

ORIGINAL RESEARCH

CORRELATION OF NUTRITIONAL STATUS AND FOOD INTAKE IN HEMODIALYSIS PATIENTS

Alvaro A. C. Morais¹, Maria A. T. Silva¹, Joel Faintuch², Erica J. Vidigal¹, Rozilene A. Costa¹, Daniele C. Lyrio¹, Celia R. Trindade¹, and Karoline K. Pitanga¹

Morais AAC, Silva MAT, Faintuch J, Vidigal EJ, Costa RA, Lyrio DC, et al. Correlation of nutritional status and food intake in hemodialysis patients. Clinics. 2005;60(3):185-92.

BACKGROUND: Patients in end-stage renal disease often suffer from poor appetite, various comorbidities, and dietary restrictions. Despite regular hemodialysis, nutritional imbalances are frequently reported. Aiming to correlate nutritional status with food ingestion, a prospective study was done in an outpatient group.

METHODS: Stable patients undergoing chronic hemodialysis for at least 3 months ($n = 44$) were investigated by dietary recall and standard anthropometric, biochemical, and bioimpedance determinations, including subjective and objective global assessment. The mean age of the group was 47.0 ± 16.9 years, and 63.6% were men. Body mass index was 22.2 ± 3.9 kg/m² (mean \pm SD), calorie intake was 1471 ± 601 kcal/day (20.7 ± 6.7 kcal/kg/day), and protein ingestion was 74.3 ± 16.6 g protein/day (1.2 g/kg/day). Dietary and clinical findings were correlated with nutritional indices by linear regression analysis.

RESULTS: Malnutrition estimated by subjective global assessment was very common (>90%), despite the fact that body mass index and serum albumin were within an acceptable range in the majority of the population. Objective global assessment yielded roughly comparable numerical findings, with 6.8% being well nourished, 61.4% at nutritional risk or lightly undernourished, 29.6% moderately malnourished, and 2.3% severely malnourished. Total calorie intake was devoid of associations, but protein, carbohydrate, and lipid input positively correlated with triceps skinfold ($P=.02$). Lipid ingestion was the only marker directly associated with arm circumference, and it correlated with body mass index, as well as with total body fat (bioimpedance analysis) ($P < .001$).

CONCLUSIONS: 1) Bioimpedance analysis was useful and was correlated with clinical findings; 2) Lipid intake was the best dietary index in this experience, surpassing protein or total energy; 3) Despite its shortcomings, dietary recall was useful in the assessment of hemodialysis patients.

KEYWORDS: Hemodialysis. Renal insufficiency. Uremia. Nutritional assessment. Subjective global assessment. Bioimpedance analysis.

Patients in end-stage renal disease often suffer from poor appetite, various comorbidities, and dietary restrictions. Despite regular hemodialysis (HD), nutritional imbalances are frequently reported.¹⁻⁴ Inflammation and infection, metabolic acidosis, and oxidative stress may cause further com-

plications,^{5,6} resulting in a poor quality of life and in increased morbidity and mortality.^{4,7}

Actual prevalence of protein-calorie malnutrition in chronic hemodialysis patients is disputed, partly because of poor agreement between different assessment tools.^{3,8,9} Especially discussed is the validity of standard whole-body bioimpedance analysis (BIA) and even more recent modalities, such as BIA spectroscopy and segmental analysis, in the investigation of body composition changes in such population.^{10,11}

Aiming to analyze possible correlations between food intake and nutritional status, including as determined by BIA, a prospective study was performed in an HD unit.

Nutrition Support Service and Hemodialysis Unit¹, Santa Rita de Cassia Hospital and Faculty of Medical Sciences of Santa Casa – Vitória/ES, Brazil.

Hospital das Clínicas², Faculty of Medicine, University of São Paulo – São Paulo/SP, Brazil.

E-mail: jfaintuch@hcnet.usp.br

Received for publication on June 03, 2004.

Accepted for publication on February 14, 2005.

