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Assessment of Malnutrition in End Stage Renal Disease Patients on Hemodialysis

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Abstract

Malnutrition is a common problem and a risk factor of mortality in haemodialysis patients. However, there is no consensus for its assessment.

Objective: To estimate the effect of malnutrition in end stage renal disease patients on hemodialysis.

Patients and methods: The current study is cross sectional retrospective study conducted on 165 end stage renal failure patients on regular hemodialysis, age range: 18-60 years old; 83 male and 82 females with mean age 46.8 ± 17.3 years, recruited from the renal and dialysis unit, Department Of Internal Medicine, Al-Minya University Hospitals, Egypt from 2018 to 2019.

Results: The present study, when adopting the limit of 18.5 kg/m^2, the prevalence of malnutrition was 40% the mean BMI was 30.1 ± 4.9 in normal nutrition group and 17.9 ± 0.4 in malnutrition group with significant decrease of body mass index in malnutrition group than normal nutrition group. BMI show positive correlation with (arm circumference, serum albumin, total cholesterol, total protein and URR) in all cases and each group.

Keywords: Malnutrition; End stage renal disease; Hemodialysis

Introduction

Malnutrition is a major issue in patients with chronic kidney disease (CKD), adversely affecting morbidity, mortality, functional activity and patients' quality of life. Our knowledge of the pathogenic mechanisms of malnutrition in patients with CKD, including end stage renal disease, has been improved. This has led to the development of clinical practice guidelines for nutritional care in CKD which provide a framework for the nutritional issues facing patients and physicians. Extensive research in the field of nutrition in patients with CKD has resulted in the formation of general guidelines, although some uncertainties still exist on some of the best therapeutic or preventive options in uremic malnutrition. It is important to search actively for malnutrition since early diagnosis and treatment can improve the prognosis for CKD patients and reduce the monetary costs connected with treatment [1].

Protein-energy malnutrition is a common feature in end-stage renal disease (ESRD) patientswhich becomes even more common after patients start on either peritoneal dialysis (PD)[2].Although it is well established that malnutrition is one important predictor of survival in ESRD patients [3].Less is known about malnutrition and its impact on clinical outcomes in patients with a modest degree of chronic kidney disease. As noted by Mitch [4]. The use of the word malnutrition has previously often been used incorrectly in the renal literature. Literally, the word "malnutrition", derived from Latin malus, means "not correctly nourished" and includes any disorder of nutrition (i.e. both under and over nutrition). In the following text, we will therefore refer to cachexia, defined as a state of under nutrition deriving from both anorexia, i.e. insufficient food intake, and low serum protein levels and the loss of muscle mass as the result of a catabolic state. All of these factors occur in the ESRD patient, usually as the consequence of a number of interrelated mechanisms stimulated by renal insufficiency. Indeed, the aetiology of the cachexia in ESRD is very complex and may include numerous factors including loss of appetite, delayed gastric emptying, impaired protein assimilation, hormonal derangements, inadequate control of acidosis, co-morbidity, inflammation, depression and other psychosocial factors [5].

Patients and Methods

All participants are subjected to thorough history taking, full clinical examination, and anthropometric measurements including weight, height and BMI. Blood samples for all patients were drawn before the beginning of dialysis and 4 minutes after end of dialysis. After centrifugation to yield platelet-poor plasma from samples on anticoagulant (3.8% sodium citrate) and serum from clotted blood samples, serum and plasma samples were stored in aliquots at 20°C until assay.

Hemolysed samples were excluded. Peripheral hemogram was performed on whole blood samples on EDTA using Beckman Coulter Hmx, USA. Liver function tests, kidney function tests and serum electrolytes: Ca and phosphorus (P) were measured by standard methods using Hitachi 911 autoanalyser.

Complete blood count

It was determined by automated cell counter, Sysmex Counter K-800, TAO Medical Incorporation, Japan.

Routine biochemical analyses

Using the commercially available kits, complete liver and renal function tests were done by automated clinical chemistry auto-analyzer system Konelab 20 i (Thermo-electron Incorporation, Finland).

