Renal Failure

ISSN: 0886-022X (Print) 1525-6049 (Online) Journal homepage: https://www.tandfonline.com/loi/irnf20

Correlation of Dietary Intakes and Biochemical Determinates of Nutrition in Hemodialysis Patients

Nevin Şanlier & Yasemin Demircioğlu

To cite this article: Nevin Şanlier & Yasemin Demircioğlu (2007) Correlation of Dietary Intakes and Biochemical Determinates of Nutrition in Hemodialysis Patients, Renal Failure, 29:2, 213-218, DOI: 10.1080/08860220601098904

To link to this article: https://doi.org/10.1080/08860220601098904

Published online: 07 Jul 2009.

Submit your article to this journal

Article views: 527

View related articles

Citing articles: 4 View citing articles

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=irnf20

Renal Failure, 29:213–218, 2007
Copyright © Informa Healthcare
ISSN: 0886-022X print / 1525-6049 online
DOI: 10.1080/08860220601098904

informa
healthcare

CLINICAL STUDY

Correlation of Dietary Intakes and Biochemical Determinates of Nutrition in Hemodialysis Patients

Nevin Şanlier and Yasemin Demircioğlu
Department of Food and Nutrition Education in Gazi University, Ankara, Turkey

Objective. The purpose of this study was to determine the effect of dietary intakes on nutritional indicators of patients on hemodialysis. *Method*. This study was carried out at the hemodialysis unit at the Ministry of Health, Ankara Hospital, from 2003–2004. Sixty-seven patients on regular hemodialysis were enrolled in the study. Nutritional status was assessed by biochemical parameters (urea, uric acid, creatinine, Na, K, Cl, Ca, P, alkaline phosphatase, SGOT, SGPT, cholesterol, total protein, albumin, hemoglobin, hematocrit) and anthropometric measurements (height, dry weight, body mass index), and dietary intakes were calculated. *Results*. In this study, the mean age of the patients was 45.3 ± 13.49, and the duration of hemodialysis was 4.9 ± 3.64 year. Dialysis time was 12.4 ± 2.7 h/week. The ratio of individuals with BMI of 20 kg/m^2 or below this value was 19.4%. Blood hemoglobin and hematocrit levels were below than the recommended level. Mean serum urea (148.0 ± 27.76 mg/dL) and creatinine (8.8 ± 2.13 mg/dL) were found to be high, while a significant negative correlation was found between blood urea level and dietary fat ($p < 0.01$, $r = -0.31$). A significant positive correlation was found between vitamin B_1, vitamin B_6, folate, potassium, iron, and magnesium; between uric acid and vitamin D; between blood creatinine level and dietary vitamin B_1, vitamin B_6, folate, vitamin C, potassium, iron, magnesium; between blood potassium level and dietary vitamin C only; and between blood cholesterol level and dietary vitamin D only ($p < 0.01$).

Keywords hemodialysis, dietary intake, biochemical determinations

Address correspondence to Nevin Şanlier, GMK Bulvarı Yuvam, Apt. 149/4, Tandogan, Ankara, Turkey; Tel.: +90 (312) 229 80 04; Fax: +90 (312)229 55 17; E-mail: ntekgul@gazi.edu.tr, nevintekgul@gmail.com

INTRODUCTION

Nutritional requirements of hemodialysis (HD) patients are high, and frequent intake of nutrition is sometimes insufficient. This explains why hemodialysis patients often face the risk of malnutrition. The prevalence of malnutrition among chronic dialysis patients is between 10 and 54%.[1] A reduction in the intake of protein energy, anorexia, and changes in the sense of taste are among the factors that cause malnutrition in HD patients.[1] The amount and type of daily protein uptake in order to preserve the nitrogen balance in HD patients is rather important.[2] However, there are a number of factors that enable patients to take a sufficient amount of protein, including medical (appetite, the insufficient duration of dialysis, and comorbid circumstances), behavioral (not being aware of the protein content of the food, and the low intradialytic liquid intake), and socio-economic (inability to shop and to cook).[3]

