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ORIGINAL ARTICLE

Chronic hemodialysis undernutrition: prevalence and associated factors

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ABSTRACT

Introduction. Chronic kidney disease (CKD) involves multiple factors that contribute to an altered nutritional status. Among these, protein-energy malnutrition (PEM) is a major concern, as it negatively affects patient prognosis. Its prevalence varies depending on the diagnostic method used. The aim of this study was to assess the prevalence of malnutrition in patients with chronic kidney disease. **Materials and Methods.** This descriptive, cross-sectional, non-interventional study evaluated the nutritional status of adult patients with end-stage renal disease (ESRD), aged 18 to 65 years, of both sexes. The assessment included dietary surveys, clinical examinations, and biochemical tests. The study was conducted in the hemodialysis unit of the Nephrology, Hemodialysis, and Transplantation Department at Ibn Sina University Hospital in Annaba, between October 2016 and January 2017. All participants completed a standardized questionnaire, underwent clinical and anthropometric assessments, and provided blood samples for biochemical analysis. Nutritional intake was also evaluated. Malnutrition was diagnosed using two tools: the Quetelet index (Body Mass Index) and the Subjective Global Assessment (SGA). **Results.** A total of 74 patients were included. The overall prevalence of malnutrition was 16.2% according to the Quetelet index and 28.4% based on the SGA score. Mean protein and energy intake levels were suboptimal, averaging 23.64 ± 28.77 kcal/kg/day and 0.87 ± 0.30 g protein/kg/day (based on dry weight), respectively. **Conclusion.** Patients with chronic kidney failure are at high risk of malnutrition. This highlights the need for systematic nutritional screening, individualized dietary interventions, and regular psychological support to optimize adherence to therapeutic diets and improve patient outcomes.

Keywords: chronic kidney disease, hemodialysis, anthropometry, malnutrition, nutritional assessment, dietary intake.

1. INTRODUCTION

Chronic renal insufficiency is a disease that is due to irreversible destruction of functional units of the kidney, leading to irrecoverable renal dysfunction, and the patient requires supplemental treatment by dialysis or kidney transplantation [1]. The preservation of functional nephrogenic capital remains an essential objective for all nephrologist; this one depends on the follow-up of patients especially at the stage of pre-dialysis, which is most often medical in a therapeutic and preventive purpose, but also in the monitoring of these patients from the nutritional point of view.

The dietary management of chronic renal failure meets several objectives : maintenance of the hydro-electrolytic balance, prevention of cardiovascular complications, maintenance of the phosphocalcic balance, slowing down the rate of deterioration of renal function, and prevention of malnutrition that can result from it and which can be fatal at the beginning of dialysis.

As shown by a prospective survey of 57 diabetic patients in themoderate renal failure followed at the National Institute of Nutrition in Tunis during the year 2010, where a first group of patients is put on the usual diabetic diet and a secondgroup is treated with protein-depleted (0.6-0.7 g/kg/d), with a follow-up of the glomerular filtration rate (GFR), albuminemia and nutritional risk index (NRI). Renal function of the 2nd group improved with an increase in GFR of 42 ml/min (d0), at 58 ml/min (d90), and 64 ml/min (d180); however,these patients tend to be undernourished withNRI 0=97.90 %, NRI 90=90.10 %, NRI 180=90 %, however, for the 1st group of phenomena, inverses occurred [2].

In Algeria, there is little data available on the prevalence of protein-energetic malnutrition (PEM) in this population. In a French national cooperative study involving 7,123 patients, PEMwasfound in 36% of patients [3]. Based on this data and the observation of the deficit in this type of nutritional support strategy within the hemodialysis centers, this study was undertaken with the perspective of proposing the implementation of technical and practical protocols strengthening the means of diagnosis and follow-up of chronic renal failure patients.

The objective of our study was to: determine the prevalence of PEM in patients with chronic hemodialysis, and to study malnutrition according to anthropometric, biological data, physical activity and according to the data of the food survey.

2. PATIENTS AND METHODS

Recruitment of subjects

This is a descriptive cross-sectional non-interventional study based on a nutritional status study of patients with chronic renal failure, established by clinical examination and biological examinations. This study is conducted at the hemodialysis unit of the nephrology-hemodialysis and kidney transplantation department, Ibn Sina Hospital of CHU Annaba, Algeria.