Human total protein measurement

The kit assay Human TP level in the sample, use purified Human TP antibody to coat microtiter plate wells, make solid phase antibody, then add TP to wells, combined TP antibody which with HRP labeled goat anti-mouse become antibody – antigen – enzyme –antibody complex, after washing completely, add TMB substrate solution, TMB substrate becomes blue color at HRP enzyme –catalyzed, reaction is terminated by the addition of a sulphuric acid solution and color change is measured spectrophotometrically at a wavelength of 450 nm. The concentration of Human TP in the samples is then determined by comparing the O.D. of the samples to the standard curve.

The kit takes out from the refrigeration should be balanced 15-30 minutes in the room temperature, if the coated ELISA plates have not been used up after opening, the plate should be stored in sealed bag.

Washing buffer will crystallization separation, it can be heated the water helps dissolve when dilution.Washing does not affect the result.

Pipette sample with pipettes each step, and proofread its accuracy frequently, avoids the experimental error. Pipette sample within 5 min, if the number of sample is much, recommend using multichannel pipetttor.

If the testing material content is excessively high (the sample OD is higher than the first standard well).

Adhesive strip only limits the disposable use to avoid cross-contamination

The substrate should be preserved evade the light.

Please refer to use instruction strictly. The test result determination must take the microtiter plate reader as a standard.

All samples, washing buffer and each kind of reject should refer to infective material process.

Transferrin measurement

The kit takes out from the refrigeration should be balanced 15-30 minutes in the room temperature, if the coated ELIZA plates have not been used up after opening, the plate should be stored in sealed bag.

Washing buffer will crystallization separation, it can be heated the water helps dissolve when dilution. Washing does not affect the result.

Pipette sample with pipettes each step, and proofread its accuracy frequently, avoids the experimental error. Pipette sample within 5 min, if the number of sample is much, recommend using multichannel pipetttor.

If the testing material content is excessively high (the sample OD is higher than the first standard well.

Adhesive strip only limits the disposable use to avoid cross-contamination

The substrate should be preserved evade the light.

Please refer to use instruction strictly. The test result determination must take the microtiter plate reader as a standard.

All samples, washing buffer and each kind of reject should refer to infective material process.

Measurement of arm circumference

Mid-Upper Arm Circumference (MUAC) is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow (olecranon process and the acromium) as Figure 1.

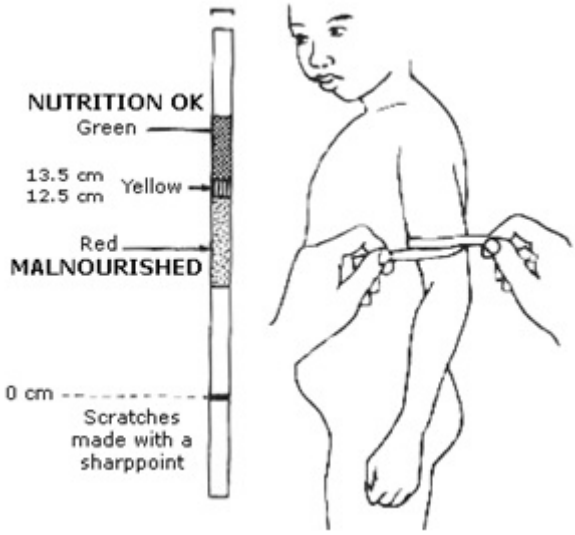

Figure 1: Measurement of arm circumference.

Results

The results are shown in the Tables 1-14 given below:

		Normal nutrition	Malnutrition	P value
		N=99	N=66	
Age	Range	(19-78)	(21-83)	0.030*
	Mean ± SD	52.4 ± 14.1	46.8 ± 17.3	
Sex	Male	51(51.5%)	32(48.5%)	0.703
	Female	48(48.5%)	34(51.5%)	
BMI	Range	(22.4-44.9)	(17-18.5)	<0.001*
	Mean ± SD	30.1 ± 4.9	17.9 ± 0.4	
Arm circumference	Range	(25-38)	(20-23)	<0.001*
	Mean ± SD	31.1 ± 2.8	22.3 ± 0.8	
Duration of dialysis	Range	(0.5-15)	(1-30)	0.003*
	Mean ± SD	4.5 ± 4	6.6 ± 5.5	