METHODS

Stable outpatient uremic adults undergoing chronic HD were recruited for this study. Criteria for inclusion were ages 18 to 85 years; men and women; HD for at least 3 months, 3 times/week; ambulatory and receiving an oral diet; residual renal clearance <1.5 mL/min; no blood transfusion or iron therapy in the previous 30 days; the study was approved by the Institutional Ethics Committee and informed consent was obtained from every patient. Exclusion criteria were severe sepsis, shock, multiple organ failure, coma, clinical or surgical hospitalization in the last 30 days, ongoing enteral or parenteral nutrition, cardiac pacemaker, advanced senility or dementia interfering with application of the nutritional questionnaire, refusal to cooperate with the study. Forty-four consecutive patients fulfilled the above conditions and were enrolled in the protocol. There were no exclusions.

General and demographic information collected included age, gender, diagnosis, comorbidities, renal function, and clinical and dialysis history. Nutritional variables were weight, height, BMI, mid-arm circumference (AC), triceps skinfold (TSF), modified subjective global assessment (SGA), and objective global assessment (OGA).

Biochemical determinations included albumin (ALB), transferrin (TRANS), ferritin (FERR), total cholesterol, HDL cholesterol, and LDL cholesterol (CHOL, HDL, LDL), triglycerides (TRIG), and C-reactive protein (CRP). A total lymphocyte count (LYMPH) was also performed.

The SGA questionnaire is divided into 2 parts. In the first part (history), information is gathered about recent weight loss, food intake, gastrointestinal symptoms, functional status, and influence of disease on nutritional needs; the second part is a brief physical examination.^{8,9}

For OGA, 3 recommended parameters were analyzed (serum albumin, transferrin, and total lymphocyte count), and results were classified into 4 levels: normal, slight depletion, moderate reduction, and severe decrease.⁸

Bioimpedance analysis (BIA) included variables of body composition including resistance, reactance, phase angle, body fat, lean body mass, total water, extracellular and intracellular water, and body cell mass.

For vascular access, a vascular surgeon constructed a fistula between the radial artery and cephalic vein, with a minimum flux of 300 mL/min; it was used after a 4 to 5 week maturation interval.

Dialysis treatment consisted of 3 weekly sessions using bicarbonate buffer dialyzers that were reprocessed using the proxitane technique (Fresenius, São Paulo, Brazil), and biochemical and microbiological control of the water followed the recommendations of the Brazilian Ministry of Health.⁹

Dialysis duration was 3 to 5 hours depending on the individual prescription. Dialysis dose delivery was estimated from the urea Kt/V^{10} . Blood flow was 300 mL/min., and dialysate flow was 500 mL/min. Standard dialysis machines (Gambro- Brazil, model AK95) were used. Polyacrylonitrile membranes (1.6 m²) were available (Fresenius, São Paulo, Brazil). The dialysate composition was 139 mEq/L sodium, 2 mEq/L potassium, 2.5 mEq/L calcium, 200 mg/dL glucose, and 39 mEq/L bicarbonate (Fresenius). The efficacy of dialysis was confirmed by standard pre- and post-dialytic biochemical tests.

Blood was collected after an overnight fast before HD and promptly sent to the laboratory. Anthropometry and BIA were documented after the procedure. Conventional (single-current) whole-body BIA was assessed by the BIA-Quantum apparatus using the classic tetrapolar technique and fluids software (RJL Systems, Clinton Twp, MI, USA).¹¹

Regarding statistical analysis, values were presented as mean \pm SD. Continuous measurements with normal distribution according to Kolmogorov-Smirnov test were compared using the Student *t* test (features of infected versus noninfected patients). Pearson's linear regression analysis was utilized for comparison of CRP, body composition, and nutritional indices after confirmation of normal distribution by the Kolmogorov-Smirnov test. In all circumstances a significance of 5% ($P < .05$) was adopted.