Patient recruitment lasted 04 months. It started on 05/10/2016 and ended on 01/30/2017. Recruitment involved 74 chronic hemodialysis patients who met the following selection criteria: patients with chronic end-stage renal insufficiency treated by hemodialysis during the study period; patients of both sexes ; age 18 to 65 years. Elderly subjects are not included in this study for the following reasons: their variable caloric needs related to tissue aging, slowed cellular metabolism, and, finally, the state of dehydration and muscle wasting, which make anthropometric measurements difficult.

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Informed consent was obtained from all participants, who were fully informed of the objectives, methods, and any potential risks associated with the research.

Study Flow:

All the participants answered a questionnaire with a signage part, pathological and comorbidity history, and sociodemographic characteristics. Subjective nutritional assessment by an interrogation: this questionnaire allows the evaluation of the nutritional status by the notation SGA (the Subjective Global Nutritional Self-Assessment), which is a complex score of malnutrition that includes a physical examination, a history assessment of the patient's food intake, gastrointestinal symptoms, and functional capacity. SGA subjectively classifies patients into 3 categories: "not malnourished," "moderately malnourished," or "severely malnourished" [4.5]. The level of physical activity was assessed according to the Marshall questionnaire. Anthropometric measurements: dry weight, height, muscle perimeters (circumference of the brachial and abdominal muscles and skin folds [6,7,8]), percentage of weight loss, calculation of the Quételet index (Body Mass Index: BMI) and percentage of fat mass (FM) and musclemass (MM) [9, 10]. These measurements were taken by the same operator, using the same calibrated instruments and were performed immediately after the dialysis session where the patient does not show any signs of hydrosodic overload (edema, ascites) or signs of dehydration, and mentioned on a pre-established form.

The assessment of intake and daily nutritional intake of each patient is carried out by filling a three-day food diary at home; it is a "report"-type " type dietary survey That is, the subject collects on a questionnaire provided for this purpose the nature and quantity of all foods consumed in detail, meal by meal and out of meal, during a specified period. The amount of food can be estimated either by using household measures (cups, plates, glasses, spoons...) or by weighing all the food consumed [11], then to calculate kilocalories and ingested nutrients from the data collection, use the Ciqual 2017 table [12].

Biochemical assays (serum levels of nutritional and non-nutritional parameters): Urea, Creatinine, Sodium, Potassium, Phosphorus, Calcium, Total Cholesterol, HDL-C, LDL-C, Triglycerides, Glucose, Albumin, Total Iron Binding Capacity (CTF), Hemoglobin (Hb), Creatine Reactive Protein (CRP).

Statistical analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS, version 20). Our results will be expressed in averages and standard deviations for the quantitative variables and numbers(n) and percentages (%) for qualitative variables. The statistical tests used: Chi2 test to compare qualitative variables; Student test to compare quantitative variables. The significance threshold was set at 5 % ($p < 0.05$).

3. RESULTS

Prevalence of Undernutrition

According to the BMI, the prevalence of undernutrition was 16.2% and 83.3% of patients were not undernourished.

Table 1. Prevalence of Undernutrition According to BMI.

Undernutrition according to BMI Effective	Effectif N	Percentage %
Undernourished	12	16.2
Not undernourished	62	83.8
Total	74	100

Prevalence of undernutrition according to SGA score : according to the SGA score, the prevalence of undernutrition was 28.4%, 21.6% of patients had mild malnutrition, and 6.8% or 05 patients were severely malnourished. 71.6% of patients had normal nutritional status.

Table 2. Prevalence of Undernutrition According to SGA Score.

SGA	N	Percentage %
Normal nutritional status	53	71,6
Mild to moderate malnutrition	16	21.6
Severe malnutrition	5	6.8
Total	74	100
Chi2 = 1.36 p= 0.5041		

Study of malnutrition according to the SGA score

Prevalence of undernutrition by age and sex: The SGA score for undernutrition was predominantly male; the average age was 44.0±14.35 years for category B and 43.0±16.46 years for category C, and the highest prevalence was observed at age 55years. 40% of the undernourished SGA patients were insufficiently active. 100% of patients with PEM had more than one associated disease.

Table 3. Distribution of malnourished patients by age and sex.