Protein intake is rather important for growth and tissue repair. Proteins play an important role in the defense against infections and the prevention of muscle mass loss. When the amount and type of dietary protein is not properly provided, the urea, which is the final digestion product of protein, increases in the blood circulation and shifts the metabolism toward acidic conditions. When a sufficient amount of energy is not taken up by HD patients in their diet, a reduction in muscle mass and weight loss will occur. This situation will lead the patient toward malnutrition. Although proteins provide energy, the main sources of energy are fat and carbohydrates. Weight and physical activity levels of the patients should be kept in mind in the determination of individual energy requirements. Extra water is retained by the body when the kidneys do not function for a long period of time; in this situation, the amount of urine decreases or does not form at all, respiration slows down, and blood pressure increases. Therefore, excessive fluids should be removed

with dialysis. Fluids (including food in the form of fluid at room temperature, or all nutritional food with fluid properties) should be carefully limited in dialysis patients.[4] During HD, losses in glycose, proteins, amino acids, and vitamins occur. The aim of this study is to determine the relationship between the biochemical determinations and the daily energy and other nutrients intake by patients in their diets.

METHOD

Subjects

This study was carried out on sixty-seven (31 male and 36 female) patients undergoing hemodialysis three times/week at the dialysis unit at Ankara SSK Hospital and the Ministry of Health, Ankara Hospital.

Dietary Assessment

Each subject's food intake was determined by 24 hour records. The volumes and portion sizes were determined with two-dimensional food models and a portion-size picture booklet, which included 120 photographs of foods, each with 3–5 different portion sizes. Two experienced dietitians assisted with the dietary recall and reviewed all questionnaires with the subjects, probing for inaccurate and omitted responses.

The average energy, protein, carbohydrate, lipid, thiamin, riboflavin, niacin, vitamin A, vitamin C, calcium, and iron content for each individual's diet were analyzed using food composition tables for preparing Turkish foods.[5]

Anthropometric Measurements

The weights of all the subjects were measured with a bathroom scale to the nearest 0.1 kg. Heights were measured with the subjects standing barefoot with heels together, arms at the side, legs straight, shoulders relaxed, and head in the Frankfort horizontal plane, with heels, buttocks, scapulae, and back of the head lying against a vertical wall. The balance of body weight with the height was evaluated with body mass index (BMI). BMI was calculated as weight (kg) divided by height (square meters) [weight (kg)/height (m^2)].[6,7] Those with a BMI below 18.5 kg/m^2 were considered underweight, a BMI between 18.5 and 24.9 kg/m^2 was considered normal, those whose BMI was between 25.0 and over kg/m^2 were accepted as obese.[7] All measurements were performed by trained two dietitian and completed according to recommendation.[6]

Biochemical Determinations

Urea, uric acid, creatinine, Na, K, Cl, Ca, P, alkaline phosphatase, SGOT, SGPT, cholesterol, total protein, albumin, Hb, and Hct were determined by the usual laboratory tests at the hospital.

Statistics

Data were analyses with SPSS for Windows 10.0 (SPSS Inc., Chicago, Illinois, USA). The results have been expressed as mean and standard deviation, and range of values have also been determined. The interrelationships between nutritional parameters and dietary intake were studied using a pearson's correlation. In terms of statistics, *p* values below 0.01 were accepted to be significant values.

RESULTS

The study was carried out on a total of 67 HD patients from which 31 were male and 36 were female. Age, body weight, height, BMI, and duration of HD of the patients according to their gender are shown in Table 1.

The ratio of individuals with BMI of 20 kg/m^2 or below this value was 19.4%, the BMIs of 75.0% of the patients were in the normal range, and the remaining were obese (see Table 1).