RESULTS

Preliminary findings: The mean age of participants was 47.0 ± 16.9 years (range, 18-82), with 63.6% being men (28/44). Hemodialysis was maintained for 34.1 ± 39.4 months (range, 3-172). The main etiology of renal failure was systemic arterial hypertension (77.2%, 34/44), followed by diabetes mellitus (15.9%, 7/44), and miscellaneous diseases. Comorbidities were identified in 45.5% (20/44), with a mean frequency of 1.8 ± 0.8 /patient in the affected group (0-3), or 0.7 ± 1.0 /patient for the entire population. The main comorbidity types encountered were arterial hypertension (95.0%, 19/20), coronary artery disease (25.0%, 5/20), and congestive heart failure (15.0%, 3/20). Minor acute infections were recognized in 9 subjects (20.5%), mostly were related to the arteriovenous fistula (15.9% of the patients, 7/44).

BMI was 22.2 ± 3.9 kg/m² (range, 14.9-29.6). Usual body weight was 60.9 ± 13.4 kg, current weight was 57.0 ± 17.3 kg, and height was 1.65 ± 0.10 m. Triceps skinfold was 14.0 ± 5.3 mm and mid-arm circumference was 25.0 ± 4.0 cm.

The SGA was 14.0 ± 4.6 points (range, 8-33). Two patients (4.6%) were classified as being well nourished according to these criteria, 40 (90.9%) as being at nutritional risk or moderately malnourished, and the remaining 2

(4.6%) as severely malnourished. OGA produced roughly comparable numerical findings, with 6.8% classified (3/44) as well nourished, 61.4% (27/44) at nutritional risk or lightly malnourished, 29.6% (13/44) as moderately malnourished, and 2.3% (1/44) as severely malnourished.

The BIA revealed no obviously deranged measurement. Total body fat was relatively low (21.2% of body weight), consistent with the equally modest BMI, but total body water was within the normal range (56.8% of body weight). (Table 1).

Table 1 - Bioimpedance analysis.

Variable	Results
Resistance (ohm)	582.6 ± 104.7
Reactance (ohm)	60.6 ± 22.3
Phase angle (degree)	6.0 ± 2.4
Total body fat (kg)	13.0 ± 7.4
Lean body mass (LBM) (kg)	48.4 ± 11.8
Body cell mass (kg)	21.7 ± 5.3
Total body water (TBW) (L)	34.6 ± 7.0
Intracellular water (L)	19.8 ± 4.8
Extracellular water (ECW) (L)	14.6 ± 4.9

The levels of serum albumin, transferrin, ferritin, total lymphocyte count, total cholesterol, HDL, LDL, triglycerides, and CRP are listed in Table 2.

Table 2 - General biochemical determinations.

Variable	Mean (Range)
ALB g/dL	3.6 ± 0.77 (1.3-5.0)
TRANS mg/dL	47.0 ± 37.0 (17.0-231.0)
FERR ug/L	770 ± 874 (5-5280)
LYMPH/mm3	1471 ± 550 (393-3374)
CHOL mg/dL	173.2 ± 51.1 (101-338)
TRIG mg/dL	178.3 ± 108.4 (64-487)
LDL mg/dL	108.5 ± 35.6 (21-201)
HDL mg/dL	34.7 ± 12.0 (16-48)
CRP mg/L	2.5 ± 5.2 (0.1-27.5)

ALB Serum albumin; TRANS Serum transferrin; FERR Serum ferritin; LYMPH Total lymphocyte count; CHOL Total cholesterol; TRIG Triglyceride concentration; LDL Low-density lipoprotein; HDL High density lipoprotein; CRP C-reactive protein.

Dietary intake

Total energy ingestion was low (1471.7 ± 601.4 kcal/day or 20.7 ± 6.7 kcal/kg/day), but protein in the diet was quite acceptable (74.3 ± 16.6 g protein/day or 1.2 ± 0.6 g/kg/day) (Table 3).

Linear regression analysis

Correlations between feeding patterns and biochemical features concerning nutritional assessment, comorbidity, and other parameters were investigated (Tables 4-7).