Variables	Category A (N=53)		Category B (N=16)		Category C (N=5)		p
	N	%	N	%	N	%	
Sexmale	25	47.2	10	62.5	2	40	0.504
Female	28	52.8	6	37.5	3	60	
Age (average, type deviation)	43.74 ±12.31		44.0±14.35		43.0±16.46		0.989
			12	62.5	3	80	0.699
Number Comorbidity	6	11.32					
>1	47	99.68	16	100.0	5	100.0	
Physical activity							
Active	23	64.6	4	60	1	60	0.833
insufficiently active	30	35.4	10	40	6	40	
Average and standard deviation	5.89±4.11		7.54±5.25		6.25±5.08		0.046

Prevalence of undernutrition according to GHS and biological data: the mean albumin level in patients of categories B and C was 35.71±5.91 g/l, with an average CRP rate of 4.73±6.91 mg/l. Mean blood cholesterol in malnourished patients was 3.56±0.80 mmol/l. The mean HDL fraction of cholesterol was 0.73±0.41mmole/l. The mean LDL fraction of cholesterol was 2.38±0.59 mmole/l. The mean triglyceridemia in malnourished patients was 1.81±0.79

Table 4. Distribution of malnourished patients and selected biological parameters.

Parameters	Category A N=53	Category BC N=21	P
Albumin (g/l)	38.18 ± 4.95	35.71 ± 5.91	0.071
CRP (mg/l)	4.31 ± 4.70	4.73 ± 6.91	0.759
Total cholesterol (mmole/l)	4.29 ± 1.53	3.56 ±0.80	0.043
HDL	1.02 ± 0.35	0.73 ± 0.41	0.319
LDL	2.63 ± 1.12	2.38 ± 0.59	0.343
Triglycerides (mmole/l)	2.02 ± 1.53	1.81 ± 0.79	0.555

Prevalence of undernutrition according to the SGA and anthropometric data : The patients malnourished according to the SGA score had an average dry weight of 54.16± 7.12 kg,a mean of the tricipital cutaneous fold (TCF) of 11.47±2.18 mm, an average of the brachial circumference (BC) of 21.09±2.14, an average of the abdominal circumference (AC) of 78.52±7.53 cm. The mean of fat and muscle mass in patients with PEM according to the rating. SGA was 15.36±5.37% and 29.22±4.45%, respectively.

Table 5. Distribution of malnourished patients and anthropometric parameters.

Variables	Category A N=53	Category BC N=21	P
Weight (kg)	73.00 ± 12.63	54.16 ± 7.12	0.001
TCF(mm)	16.35 ± 4.40	11.47 ± 2.18	0.001
BC(cm)	26.24 ± 3.43	21.09 ± 2.14	0.001
AC(cm)	90.30 ± 13.56	78.52 ± 7.53	0.001
MM(%)	31.80 ± 4.37	29.22 ± 4.45	0.026
FM(%)	19.52 ± 6.28	15.36 ± 5.37	0.009

Prevalence of undernutrition according to the SGA and the food survey data: The mean daily calorie intake (DCI) in patients of categories B and C was 1236.31±436.73 kcal/d, with an average protein intake of 41.17±20.02 g/d.

Table 6. Distribution of malnourished patients and protein-energetic intakes.

Parameters	Category A N=53	Category BC N=21	P
DCI (kcal/d)	1743.69 ±291.88	1236.31 ±436.73	0.001
Protein (g/d)	66.06 ±16.56	41.17 ±20.02	0.001

4. DISCUSSION:

Prevalence of protein-energy malnutrition

The nutritional status of hemodialysis patients is difficult to assess , due to the lack of a single criterion for its identification. Several national studies have objectified malnutrition based on a single assessment score, in contrast to multiple international studies that used multiple nutritional scores and indicators. The present study diagnoses two scores, the Quetelet index and the SGA score. The overall prevalence of PEM reported in the literature was 23% to 76% of patients , [13,14], differs between studies, and varies considerably depending on the index used. There is therefore a risk of underestimation or overestimation. Our results objectify a prevalence of undernutrition according to the BMI which was estimated at 16.2% or 12 patients (Table 01) thus classifying these patients as undernourished grade I with an BMI < 18.5 (kg/m2).

This prevalence is close to that of the Tunisian study of El Ati and al published in 2016 with a prevalence of 20% [15], but this figure is lower than previous studies: 24.1% for the Moroccan study [16], 29.3% for a more recent national study in 2019 [17] , but with the work carried out in patients undergoing hemodialysis in Benin in 2015, the prevalence was higher and malnutrition according to BMI was 68,46% of patients, this increase could be explained by the inclusion of patients over 65 years old up to 79 years in previous studies and which represented a significant proportion of undernourished patients, and limiting the population to patients with a dialysis duration of more than six months, since dialysis seniority increases the risk of malnutrition.