The calculations based on the three-day food consumption data of the HD patients revealed that the patients' average energy intake was 20.1 kcal/kg/day, the protein intake was 0.75 g/kg/day, 52.9% of the energy was provided by carbohydrates, 31.3% was provided by fats, and they took in 17.6 g of fiber per day. (The recommended daily energy intake for dialysis patients is 35 kcal/kg body wt per day.) In addition to the dietary intake of HD patients of energy, protein, carbohydrate, fibers, vitamin C, vitamin B_1, vitamin B_2, vitamin B_6, sodium, calcium, iron, zinc, and magnesium were below the recommended amounts, and fat, vitamin B_{12}, and sodium intake were found to be above the recommended amounts (see Table 2).

The assessment of nutritional status should be based on a combination of clinical parameters with biophysical and biochemical parameters. The most commonly used laboratory parameters for routine assessment of nutritional status are plasma concentrations of albumin, pre-albumin,

Table 1
The distribution of age, weight, height, and BMI* and the duration of HD† according to the patients' gender

Characteristics	Male (n = 31) Mean ± SD	Female (n = 36) Mean ± SD	Total (n = 67) Mean ± SD
Age (years)	46.7 ± 14.26 (18–73)	43.5 ± 12.5 (19–70)	45.28 ± 13.49 (18–73)
Weight (kg)	64.5 ± 9.60 (34–90)	55.5 ± 9.10 (42.5–75)	60.32 ± 10.39 (34–90)
Height (cm)	167.3 ± 7.37 (145–180)	159.2 ± 4.20 (150–165)	163.5 ± 7.32 (145–180)
BMI (kg/m^2)	22.9 ± 2.95 (15.9–31.5)	21.8 ± 3.11 (17.5–28.3)	22.45 ± 3.06 (15.9–31.5)
Duration of HD (years)	3.5 ± 2.88 (1–17)	6.4 ± 3.85 (1–17)	4.86 ± 3.64 (1–17)

*BMI = Body Mass Index
†HD = hemodialysis

Table 2
Dietary intake of nutrients on HD patients

Daily dietary intake	Mean ± SD
Energy (kcal/kg)	20.1 ± 9.73 (5.6–57.8)
Protein (g/kg)	0.8 ± 0.34 (0.2–2.1)
Carbohydrate (energy%)	53.0 ± 9.65 (28.0–74.0)
Fat (energy%)	31.3 ± 8.12 (14.0–54.0)
Fiber (g)	17.6 ± 8.26 (4.1–38.5)
Vitamin A (RE)	821.9 ± 868.9 (103.1–5833.5)
Vitamin D (mcg)	0.8 ± 0.51 (0–1.9)
Vitamin C (mg)	87.5 ± 62.01 (7.6–327.9)
Vitamin B_1 (mg)	0.5 ± 0.23 (0.2–1.1)
Vitamin B_2 (mg)	0.9 ± 0.33 (0.2–1.9)
Vitamin B_6 (mg)	0.9 ± 0.37 (0.4–2.1)
Vitamin B_{12} μ(g)	2.2 ± 2.08 (0.1–17.1)
Folate μ(g)	99.0 ± 40.94 (34.4–199.9)
Sodium (mg)	1294.1 ± 704.00 (308.1–3841.9)
Potassium (mg)	1533.7 ± 637.75 (555.6–3125.5)
Calcium (mg)	490.6 ± 198.59 (125.0–883.9)
Phosphorus (mg)	695.4 ± 242.91 (282.2–1212.2)
Iron (mg)	7.9 ± 3.44 (2.2–17.1)
Zinc (mg)	5.8 ± 2.36 (1.7–11.4)
Magnesium (mg)	166.3 ± 68.35 (57.7–365.8)