Table 3 - Intake of main nutrients.

Total energy (kcal/day)	1471.7 ± 601.4
Carbohydrates (g/day)	208.3 ± 126.5
Carbohydrates (kcal/day)	833.2 ± 506.0
Carbohydrates (% daily kcal)	56.6 ± 34.4%
Lipids (g/day)	37.9 ± 25.3
Lipids (kcal/day)	341.1 ± 227.7
Lipids (% daily kcal)	23.2 ± 15.5%
Protein (g/day)	74.3 ± 16.6
Protein (kcal/day)	297.2 ± 66.4
Protein (% daily kcal)	20.2% ± 4.5%

As shown, SGA was positively correlated with age and comorbidity (p= 0.02), and negatively correlated with BMI, AC, TSF, LYMPH (p= 0.02 for each one), and ALB (p<0.005). The OGA numbers were in line with those for BMI (p<0.001), LYMPH (p<0.005), ALB, TRANSF (p<0.001 for each of those), CHOL, and TRIG (p= 0.01 for

Table 4 - Regression analysis of the modified subjective global assessment (SGA).

Variable	Pearson index (r)	Significance
Age	0.309	P = 0.20
BMI	-0.335	P = 0.2<.05
TSF	-0.311	P = 0.2<.05
AC	-0.329	P = 0.2<.05
LYMPH	-0.371	P = 0.2<.05
ALB	-0.450	P <.005
COMORB	0.333	P = 0.2<.05

BMI Body mass index; TSF Triceps skinfold; AC Mid-arm circumference; LYMPH Total lymphocyte count; ALB Serum albumin; COMORB Comorbidities.

Table 5 - Regression analysis of objective global assessment (OGA).

Variable	Pearson index (r)	Statistical probability
BMI	0.549	P <.001
LYMPH	0.490	P <.005
ALB	0.556	P <.001
TRANS	0.549	P <.001
CHOL	0.420	P = 0.1<.01
TRIG	0.427	P = 0.1<.01

BMI Body mass index; LYMPH Total lymphocyte count; ALB Serum albumin; TRANSF Serum transferrin; CHOL Total cholesterol.

Table 6 - Correlations of C-Reactive Protein.

Variable	Pearson index (r)	Statistical probability
COMORB	0.367	P = 0.2<.0
TRANS	-0.398	P = 0.1<.01
ALB	-0.565	P <.001
SGA	0.545	P <.001

COMORB Comorbidities; TRANS Serum transferrin; ALB Serum albumin; SGA Subjective global assessment.

each). However, C-reactive protein was positively correlated with comorbidities ($p = 0.02$) and SGA ($p = 0.01$), but it negatively with ALB and TRANS ($p < 0.001$ for each one). Comorbidities followed changes in CRP and SGA ($p = 0.02$), but exhibited links with bioimpedance parameters.

Interestingly, time on hemodialysis directly correlated to FERR and indirectly with CHOL, but not to other indices of nutritional status or body composition.

Dietary recall failed to demonstrate any correlation with total daily energy. Protein and carbohydrate associations were disappointing, with positive results for TSF only. On the other hand, lipid ingestion (Table 7) significantly signaled not only measurements linked to body lipids (total fat, TSF), but also to those more dependent on protein input (AC, BMI).

Table 7 - Correlations of macronutrient ingestion (Pearson index (r) and statistical probability).

Variable	Lipids	Carbohydrates	Proteins
BMI	0.280 ($P = 0.3 < .0$)		
AC	0.306 ($P = 0.2 < .0$)		
TSF	0.474 ($P < .005$)	0.312 ($P = 0.2 < .05$)	0.337 ($P = 0.2 < .01$)
Body fat	0.545 ($P < .001$)		

BMI Body mass index; AC Mid-arm circumference; TSF Triceps skinfold.