In this study, the prevalence of undernutrition according to SGA rating was estimated at 28.4%, including patients with moderate and severe undernourished SGA of category B and C (Table 02), a prevalence similar to that of other studies: 18.6% for the US DOPPS study published in 2002 and 20% for the Tunisian study, but lower than the Brazilian study [18, 15, 19] with a prevalence of 39.7%, this study evaluated 58 hemodialysis patients from a single dialysis center in the North region East of Brazil.The study included patients over 18 years of age and on dialysis for more than 3 months. This increase in the prevalence of undernutrition could always be explained by the age in hemodialysis which is more important, and by a more precise evaluation of anthropometric measures with an adequacy of measurements of skin folds and brachial circumference, FM and MM in 50th percentile by Nutwin 40 software (a nutrition support program), version 1.5 [20].

There is a significant discrepancy between the prevalence of malnutrition according to BMI and that assessed with the SGA score, which could be explained by the fact that the SGA score includes not only malnourished patients but also those at risk of malnutrition.

Study of PEM

In the present study, the SGA score diagnosed as undernutrition was predominantly male (Table 03) as reported in the literature review [21]. This is explained by the higher recommended caloric and protein requirements of males.

In our study, the prevalence of undernutrition according to SGA score (category B and C) was associated with a decrease in serum albumin (35.71±5.91 g/l) compared to patients in category A (38.18±4.95) (Table 05), this is consistent with the results obtained by Agboton and al in Benin [22], but the relationship between SGA and albumin levels was not significant in other studies such as the Brazilian and English ones [23], this could be explained by the cut-off point of the serum albumin level considered for each study, Mancini and al [24], who considered malnourished patients with an albuminemia of less than 40 g/l using the BCG method, also Lowrie and Lew [25], evaluating 19,746 patients, reported 66% of patients with albumin levels below 40 g/l with a mortality risk at least twice that of patients with albumin levels above 40 g/l and considered this cut-off point associated with nutritional parameters, whereas Valenzuela and al [26], studying 165 dialysis patients, reported albumin levels below 35 g/l (BCG method) in only 8% of patients, no difference was found in albumin levels between eutrophic and undernourished.

In this study population, we found an association between the prevalence of undernutrition according to SGA and CRP with a mean of 4.73±6.91 (Table 04), indeed in previous studies [27, 28] this association was objectified. Our results have objectified an average serum cholesterol level of 3.56±0.80 mmole/l , this mean is considered normal according to the literature which fixes the cholesterol level in the hemodialysis population between 4,0 and 4.10 mmole/l, however it is considered as pathological according to the ISRNM expert group which relies on a cholesterol level not exceeding 2.50 mmole/l (Table 04). This dyslipidemia makes our population a high cardiovascular risk group, especially in the presence of the reduction of the HDL fraction of cholesterol ≤ 1 mmole/l and hypertriglyceridemia ≥ 1.23 mmole/l [29,30, 31].

In our study, patients diagnosed with SGA had mean BC and DCI values of 21.09±2.14 cm, 1236.31±436.73 kcal/d (Tables 05, 06), low rates compared to literature review recommendations [32, 33, 34], and which indicates a loss of muscle mass probably due to nutritional factors, these data have been little studied, the team from Jones et al found this positive correlation between SGA and BC with a significantly reduced brachial circumference [23], and the Brazilian [19] concluded on the basis of these anthropometric and dietary data that the SGA rating was more sensitive than the Quetelet index.

Study limitations: Although justified from a statistical point of view, a main limitation of our study was the small sample size; this small sample cannot be representative of the entire Algerian population, with only a limited number of subjects (74 patients for a cross-sectional study). A low statistical power with a high risk of type II error, as well as the single-center nature of the study (CHU Annaba).

5. CONCLUSION

Despite the existence of numerous studies on the determination of nutritional status and prevalence of malnutrition in patients with chronic renal failure, there is no precise assessment method to date that will diagnose this health problem, which can be fatal in this population at different stages of renal failure. Our results allowed us to determine the prevalence of malnutrition in chronic hemodialysis patients in the Nephrology department - Hemodialysis Transplantation CHU Annaba, with a prevalence of 16.2-71.6% according to the diagnostic methods used. This prevalence of undernutrition is not negligible in view of the complications that may result from this protein-energy balance, hence the need for rigorous and regular monitoring by qualified dieticians and nutritionists. The present study has shown that the frequency of this malnutrition increases with age, age in hemodialysis, and inappropriate diet; hence, the need to increase the rate of measurement of nutritional indicators in these patients from 45 years. We propose to conduct case-control studies to determine the risk factors associated with malnutrition in chronic renal insufficiency.

Competing interests: The authors declare that they have no competing interest.

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