	Median	3	6	
HCV	-Ve	54(54.5%)	31(47%)	0.34
	+Ve	45(45.5%)	35(53%)	
Protein diet restriction	No	53(53.5%)	22(33.3%)	0.011*
	Yes	46(46.5%)	44(66.7%)	
Bowel habits	Normal	84(84.8%)	57(86.4%)	0.214
	Constipation	14(14.1%)	6(9.1%)	
	Diarrhea	1(1%)	3(4.5%)	
SBP	Range	(90-170)	(90-180)	0.728
	Mean ± SD	126.1 ± 16.9	125 ± 20.5	
DBP	Range	(60-100)	(50-100)	0.418
	Mean ± SD	80.4 ± 8.7	79.1 ± 11.1	
	Median	100	100	

Table 1: There is significant increase of age in mal-nutrition group (p value 0.030). There is significant decrease of BMI and arm circumference in mal-nutrition group (p value<0.001). There is significant increase duration of dialysis in malnutrition group (p value 0.003). There is significant increase in protein diet restriction in mal-nutrition group (p value 0.001). Independent samples T test for parametric quantitative data between the two groups. Mann Whitney test for non-parametric quantitative data (expressed as median) between the two groups. Chi square test (if expected value pre cell>5) and Fisher exact test (if expected value per cell<5) for qualitative data between the two groups *Significant difference at p value<0.05.

		Normal nutrition	Malnutrition	P value
		N=99	N=66	
Urea before dialysis	Range	(118-148)	(116-148)	0.15
	Mean ± SD	133.1 ± 6.2	131.6 ± 6.9	
Urea after D.	Range	(55-96)	(56-77)	0.11
	Mean ± SD	66.3 ± 5.9	64.9 ± 5.1	
BUN	Range	(56-74)	(58-74)	0.392
	Mean ± SD	66.2 ± 3.3	65.8 ± 3.5	
Creatinine	Range	(4.5-6.5)	(4.55-6.3)	<0.001*
	Mean ± SD	5.7 ± 0.4	5.1 ± 0.4	
URR	Range	(40.6-58.3)	(41.4-56.8)	0.523
	Mean ± SD	50.3 ± 3.4	50.6 ± 3.3	
Residual renal function	Range	(30-1000)	(50-1500)	0.048*
	Mean ± SD	237.7 ± 233.7	165.2 ± 203.6	

Table 2: There is significant decrease of creatinine level in mal-nutrition group (p value<0.001). There is significant decrease of residual renal function in mal-nutrition group (p value 0.048). Independent samples T test for parametric quantitative data between the two groups. Mann Whitney test for non-parametric quantitative data (expressed as median) between the two groups. *Significant difference at p value<0.05.

		Normal nutrition	Malnutrition	P value
		N=99	N=66	
ALT	Range Mean ± SD Median	(19-63) 40.4±13.2 36	(19-71)	0.074
AST	Range Mean ± SD	(21-58)	(19-52)	0.085
Total protein	Range Mean ± SD	(5.6-7.8)	(5.6-7.5)	<0.001*

Table 3: There is significant decrease of serum albumin level in mal-nutrition group (p value<0.001). There is significant decrease of total protein level in mal-nutrition group (p value<0.001). Independent samples T test for parametric quantitative data between the two groups. Mann Whitney test for non-parametric quantitative data (expressed as median) between the two groups. *Significant difference at p value<0.05.

		Normal nutrition	Malnutrition	P value
Phosphate	Range	(3.4-6.8)	(3.3-6.8)	0.005*
	Mean ± SD			
Total calcium	Range	(7.7-9.1)	(7.8-9.1)	0.016*
PTH	Range	(130.6-1652)	(127.1-1774)	0.016*
	Mean ± SD	698.7 ± 344.6	857.1 ± 419.5	
	Median	680	860	
Transferrin	Range	(17-102)	(14-94)	0.676
	Mean ± SD	53.5 ± 25.4	55.6 ± 22.4	
	Median	56	62	

Total cholesterol	Range	(100-280)	(100-270)	0.011*
	Mean ± SD	161 ± 43.4	144.2 ± 38.2	

Table 4: There is significant decrease of phosphate level in mal-nutrition group (p value 0.005). There is significant increase of total calcium level in mal-nutrition group (p value 0.016). There is significant increase of PTH level in mal-nutrition group (p value 0.016). There is significant decrease of total cholesterol level in mal-nutrition group (p value 0.011). Independent samples T test for parametric quantitative data between the two groups. Mann Whitney test for non-parametric quantitative data (expressed as median) between the two groups. *Significant difference at P value<0.05.