Infected patients were no different from noninfected patients regarding BMI (20.9 ± 3.0 vs 22.5 ± 4.0 kg/m², NS), SGA (14.1 ± 6.2 vs 13.1 ± 4.0 , NS), or time on dialysis (12.5 ± 16.2 vs 34.0 ± 39.4 months, NS). Energy consumption (1263.5 ± 667.6 vs 1514.1 ± 644.3 kcal/day) and protein intake (63.0 ± 30.8 vs 78.2 ± 17.6 g/day) were somewhat lower for the infected population, but these changes were not statistically significant.

DISCUSSION

Renal replacement therapy including hemodialysis, peritoneal dialysis, and renal transplantation are accepted and successful modalities for supporting patients with end-stage renal disease. They have changed its outlook over the last decades, offering new hope and additional years of life for affected patients.^{3,4} However, factors such as age, comorbidity with emphasis on cardiovascular diseases, and malnutrition still cause serious complications and mortality in this population.^{4,7,12}

For many years, undernutrition was predominantly viewed in the light of insufficient intake because of poor appetite, dietary restrictions, and dialytic losses of amino acids and proteins. These aspects have not lost their rel-

evance, and careful adjustment of calories and nitrogen are still a mainstay of therapy in this context.^{8,13} Hemodialysis dose and frequency must be regarded as nutritional variables, and prescribed accordingly.^{3,14}

Nevertheless, deterioration of body composition and biochemical markers cannot be extricated from a larger and more complex context, encompassing malnutrition, inflammation, and cardiovascular disease.^{5,7,15,16} Inflammatory markers tend to display a high degree of prognostic significance in this population and have been carefully documented in recent years.^{5,7,15-17}

In the present cross-sectional study, various objective and subjective nutritional tools were applied to the population, aiming to highlight the multifactorial influences that end-stage renal disease and hemodialysis per se impart on the patients. As mentioned, CRP was markedly elevated in some of the subjects.

Many of the registered parameters, as well as a large share of the demonstrated associations, pertained to bioimpedance analysis. This approach has been criticized for its lack of precision in extreme situations, namely in severe malnutrition, advanced obesity, or frequent fluid shifts, because devices fitted with standard equations may fail in nonstandard settings. In this series, massive adiposity was uncommon, but malnutrition was not. At the same time, hemodialysis itself removes fluid and periodically modifies body compartments.^{1,2}

All these limitations notwithstanding, bioimpedance seemed useful and reliable for the nutritional screening of this population, in agreement with other protocols.^{10,18} Major aberrations were absent, as dietary guidance and dialytic assistance were generally adequate in this series.

Average energy intake was actually low,^{3,8,13,14} and the consequence can be seen in the acceptable but low figures for BMI (anthropometry) and total body fat (Table 1). On the other hand, no third space water or exaggerated extracellular compartment was identified, consistent with good balancing of dietary fluid intake and dialysis prescription.

According to Panzetta et al.,¹⁹ 35 kcal/kg/day and 1.0 to 1.2 g/kg/day are ideal for hemodialysis populations. Carbohydrates should represent 45% to 50% and lipids 35% to 40% of the total energy input. In the current circumstances, calorie ingestion fell behind the recommendations, while the protein level was adequate, or even high, if relative instead of absolute intake is considered. When the contribution of nutrient sources is examined, carbohydrates were excessive and lipids contributed less than the 35% of total calories (Table 3).

This imbalance should be corrected in the future, not only because insufficient energy is a factor for undernutrition, but also because intake of too much carbohydrate has

been associated with undesirable fat accumulation during peritoneal dialysis.²⁰ Total body fat was within the normal range in this experience (Table 1), but it should be noted that this was a malnourished population; therefore, lower values should be expected.²⁰

Other Brazilian studies confirm a larger deficit of calories than of protein in the diet of hemodialysis subjects. In the experience of Valenzuela et al.,²¹ protein input was an acceptable 1.3 ± 0.4 g/kg/day, very close to current findings, whereas energy gain was higher than in our study but definitely inadequate (29.5 ± 10.2 kcal/kg/day). For non-dialysed chronic renal-disease patients,²² calorie ingestion was even lower and almost identical to the present series (22.4 ± 7.2 kcal/kg/d), whereas diet protein content was less affected. The authors support the contention that selective underreporting of energy intake occurred with many patients.