Table 3
General biochemical determinations

Biochemical determinations	Mean ± SD
Urea (mg/dL)	148.0 ± 27.76 (62.0–203.0)
Uric acid (mg/dL)	5.8 ± 1.38 (3.1–9.9)
Creatinine (mg/dL)	8.8 ± 2.13 (3.9–16.4)
Na (mEq/L)	138.1 ± 3.93 (128.0–149.0)
K (mEq/L)	4.9 ± 0.77 (3.2–7.0)
Cl (mEq/L)	104.1 ± 4.90 (90.0–120.0)
Ca (mg/dL)	9.05 ± 0.92 (7.2–11.5)
P (mg/dL)	6.2 ± 1.53 (3.6–10.0)
Alkaline phosphatase (IU/L)	273.7 ± 205.99 (99.0–1085.0)
SGOT (IU/L)	13.86 ± 6.53 (6.0–36.0)
SGPT (IU/L)	17.0 ± 9.88 (5.0–47.0)
Cholesterol (mg/dL)	160.8 ± 38.50 (88.0–251.0)
Total protein (g/dL)	7.1 ± 0.68 (5.0–9.1)
Albumin (g/dL)	4.1 ± 0.50 (2.1–4.9)
Hb (g/dL)	10.2 ± 1.84 (6.2–16.9)
Hct (%)	31.3 ± 6.01 (18.5–54.1)

transferring, and other liver-derived proteins. Although serum albumin is by far the most commonly used nutritional marker in dialysis patients, its value has been questioned, as low serum albumin levels not only reflect poor nutritional status but also albumin losses in urine (and/or dialysate) and, as albumin is a negative acute phase protein, the presence of an inflammatory process.[8–10]

Table 3 shows that serum levels of urea, uric acid, creatinine, phosphorus, and alkaline phosphatase were above the levels recommended for HD patients. However, the hemoglobin and hematocrit levels were found to be below the acceptable levels.

When the correlation between blood chemistries of the HD patients and the dietary energy intake and other nutritional element amounts were examined, it was observed that blood urea, uric acid, creatinine, potassium, and cholesterol levels from the blood results showed a correlation with the dietary nutrients intake. A significant negative correlation was found between blood urea level and dietary fat. A significant positive correlation was found between vitamin B_1, vitamin B_6, folate, potassium, iron, and magnesium; between uric acid and vitamin D; between blood creatinine level and dietary vitamin B_1, vitamin B_6, folate, vitamin C, potassium, iron, and magnesium; between blood potassium level and dietary vitamin C only; and blood cholesterol level and dietary vitamin D only ($p < 0.01$). No significant correlation was found between the other blood parameters and other nutrients (see Table 4).

Table 4
The correlation between biochemical determinations and daily dietary intake

	Urea	Uric acid	Creatinine	Potassium	Cholesterol
Fat	–0.31				
Vitamin D		0.34			0.35
Vitamin B_1	0.34		0.39		
Vitamin B_6	0.33		0.42		
Folate	0.34		0.42		
Vitamin C			0.46	0.33	
Potassium	0.35		0.35		
Iron	0.31		0.38		
Magnesium	0.33		0.37		

Values were presented when $p < 0.01$ (n = 67).

DISCUSSION

Weight loss in HD patients have been identified to be an independent and important risk factor for mortality. While the death rate in low weight patients is high, the rate decreases in patients with normal weight and decreases further with those above the normal weight and the obese.[11] In this study, the rate of individuals with a BMI of 20 kg/m^2 or below were found 19.4%. The nutritional profiles of 27 patients suffering from chronic kidney dysfunction were investigated; the BMIs of 75.0% of the patients were in the normal range, and the remaining were obese. A study evaluating the nutrition and blood results of Korean HD patients established that the average BMI of the patients were 20.7 ± 2.3 kg/m^2 and that the weight of 93% remained stable for six months.[12] It was observed that fat stores were initially consumed in patients who were untreated with advanced chronic kidney dysfunction. The decrease of fat stores are thought to be related to low energy intake and not with inflammation or with visceral protein loss.[13] Teehan et al.[14] have stated that the serum albumin concentration does not always show a correlation with the amount of dietary protein intake. There are a number of factors affecting hypoalbuminemia. In this study, no correlation was found between the amount of protein intake and the serum albumin levels ($p > 0.01$).The findings of present study are supported by another studies.