		Normal nutrition	**Malnutrition**	**P value**
		N=99	**N=66**	
Hb	Range	(6.3-15.5)	(6.5-12.9)	0.006*
	Mean ± SD	10.3 ± 1.9	9.5 ± 1.7	
HCT	Range	(19.1-49.1)	(19.3-38.2)	0.010*
	Mean ± SD	30.9 ± 5.4	28.8 ± 5.1	
RBCs	Range	(2.4-6.1)	(2.5-6.5)	0.213
	Mean ± SD	3.8 ± 0.7	3.9 ± 0.8	
Platelets	Range	(56-378)	(53-346)	0.211
	Mean ± SD	172.1 ± 62.7	161.2 ± 50.3	
	Median	172	158.5	
WBCs	Range	(2.1-9.7)	(2.5-9.9)	0.379

Table 5: There is significant decrease of HB level in mal-nutrition group (p value 0.006). There is significant decrease of HCT level in mal-nutrition group (p value 0.010). Independent samples T test for parametric quantitative data between the two groups. Mann Whitney test for non-parametric quantitative data (expressed as median) between the two groups. *Significant difference at p value<0.05.

All cases (n=165)	**BMI**	
	r	**P value**
Arm circumference	0.914	<0.001*
Serum albumin	0.785	<0.001*
Total cholesterol	0.367	<0.001*
Total protein	0.498	<0.001*
phosphate	0.548	<0.001*

Table 6: BMI is showing positive correlation with (Arm circumference, serum albumin, Total cholesterol, Total protein, phosphate) in all cases at p value<0.001; Pearson's correlation; *Significant level at p value<0.05.

All cases (n=165)	**Arm circumference**	
	r	**P value**
BMI	0.914	<0.001*
Serum albumin	0.773	<0.001*
Total cholesterol	0.351	<0.001*
Total protein	0.445	<0.001*
phosphate	0.449	<0.001*

Table 7: Arm circumference is showing positive correlation with (BMI, serum albumin, Total cholesterol, Total proteins, phosphate) in all cases at p value<0.001; Pearson's correlation; *Significant level at p value<0.05.

All cases (n=165)	**URR**	
	r	**P value**
BMI	0.213	0.006*
Arm circumference	0.157	0.044*
Serum albumin	0.305	<0.001*
phosphate	0.487	<0.001*

Table 8: URR is showing positive correlation with (BMI, Arm circumference, serum albumin, phosphate) in all cases at p value<0.001; Pearson's correlation; *Significant level at p value<0.05.

Normal nutrition (n=99)	**BMI**	
	r	**P value**
Arm circumference	0.676	<0.001*
Serum albumin	0.645	<0.001*
Total cholesterol	0.45	<0.001*
Total protein	0.375	<0.001*
phosphate	0.787	<0.001*

Table 9: BMI is showing positive correlation with (Arm circumference, Serum albumin, Total cholesterol, Total proteins and phosphate) in normal nutrition group at p value<0.001; Pearson's correlation; *Significant level at p value<0.05.

Normal nutrition (n=99)	**Arm circumference**	
	r	**P value**
BMI	0.676	<0.001*
Serum albumin	0.538	<0.001*
Total cholesterol	0.424	<0.001*
Total protein	0.222	0.027*

phosphate	0.619	<0.001*

Table 10: Arm circumference is showing positive correlation with (BMI, Serum albumin, Total cholesterol, Total protein and phosphate) in normal nutrition group at p value<0.001; Pearson's correlation; *Significant level at p value<0.05.

Normal nutrition (n=99)	**URR**	
	r	**P value**
BMI	0.576	<0.001*
Arm circumference	0.469	<0.001*
Serum albumin	0.456	<0.001*
phosphate	0.553	<0.001*

Table 11: URR is showing positive correlation with (BMI, Arm circumference, Serum albumin and phosphate) in normal nutrition group at p value<0.00.