Many of the respected international cooperative protocols of hemodialysis populations, are compatible with our findings, even discarding any underestimation hypothesis. The HEMO team reports not more than 22.7 ± 8.2 kcal/kg/day and 0.9 ± 0.4 grams of protein/kg/day in their most recent communication²³ and a quite similar 23.0 ± 8.4 kcal/kg/day and 0.9 grams of protein/kg/day in their previous computation.²⁴

It is true that patients in our study had comparatively diminished body weights, with a low-normal BMI of 22.2 ± 3.9 kg/m². This explains why not only relative (per kg body weight) daily calories but especially absolute (total) daily calories seem particularly low, in contrast to other investigations concerning better nourished populations.

Poor appetite and hypermetabolism are unquestionably deleterious for food intake in the context of chronic hemodialysis, especially in public hospitals and Social Security services.^{1,4-7} The fact that calorie intake may be more compromised than protein alimentation has received less attention.²² In any case, such imbalances should be dealt with by a multidisciplinary team, as recommended for other high-risk populations.²⁵

The SGA revealed only 36% of patients with normal findings, with 51% displaying mild malnutrition, and 13% in advanced nutritional deficit. Older patients and those with more comorbidities were the most affected, but reduced body weight, hypoalbuminemia, and increased CRP were also suggestive of the deleterious impact of chronic renal impairment.

The OGA is not often employed with HD subjects, but in the present series, it confirmed what anthropometry and biochemical work-up had already anticipated, namely an elevated proportion of undernourished patients. The expected correlation between this measurement and individual objective tests is shown in Table 5.

All these observations fit in the general picture of a reported multicenter clinical trial²⁶ involving 1,000 patients, in which all anthropometrics were reduced in chronic HD cases, with the exception of diabetic patients, who were overweight. Duration of HD and comorbidities were demonstrated to have an impact on these results.

Whereas hypoalbuminemia is accepted as one of the indices of depressed nutritional status in these circumstances,^{27,28} some have disputed the existence of hypoalbuminemia outside the context of infection and inflammation.²⁹ Indeed, with rare exceptions, serum albumin is reported as not correlated to anthropometric indices, but is a strong and independent predictor of mortality in HD groups.²⁷⁻²⁹

The combined analysis of serum albumin and transferrin, along with total lymphocyte count, revealed that not more than between 20% and 40% of the values corresponded to expectations. When serum lipids were examined, the panorama became less straightforward, because about one quarter of the current population was overweight, and in addition hyperlipidemia is not unusual in end-stage renal disease. Still, almost half of the population had low levels of total cholesterol and triglycerides (Table 2).

The SGA correlated with age and comorbidities, which is intuitive and corresponds to other studies.^{1,21} Less understandable was the negative correlation to BMI, serum albumin, and lymphocyte count, given the fact that these are classical tools for nutritional screening. Although, a lack of association has been found in some contexts, and subjective assessment maintains a substantial degree of independence from objective measurements,¹⁰ a negative correlation is less common and should be further investigated.³⁰

Although not specifically mentioned, serum albumin exhibited a low Pearson index regarding BMI, other nutritional markers, and demographic and clinical variables except those shown in Tables 4 and 5, reinforcing the suspicion that serum albumin is not as reliable a nutritional marker during HD as it is in other circumstances.^{9,17,29}

It was noticed that HD of long duration had a positive impact on ferritin concentrations and a negative one on total cholesterol. As a marker of iron status, ferritin is influenced by anti-anemic prescriptions, but augmented findings correlate with CRP as well.³¹ However, no correlation with duration of HD could be found in other series. Also with regard to cholesterol, a negative association between CRP and HDL has been reported,³² but total cholesterol is deemed to be diminished only within the context of a non-specific malnutrition-inflammation complex syndrome.¹⁶

