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# Investigating the relationship between the level of serum albumin and body mass index, as nutritional indicators, with dialysis adequacy in patients under hemodialysis

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Original Article

## Abstract

BACKGROUND: Patients with end-stage renal disease (ESRD) who undergo hemodialysis have many complications; one of the most important of which is malnutrition, which affects these patients' quality of life. The aim of this study was to evaluate serum albumin and body mass index (BMI) as nutritional indicators, and their relationship with dialysis adequacy in patients under hemodialysis.

METHODS: In this study, 100 patients who underwent hemodialysis in Razi Hospital, Qaemshahr City, Iran, in 2016 were selected via convenience sampling method. The data were collected using demographic questionnaire, albumin test, and measuring height and weight of patients. Data were analyzed using linear regression and correlation coefficient tests.

RESULTS: The correlation between the hemodialysis adequacy with albumin was 0.634, which was significant ($P < 0.050$). For the second hypothesis, the quality of dialysis with BMI was not positively correlated. The correlation between the hemodialysis adequacy with BMI was -0.007, which was not significant ($P > 0.050$). Although, in the third hypothesis, the regression between the adequacy of hemodialysis, as a dependent variable, and serum albumin and BMI, as independent variables, indicated significant relationship between serum albumin and hemodialysis adequacy; but there was no significant relationship between BMI and adequacy of hemodialysis.

CONCLUSION: Adequacy of hemodialysis is in relationship with malnutrition and improving the KT/V dialysis adequacy may have a significant effect on the malnutrition control in these patients.

KEYWORDS: Hemodialysis, Serum Albumin, Body Mass Index

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## Introduction

Chronic kidney disease (CKD) is a public health problem.[1] CKD is defined as progressive and irreversible loss of renal function.[2] Reduced renal function and progression of end-stage renal disease (ESRD) depend on underlying disorder, urinary protein excretion, and high blood pressure. Disease in people with high levels of protein excretion or high blood pressure progresses faster than other patients.[3] Two major treatments for ESRD include hemodialysis and transplantation.[2] Hemodialysis aims to remove nitrogen, toxic substances, and excess water from the blood.[3]

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Prolonged prognosis of patients under chronic hemodialysis is affected by the adequacy of hemodialysis treatment, and its evaluation is very important in the management of these patients.[4-6]

Variables that allow us to correctly evaluate the adequacy of dialysis are measurable, mostly affected by dialysis and a reflection of metabolic disorders of urea. Since 1993, the guideline of Nephrologists Association has determined the adequacy of dialysis as the minimum reduction ratio of urea reduction ratio (URR) 65%, and Kt/V > 1.2.[7]

In dialysis, urea clearance is calculated using the Kt/V formula. K as dialyzer clearance of urea, which depends on the coefficient of removal of the substance in the filter (KOA); which is constant for each filter, and the blood flow; t demonstrates time, and V as the volume of urea distribution in body fluids, which depends on height, weights, and gender. Kt/V is calculated at a normal level of 1.2. According to valid sources, a level below 0.8 is considered as inadequate.[7,8] Protein-energy malnutrition, as one of the most important risk factors for cardiovascular diseases, is common among patients under hemodialysis.[9]

If urea clearance is inadequate, hemodialysis will be inadequate regardless of plasma urea. On the other hand, only low plasma urea level does not necessarily indicate adequate dialysis. Urea plasma depends not only on the amount of urea, but also its production. The amount of urea produced is related to the protein received. The low level of plasma urea before dialysis may be due to low protein intake. Therefore, in evaluating the adequacy of dialysis, what is important is urea clearance in a 4-hour phase of dialysis, and does not depend on the plasma level of urea alone.[8]

Patient with CKD should initially receive low-protein diets, which will slow down the progression of kidney failure, and delay the need for dialysis and kidney transplant as replacement therapies. However, after patient's progression to advanced kidney failure and treatment with dialysis, the need to use protein is essentially increasing. Some of the patients continue to follow the same diet pattern due to the habit of consuming low-protein diets, anorexia, lack of awareness, and even the false education given to them.[10] Malnutrition in patients under hemodialysis leads to decreased quality of life, and increased incidence of diseases and mortality.[11] To evaluate the nutritional status of the these patient, there are several ways, including patient interview, comparing actual and required weight, measuring the thickness of the skin of the arm and arm circumflex, bioempedance or estimating muscle mass by measuring resistance and body reactions to an alternating electric current, measuring serum albumin, urea, and nitrogen, and calculating the rate of urea production.[10] Low serum albumin is one of the most important causes of mortality in patients under hemodialysis.[9]