Malnutrition (n=66)	**BMI**	
	r	**P value**
Arm circumference	0.825	<0.001*
Serum albumin	0.674	<0.001*
Total cholesterol	0.443	<0.001*
Total protein	0.434	<0.001*
phosphate	0.795	<0.001*

Table 12: BMI is showing positive correlation with (Arm circumference, Serum albumin, total cholesterol, total protein and phosphate) in mal-nutrition group at p value<0.001; Pearson's correlation; *Significant level at p value<0.05.

Malnutrition (n=66)	**Arm circumference**	
	r	**P value**
BMI	0.825	<0.001*
Serum albumin	0.525	<0.001*
Total cholesterol	0.416	0.001*
Total protein	0.281	0.022*
phosphate	0.774	<0.001*

Table 13: Arm circumference is showing positive correlation with (BMI, serum albumin, total cholesterol, total protein and phosphate) in malnutrition group at p value<0.001; Pearson's correlation; *Significant level at p value<0.05.

Malnutrition (n=66)	**URR**	
	r	**P value**
BMI	0.592	<0.001*
Arm circumference	0.571	<0.001*
Serum albumin	0.501	<0.001*
phosphate	0.45	<0.001*

Table 14: URR is showing positive correlation with (BMI, arm circumference, serum albumin and phosphate) in malnutrition group at p value<0.001; Pearson's correlation; *Significant level at p value<0.05. The results are shown in the Figures 2-13 given below:

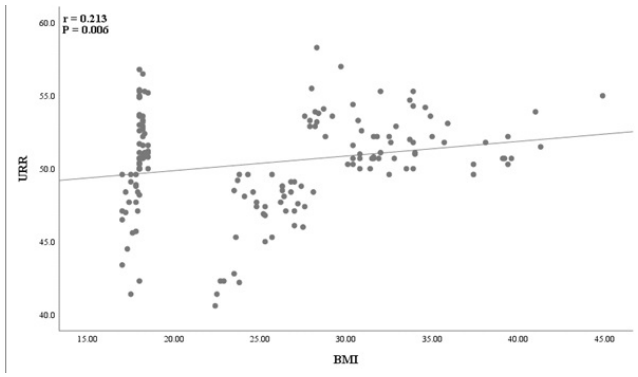

Figure 2: Show relation between URR and BMI in all cases.

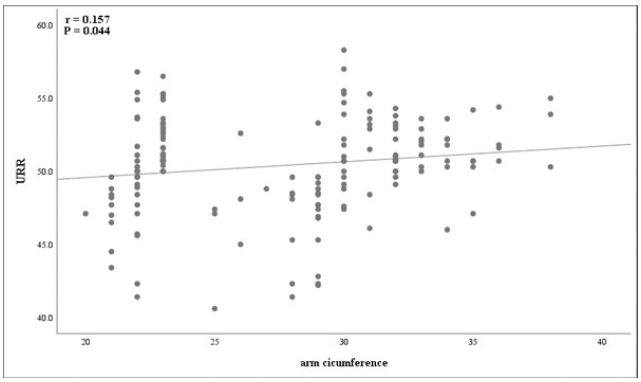

Figure 3: Show relation between URR and arm circumference in all cases.

Discussion

Patients with chronic kidney disease are at substantial risk for malnutrition, characterized by protein energy wasting and micronutrient deficiency [6].

The nutritional status of patients on dialysis is difficult to assess, due to the lack of a single criterion that can be used for its identification, sometimes delaying the diagnosis. Assessment of malnutrition of dialysis patients has been suggested to be based on multiple indicators of the nutritional status, comprising the assessment of visceral protein deposits (by use of biochemical parameters) and somatic deposits by use of the analysis of body composition (weight, anthropometry, BMI and total body nitrogen) [7].