Table 6 emphasizes that both ALB and TRANS were negatively correlated with CRP, reaffirming their property as "negative" acute phase proteins in this context, more than as indicators of nutritional status.^{9,17,29}

The same table implies that a higher comorbidity index and the SGA result are linked to elevated CRP values. The profile of more comorbidity fits the pattern of more severely ill subjects with a higher risk of mortality, while CRP has been noted as a non-specific marker of clinical morbidity.²⁷ The opposite should be expected for SGA, and current findings differ from those reported by others.^{26,27} It should be noted that in spite of its widespread use, SGA is observer-dependent and tends to be only poorly correlated with the objective assessment of patients.¹⁸

There is no obvious explanation for the poor correlations of total energy, protein, and carbohydrates with anthropometric and bioimpedance variables in our study (Table 7). To the best of our knowledge, such correlations have not been attempted in other studies; consequently, it is not possible to indicate whether or not this trend will be confirmed in the future. The same applies to lipid intake, which in this study was the best dietary parameter, correlating with body mass index, total body fat, and other determinations.^{13,33}

RESUMO

Morais AAC, Silva MAT, Faintuch J, Vidigal EJ, Costa RA, Lyrio DC, et al. Correlação entre estado nutricional e ingestão alimentar em pacientes de hemodiálise. Clinics. 2005;60(3):185-92.

OBJETIVOS: Pacientes em fase final de enfermidade renal frequentemente sofrem de falta de apetite, várias comorbidades e restrições dietéticas, e a despeito de hemodiálise regular, desequilíbrios nutricionais são frequentemente relatados. Com o propósito de correlacionar estado nutricional com ingestão alimentar, um estudo prospectivo foi realizado com pacientes ambulatoriais.

MÉTODOS: Doentes estáveis submetidos a hemodiálise crônica por no mínimo 3 meses (n= 44) foram investigados mediante recordatório alimentar e determinações convencionais antropométricas, bioquímicas e de bioimpedância, incluindo-se avaliação global subjetiva e também objetiva. A idade do grupo era de 47.0 ± 16.9 anos com 63.6% de homens. O índice de massa corporal situava-se em 22.2 ± 3.9 kg/m², a

ingestão calórica foi de 1471 ± 601 kcal/dia (20.7 ± 6.7 kcal/kg/dia) e o consumo proteico atingiu 74.3 ± 16.6 g proteína/dia (1.2 g/kg/dia). As variáveis dietéticas e clínicas foram correlacionadas com os índices nutricionais através da análise de regressão linear.

RESULTADOS: A desnutrição estimada pela avaliação global subjetiva foi muito comum (>90%), apesar de que o índice de massa corporal e a taxa de albumina estavam aceitáveis na maioria da população. A avaliação objetiva global evidenciou resultados numericamente parecidos, com 6,8% bem nutridos, 61,4% com risco nutricional ou desnutrição leve, 29,6% no patamar moderado e 2,3% exibindo desnutrição grave. O ganho calórico total não apresentou associações, todavia ingressos de proteína, carboidratos e lipídeos se correlacionaram positivamente com a prega cutânea do tríceps (P=0.02). Apenas a ingestão lipídica associou-se diretamente com a circunferência do braço, demonstrando ainda correlação com o índice de massa corporal bem como com a gordura corpórea total (bioimpedância) (P<0.001).

CONCLUSÕES: 1) Os teores de proteínas, lípidos e carboidratos na dieta exibiram um certo número de correlações com variáveis antropométricas e de bioimpedância; 2) A ingestão lipídica foi o melhor índice nesta experiência, ultrapassando a proteína ou o ganho energético total; 3) Em que pesem algumas limitações, o recordatório ali-

mentar foi útil na avaliação destes pacientes de hemodiálise;

UNITERMOS: Hemodiálise. Insuficiência renal. Uremia. Avaliação nutricional. Avaliação subjetiva global. Bioimpedância.