Shasti and Baba Haji reported that only half of the patients (50.5%) had adequate dialysis with Kt/V of more than 1.2, and only 46% with URR of more than 65%.[8] Saad et al., in studying the quality of life predictors in patients with CKD that underwent hemodialysis, showed that serum phosphate levels, weight between two dialysis sessions, and dialysis adequacy are associated with higher levels of quality of life.[12] Machingura et al. reported that 76.7% of patients that underwent hemodialysis in Parirenyatwa group of hospitals and Chitungwiza central hospital in Zimbabwe had hypoalbuminemia, and monitoring serum albumin was necessary to reduce mortality in these patients.[13] In another study, the prevalence of malnutrition was high with an outbreak of 29 at younger age and in people with low income families. Moreover, there was a longer hemodialysis duration, higher KT/V, and inadequate calories and protein intake. Reversing this situation needed more nutritional care.[14]

The aim of this study was to evaluate serum albumin and body mass index (BMI) as nutritional indicators, and their relationship with dialysis adequacy in Razi hospital in Qaemshahr City, Iran. The results of this study were presented to the relevant authorities to increase the life span, and improve the quality of life among the patients under hemodialysis.

## Materials and Methods

In this descriptive correlational study, which was done in Razi hospital in year 2016, the study population consisted of people who had a medical record in hospital, and according to their scheduled appointments referred to hospital for hemodialysis. We included patient who aged 18 years and more, hemodialyzed at least 1 and at most 3 times in a week, and had no kidney transplant and mental disorders (major depressive disorder or bipolar mood disorder).

To collect the data, the researcher enquired permission from the related authorities of Mazandaran University of Medical Sciences, and Razi Hospital in Qaemshahr, and completed the research data using patient records and laboratory tests.

In order to collect the data in this study, researchers were present in the environment and collected the required information by using a demographic questionnaire and patient records. The adequacy of dialysis was calculated using the Kt/V formula as: $Kt/V = -\ln(R - 0.008 \times t) + [(4 - 3.5\ R) + UF/W]$

The range for reporting Kt/V score was considered from 0.7 to 1.3.

BMI was obtained from the squared height on the patient's weight.

Serum albumin was obtained from a patient's blood sample.

After collecting information regarding variables of the research, Kolmogorov-Smirnov test was performed to determine the normality of the data. In the case of normal data, we used parametric tests to examine the hypotheses; otherwise we used a nonparametric coefficient.

The study hypothesis were as the adequacy of hemodialysis has a significant positive relationship with serum albumin; the adequacy of hemodialysis has a significant positive relationship with BMI; and the adequacy of dialysis has a significant positive correlation with serum albumin and BMI. To examine this hypothesis, we have used dual linear regression test.

## Results

In our study, among 100 patients, 52 cases (52%) were men and 48 (48%) were women, 13 (13%) were single and 87 (87%) were married. 5 persons aged 18-30 years (5%), 3 persons (3%) 30-40 years, 12 persons (12%) 40-50 years, 24 persons (24%) 50-60 years, and 56 persons (56%) over 60 years. The number of dialysis sessions was reported to be twice a week in 12 cases (12%), and three times a week in 88 cases (88%). Based on occupational status, 3 cases (3%) were government employees, 35 cases (35%) were retired, 50 cases (50%) were housekeeper, and 12 cases (12%) had other occupations.

In our study, 54 cases (54%) were hemodialyzed with A-V fistulas, 38 cases (38 %) had A-V grafts, 5 cases (5%) had temporary dialysis catheters, and 3 cases (3%) had permanent catheter catheters.

Finally, the descriptive data analyses showed that 43 cases (43%) have progressed to ESRD due to diabetes mellitus, 46 cases (46%) due to hypertension, and 11 cases (11%) due to other medical causes.

Table 1 shows the results of testing the normal variables in each group. The method of conclusion in this test was that if the level of significance (P) was less than 0.05, the data were abnormal and, if more than 0.05, the data were normal.

According to table 1, the KT/V was not a normal variable, but the serum albumin and BMI were normal.

**Table 1. Kolmogorov-Smirnov statistics to determine normal or non-normal variables**

| Variables | Kolmogorov-Smirnov statistics | P | Test result |
|---|---|---|---|
| KT/V | 2.44 | < 0.0001 | Non-normal |
| Serum albumin | 1.22 | 0.0997 | normal |
| BMI | 0.96 | 0.3203 | normal |

BMI: Body mass index

Before examining the research hypotheses, we examined descriptive variables. Table 2 shows descriptive indicators such as average, median, mode, standard deviation, minimum and maximum. The KT/V as the variable had an average of 1.18, median of 1.20, a mode of 1.20, a standard deviation of 0.50, a minimum of 0.80, and a maximum of 1.30. In the case of serum albumin, the average was 3.36, median 3.70, mode 4.00, standard deviation 0.50, minimum 2.50 and maximum 5.00. For BMI, the average was 24.30, median 24.43, mode 30.19, standard deviation 4.9, minimum 16.00, and maximum 20.36.

To test the research hypotheses, correlation coefficient and linear regression were used. The correlation between the adequacies of hemodialysis with albumin was 0.634, which was statistically significant (P < 0.0001). The correlation between the hemodialysis adequacy and BMI was -0.007, which was not significant (P = 0.9440).

Table 3 shows the correlation between adequacy of hemodialysis, as a dependent variable, and serum albumin and BMI as independent variables.