The insufficient energy intake of HD patients negatively affects their usage of protein. Therefore, the energy intake of HD patients should not be lower than 35–45 kcal/kg/day.[15,16] The dietary energy intake of the patients included in this study was calculated to be 20.1 ± 9.73 kcal/kg/day. Protein intake below 0.8 g/kg/day every day in HD patients has been found to increase the rate of morbidity and mortality.[3] It has been recommended that more than 1–1.2 g/kg of protein should be given to hemodialysis patients in order to sustain the positive nitrogen balance. In another study, it has been observed that the energy and protein intake of HD patients receiving treatment was lower in comparison to those not receiving treatment.[17] It was determined in this study that the amount of dietary intake of protein was 0.75 g/kg/day, which was lower than the recommended amount. The dietary carbohydrate amount should be kept at a high level with the aim of preserving the substitutional protein, which will be used to compensate for the energy loss and the synthesis of tissue protein. It is recommended that approximately 60–65% of the daily energy intake should be gained from carbohydrates. However, in this study, it was determined that 52.9% of the dietary energy was gained from carbohydrates. The amount of fat in the diet should not be high, as hyperlipidemia develops in a large proportion of the patients. The total amount of energy gained from fats should not exceed 25–30%. It was determined in this study that 31.3% of the dietary energy was gained from fats, and the blood cholesterol levels of the HD patients were 160.8 mg/day, which is in the optimum range. It may be necessary to give extra sodium during dialysis especially to prevent hypotension. However, in order to keep thirst and hypertension under control, the intake of sodium is limited via diets without salt. In this study, the dietary sodium intake of the HD patients was 1294.1 mg/day, which is above the recommended amount, and the patients average potassium intake was found to be in the optimum range. In order to control hyperphosphatasemia and to prevent secondary hyperparathyroidism and renal osteodystrophy in dialysis patients, it is recommended that the dietary phosphorus content should be limited to under 1000 mg/day. In present study, the average amount of dietary phosphorus intake of HD patients was below 1000 mg/day, and hyperphosphatemia (with an average blood phosphate levels of 6.2 mg/dL) was

observed. Therefore, choosing foods that contain the same amount of protein but with low phosphate content instead of high phosphate-containing foods could be effective in the control of hyperphosphatemia.

The food consumption of HD patients and patients not receiving HD treatment were compared, and it was observed that HD patients were consuming insufficient amounts of vitamin C, dietary fibers, potassium, cryptoxanthin, and lipophene in comparison to HD patients not receiving treatment. It was put forward that the low intake of vitamin C, fibers, and carotenoids of HD patients could result in a atherogenic effect, and the limitation of potassium could result in the reduction of vegetable and fruit intake; hence, the main energy source would be supplied by meat and fats, which would trigger atherosclerosis in HD patients and could increase the risk of cardiovascular morbidity and mortality.[18]

Insufficient dietary intake of energy of HD patients negatively affects their usage of protein. In this study, it was found that 31.3% of the dietary energy was obtained from fats, and that the blood cholesterol levels of the HD patients were 160.8 mg/day, which was in the optimum range.

The use of biomarkers such as serum albumin and serum creatinine altogether in the evaluation of nutritional status is thought to be beneficial in the increase of life standard. It has been generally observed that iron, calcium, zinc, thiamin, riboflavin, and folate levels are either borderline or low in HD patients who are nourished on low-protein diets. In this study, the dietary intake of these nutritional elements has been found to be below the recommended amounts. In this situation, extra additions are recommended, especially water-soluble vitamins (group B vitamins, folic acid, and vitamin C). In the treatment of HD patients, the evaluation of nutritional status and the attention to the dietary treatment positively affects the course of the illness.

While a significant negative correlation was found between blood urea level and dietary fat, a significant positive correlation was found between blood urea level and vitamin B_1, vitamin B_6, folate, potassium, iron, and magnesium; between uric acid and vitamin D; between blood creatinine level and dietary vitamin B_1, vitamin B_6, folate, vitamin C, potassium, iron, and magnesium; between blood potassium level and dietary vitamin C only, and between blood cholesterol level and dietary vitamin D only ($p < 0.01$). No significant correlation was found between the other blood parameters and other nutrients.