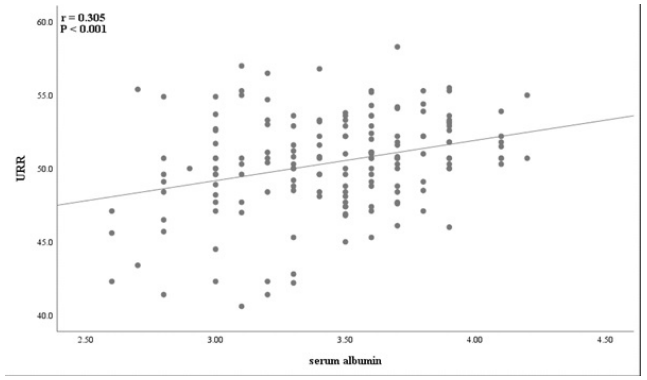

Figure 4: Show relation between URR and serum albumin in all cases.

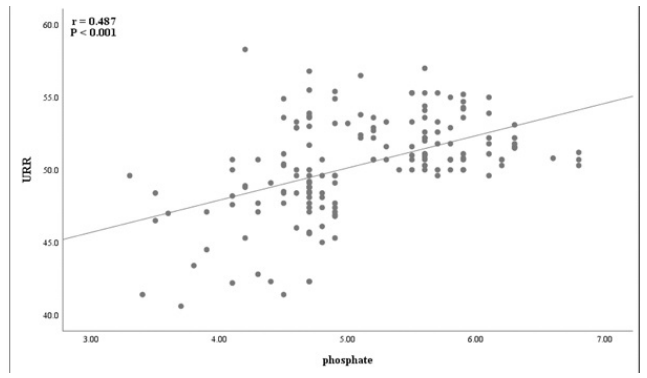

Figure 5: Show relation between URR and phosphate in all cases.

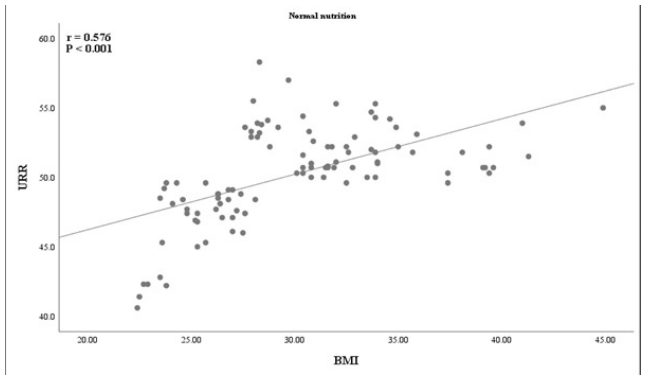

Figure 6: Shows relation between URR and BMI in normal nutrition group.

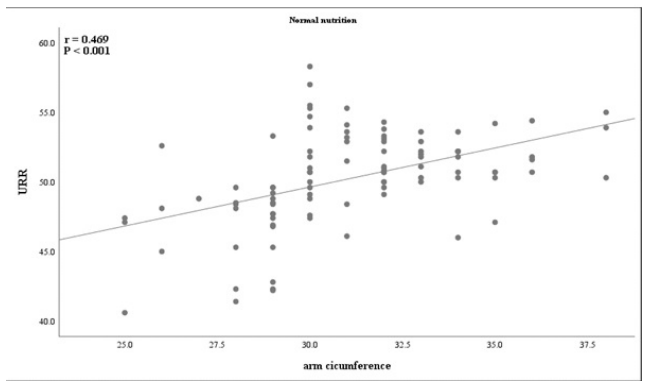

Figure 7: Show relation between URR and arm circumference in normal nutrition group.

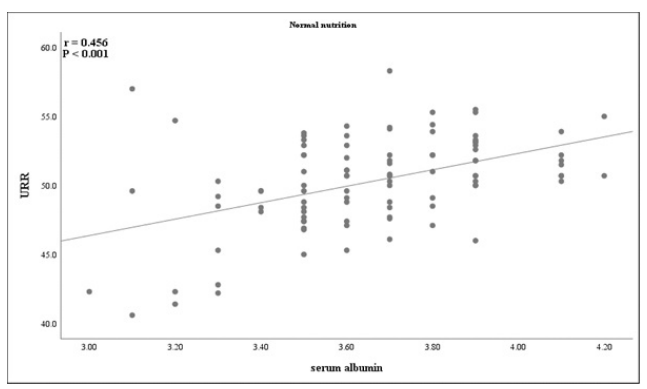

Figure 8: Show relation between URR and serum albumin in normal nutrition group.

