge is to decrease sodium, potassium and phosphate intakes without compromising energy and protein intakes in order to improve clinical outcomes, nutritional status and the quality of life of chronic kidney patients.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflicts of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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