As a result, the aim to be achieved in the nutrition of dialysis patients is to provide the necessary intake of dietary protein, but to limit the intake of phosphorus without changing nutritional habits and lifestyle.

The present study carries a number of limitations, such as the fact that data from only small groups of patients were collected. It could be worthwhile to gather information on food preference habits and food consumed by HD patients. This study should be replicated using a greater number and variety foods to accurately assess food preferences and biochemical parameters relationship. Also, consumption frequencies, serving size, and biochemical parameters should be included. Longitudinal data are needed to understand the long-term results.

REFERENCES

1. Laville M, Fouque D. Nutritional aspects in HD. *Kidney Int*. 2000;76(Suppl.):133–139.
2. Koople JD. Pathophysiology of protein-energy wasting in chronic renal failure. *J Nutr*. 1999;129:247S–251S.
3. Harter HR, Lairal NM, Teehan BT. Effects of dialysis prescription on bone and mineral metabolism: the National Cooperative Dialysis Study. *Kidney Int*. 1983;23:73–79.
4. Gambro Healthcare. Available at: http://www.gambrohealthcare.com/gambro/nutrition_hemo. cfm. Accessed February 15, 2005.
5. Baysal, A. *Sinir sistemi hastalıklarında beslenme. Diyet El Kitabı*. Ankara, Turkey: Hatipoğlu Kitabevi, Baskı, 1999.
6. Gibson, RS. *Principle of Nutritional Assessment.* New York: Oxford University Press, 1990.
7. WHO Obesity. *Prevention and Managing the Global Epidemic*. WHO Technical Report Series: 894. Geneva: World Health Organization; 2000.
8. Heimburger O, Qureshi AR, Blaner WS, Berglund L, Stenvinkel P. Hand-grip muscle strength, lean body mass, and plasma proteins as markers of nutritional status in patients with chronic renal failure close to start of dialysis therapy. *Am J Kidney Dis*. 2000;36(6):1213–1225.
9. Jones CH, Newstead CG, Will EJ, Smye SW, Davison AM. Assessment of nutritional status in CAPD patients: serum albumin is not a useful measure. *Nephrol Dial Transplant*. 1997;12(7):1406–1413.
10. Kaysen GA. Biological basis of hypoalbuminemia in ESRD. *J Am Soc Nephrol*. 1998;9(12):2368–2376.
11. Wiesholzer M, Harm F, Schuster K, et al. Initial body mass indexes have contrary effects on change in body weight and mortality of patients on maintenance hemodialysis teratment. *J Renal Nutr*. 2003;13:174–185.
12. Han H, Bleyer AJ, Houser RF, et al. Dialysis and nutrition practices in Korean hemodialysis centers. *J Renal Nutr*. 2002;12:42–48.
13. Trindade CK, Silva MIB, Bregman R. Nutritional profile of patients with chronic renal failure. *J Renal Nutr*. 2004;14:97–100.
14. Teehan BP, Schleifer CR, Brown JM, et al. Urea kinetic analysis and clinical outcome on CAPD: A five year longitudinal study. *Adv Perit Dial*. 1990;6:181–185.
15. Kalender B, Erdoğan MS, Şengül E, et al. Hemodiyaliz hastalarında beslenme durumu ve diyaliz yeterliliği arasındaki ilişki. *Cerrahpaşa Tıp Dergisi*. 2002;33:223–230.

16. Blumankrontz MJ, Gahl G, Kapple JD, et al. Protein losses during peritoneal dialysis. *Kidney Int*. 1981;19:593–602.
17. Burrowes JD, Larive B, Cockram DB, et al. Effects of dietary intake, appetite, and eating habits on dialysis and non-dialysis teratment days in hemodialyis pateinets: Cross-sectional results from the HEMO study. *J Renal Nutr*. 2003;13:191–198.
18. Kalantar-Zadeh K, Kopple JD, Deepak S, et al. Food intake characteristics of HD patients as obtained by food frequency questionnaire. *J Renal Nutr*. 2002;12:17–31.