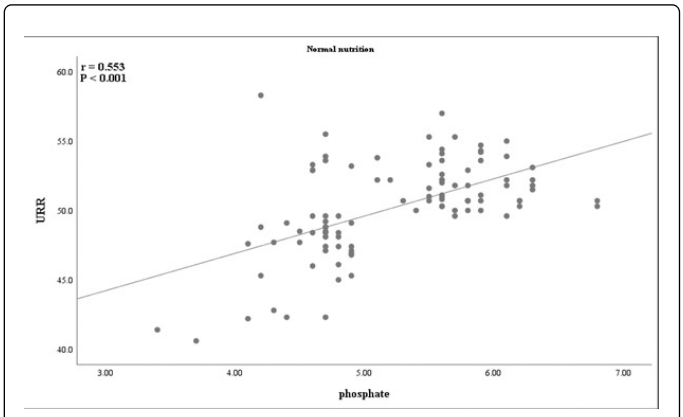

Figure 9: Show relation between URR and phosphate in normal nutrition group.

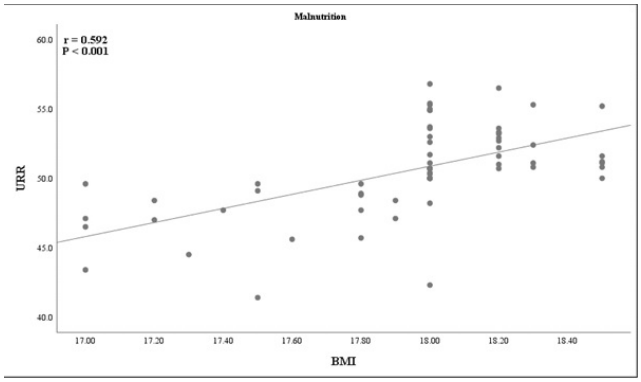

Figure 10: Show relation between URR and BMI in mal-nutrition group.

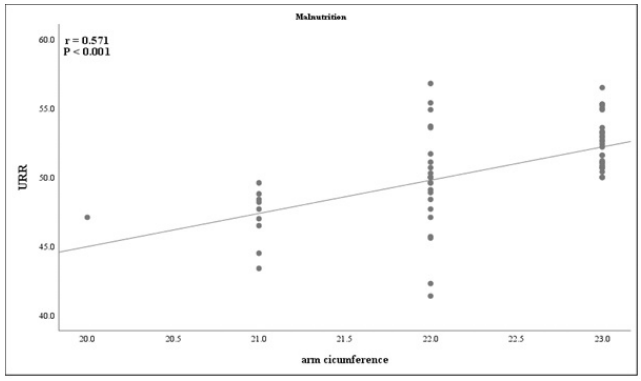

Figure 11: Show relation between URR and arm circumference in malnutrition group.

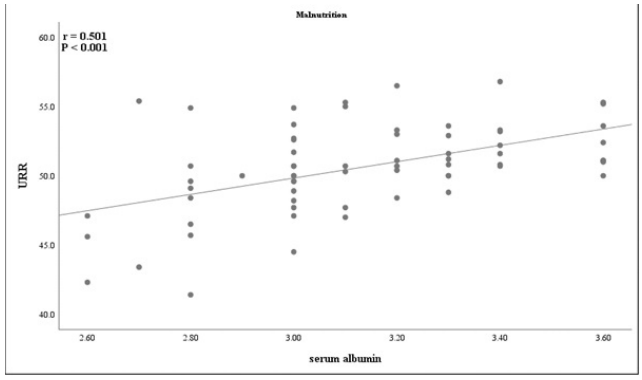

Figure 12: Show relation between URR and serum albumin in malnutrition group.