According to table 3, the relationship between serum albumin and hemodialysis adequacy with regression coefficient of 0.129 and t of 7.81 was statistically significant; but BMI with regression coefficient of -0.001 and t of -0.72 had not statistically significant relationship with hemodialysis adequacy; it should be noted that the coefficient of determination of the $R^2$ model iwass 0.386. The result confirms that there was a significant relationship between serum albumin and hemodialysis adequacy, but there was no significant relationship between BMI and hemodialysis adequacy.

## Discussion

The result of our study in the first hypothesis showed that the adequacy of hemodialysis with had a significant positive correlation serum albumin. In explaining the reason, it should be said that CKD varies from proteinuria to increasing serum creatinine, which is indicative of decreased glomerular filtration, and ultimately complete loss of renal function and ESRD.[2] Prolonged prognosis of patients under chronic hemodialysis is affected by the adequacy of dialysis treatment, and its evaluation is very important in the management of these patients.[7] Protein-energy malnutrition, as one of the most important risk factors for cardiovascular diseases, is common among patients under hemodialysis.[9,15-17] Therefore, assessment of nutrition status in patients is necessary for both malnutrition prevention, and intervention in malnutrition cases.[1]

Hashemi and Garshad, in their study on the evaluation of the adequacy of hemodialysis and other biochemical factors related to it in patient under hemodialysis in Bojnourd City, Iran, did not find any correlation between the adequacy of hemodialysis and serum albumin.[16]

**Table 2. Descriptive indexes of research variables**

| Variables | Number | Average | Median | Mode | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| KT/V | 100 | 1.18 | 1.20 | 1.20 | 0.10 | 0.80 | 1.30 |
| Serum albumin | 100 | 3.63 | 3.70 | 4.00 | 0.50 | 2.50 | 5.00 |
| BMI | 100 | 24.30 | 23.44 | 19.30 | 4.19 | 16.00 | 36.20 |

BMI: Body mass index

**Table 3. Regression coefficients between the hemodialysis adequacy with serum albumin and body mass index**

| Dependent variable | Independent variables | $R^2$ determination Coefficient | B (beta) | t statistics | P |
|---|---|---|---|---|---|
| Dialysis adequacy (KT/V) | Constant | 0.386 | 0.751 | 10.10 | < 0.0001 |
| | Serum albumin | | 0.129 | 7.81 | < 0.0001 |
| | BMI | | -0.001 | -0.72 | 0.4737 |

BMI: Body mass index

Contrary to our results, another study by Rashidfarokhi et al., with the aim of evaluating dietary protein intake by calculation of urea generation rate in patients under chronic hemodialysis in Kerman, Iran, did not show a significant relationship between serum albumin and hemodialysis adequacy.[17] It seems the probable reason for this inconsistency is that serum albumin is also altered by other factors such as liver problems, plasma volume changes, and inflammatory conditions.

In a study by Garagarza et al. in Portugal, to investigate the relationship between hypophosphatemia, nutritional status, and body composition with mortality in patients under hemodialysis, patients with lower plasma albumin levels had lower survival rates.[18] Azar et al. conducted a study to investigate the association between hemodialysis dose improvement and nutritional status among the patients under hemodialysis. The results showed a significant positive correlation between the adequacy of hemodialysis and serum albumin.[19] Teixeira Nunes et al. found a significant positive correlation between the adequacy of hemodialysis and BMI;[20] that was not consistent with the results of our study.

Moreover, Teixeira Nunes et al.,[20] and Stolic et al.,[21] in separate studies aimed to evaluate hemodialysis adequacy and nutritional status in patients under hemodialysis, and found a significant positive relationship between albumin and hemodialysis adequacy markers. Another study by Song et al. in China, aimed to analyze factors associated with death in patients on maintenance hemodialysis, and found a significant positive association between albumin and dialysis adequacy with death.[22] The results of the studies mentioned above are consistent with the present study. Therefore, it seems that improving hemodialysis adequacy, and increasing the frequency of dialysis per week can lead to a better excretion of uremic toxins, and thus improve appetite and protein intake in patients. Consequently, malnutrition in patients under hemodialysis can be controlled by improving the adequacy of hemodialysis.

Unlike the results of a study in Birjand on patients under chronic hemodialysis,[23] there was not a significant positive correlation between BMI and dialysis adequacy in our study.

Zafar Mohtashami et al., in a study on determining the adequacy of hemodialysis in patients under chronic hemodialysis in Khorramabad, Iran, showed a significant positive correlation between BMI and dialysis adequacy.[24] Likely, the probable causes of these inconsistent findings are the patients' different races, underlying diseases such as diabetes mellitus, and patients' lack of protein intake.

## Conclusion

The results of our study indicated that a significant relationship existed between adequacy of dialysis and malnutrition; and promoting Kt/V dialysis adequacy may have a great impact on malnutrition control in these patients.

## Conflict of Interests

Authors have no conflict of interests.

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