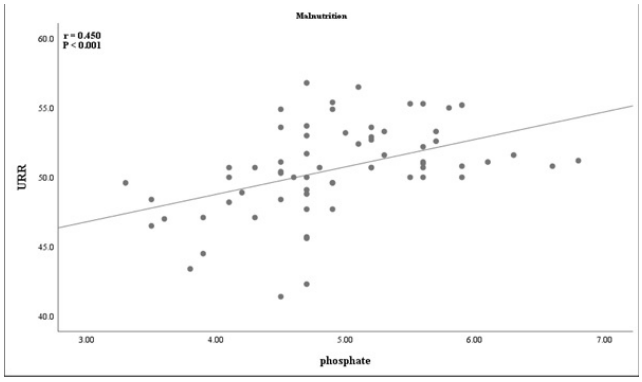

Figure 13: Show relation between URR and phosphate in malnutrition group.

The pathogenic mechanisms of malnutrition in heamodialyzed patients are complex and involve an inter play of multiple pathophysiologic alterations including decreased appetite and nutrient intake, hormonal derangements, metabolic imbalances, inflammation, increased catabolism, and dialysis related abnormalities. Malnutrition increases the risk of morbidity, mortality and overall disease burden in these patients [6].

The prevalence of malnutrition in the population studied varied a lot (from 12.1% to 94.8%), depending on the method used for diagnosis.

Our study shows high prevalence of malnutrition in the patients of hemodialysis unit in Minia University (40%) in comparison with other studies as in Morocco prevalence of malnutrition among patients on hemodialysis was (29%) [8].

Malnutrition was significantly higher in elderly hemodialyzed chronic renal failure patients compared to younger and middle aged patients in this study. This finding was similar to [6].

This pattern is not surprising because aging is associated with malnutrition in the elderly even without renal failure [8].

Decline in growth hormone and insulin growth factor-1, accumulation of free radicals, reduced immunity and chronic inflammation that occur with aging are factors contributing to malnutrition in elderly hemodialyzed patients [9].

There is no significant difference of genders in our study.
But in other studies, malnutrition was more common in males compared to females in hemodialysis patients [10].

The mean age of our study in normal nutrition group is 52.4 ± 14.1 the mean age of malnutrition group is 46.8 ± 17.3 nutrition groups.

In a study of 165 patients on dialysis in the Brazilian State of Amazonas, the mean age was 44.9 Â ± 15 years 45. In another Brazilian study about nutritional evaluation of HD patients; the mean age was 50.4 Â ± 16.3 years [11].

In our study, the results show significant increase of creatinine in normal nutrition group in compare to malnutrition group at p value (<0.001). Also, in the present study serum albumin and total protein are significant low in malnutrition group compare to normal nutrition group at p values (<0.001).

In our study, there is significant decrease of phosphate level in malnutrition group in compare to normal nutrition group at p value (0.005).

Our study showed decrease in URR and decrease in efficacy of hemodialysis in malnutrition group in compare to normal nutrition group.

Also there is significant positive correlation between URR and (serum albumin, phosphate and BMI).

The present study, when adopting the limit of 18.5 kg/m^2, the prevalence of malnutrition was 40% the mean BMI was 30.1 ± 4.9 in normal nutrition group and 17.9 ± 0.4 in malnutrition group with significant decrease of body mass index in malnutrition group than normal nutrition group.

BMI show positive correlation with (arm circumference, serum albumin, total cholesterol, total protein and URR) in all cases and each group.

The choice of a BMI cutoff point of 18.5 kg/m^2 for the dialysis population can be questioned, because patients with a BMI lower than 22 kg/m^2 already seem to be at a greater risk of mortality. Some authors have shown that, in dialysis, a high BMI associates with a better prognosis. (1) Have reported that a BMI lower than 23.9 kg/m^2 associated with an increase in the mortality rate.

Other study has reported that the BMI associated with lower morbidity was 22.2 kg/m^2 for men and 21.9 kg/m^2 for women, and have suggested that the ideal body weight would be the one associated with a BMI of 22.0 kg/m^2 [8].

This study was approved by the Institutional Ethics Committee of School of Medicine, Minia University, Egypt, and all patients gave informed consent before participation in this study. The study conducted in accordance with the ethical guidelines of the 1975 Declaration of Helsinki and International Conference on Harmonization Guidelines for Good Clinical Practice.

Conclusion

Malnutrition is very common in hemodialyzed patients. The prevalence of malnutrition increases with increasing age and worsening kidney function. Nutritional status should be assessed early and regularly in these patients.

Conflict of Interest

The authors declare that there is no conflict of interests.

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