REFERENCES

- Morais AAC, Costa RA, Grilo MG, Faintuch J. Measurement of body changes during hemodialysis by bioimpedance analysis. *Rev Hosp Clin Fac Med S Paulo*. 1996;51:121-4.
- Morais AAC, Comarella AP, Pitanga KC, Faintuch J. Interest of conventional clinical, biochemical and bioimpedance measurements as indicators of mortality risk critical patients. *Rev Hosp Clin Fac Med S Paulo*. 1998;53:176-80.
- Sanaka T. Nutritional effect of dialysis therapy. *Artif Organs*. 2003;27:224-6.
- Laws RA, Tapsell LC, Kelly J. Nutritional status and its relationship to quality of life in a sample of chronic hemodialysis patients. *J Ren Nutr*. 2000;10:139-47.
- Danielski M, Ikizler TA, McMonagle E, Kane JC, Pupim L, Morrow J, et al. Linkage of hypoalbuminemia, inflammation, and oxidative stress in patients receiving maintenance hemodialysis therapy. *Am J Kidney Dis*. 2003;42:286-94.
- Lin SH, Lin YF, Chin HM, Wu CC. Must metabolic acidosis be associated with malnutrition in haemodialysed patients? *Nephrol Dial Transplant*. 2002;17:2006-10.
- Pifer TB, McCullough KP, Port FK, Goodkin DA, Maroni BJ, Held PJ, et al. Mortality risk in hemodialysis patients and changes in nutritional indicators: DOPPS. *Kidney Int*. 2002;62:2238-45.
- O'Keefe A, Daigle NW. A new approach to classifying malnutrition in the hemodialysis patient. *J Ren Nutr*. 2002;12:248-55.
- Brasil. Leis Decretos, etc. Portaria MS/GM 82 348 03/01/2000. Regulamento técnico para o funcionamento dos serviços de diálise e as normas para cadastramento destes junto ao Sistema Único de Saúde. *Diário Oficial da União, Brasília (DF)*, 8 fev. 2000. Seção 1, p. 13.
- Huidobro A, Velasco N, Rojas T. Prevalencia de desnutricion calorico-proteica en pacientes en hemodialisis cronica. *Rev Med Chil*. 2001;129:495-502.
- Dittmar M. Comparison of bipolar and tetrapolar impedance techniques for assessing fat mass. *Am J Hum Biol*. 2004;16:593-7.
- Prichard SS. Comorbidities and their impact on outcome in patients with end-stage renal disease. *Kidney Int*. 2000;57(suppl 74):S100-S104.
- Vendrey B, Chauveau P, Barthe N, El Haggan W, Castaing F, de Precigout V, et al. Nutrition in hemodialysis patients previously on a supplemented very low protein diet. *Kidney Int*. 2003;63:1491-8.
- Nakao T, Matsumoto H, Okada T, Kanazawa Y, Yoshino M, Nagaoka Y, et al. Nutritional management of dialysis patients: balancing among nutrient intake, dialysis dose, and nutritional status. *Am J Kidney Dis*. 2003;41(3 Suppl 1):S133-6.
- Sezer S, Ozdemir FN, Arat Z, Turan M, Haberal M. Triad of malnutrition, inflammation, and atherosclerosis in hemodialysis patients. *Nephron*. 2002;91:456-62.
- Kalantar-Zadeh K, Stenvinkel P, Pillon L, Kopple JD. Inflammation and nutrition in renal insufficiency. *Adv Ren Replace Ther*. 2003;10:155-69.
- Memoli B, Guida B, Saravo MT, Nastasi A, Trio R, Liberti R, et al. Predictive and diagnostic factors of malnutrition in hemodialysis patients. *G Ital Nefrol*. 2002;19:456-66.
- Pupim LCB, Ribeiro CB, Kent P, Ikizler TA. Atualização em diálise: Uso da impedância bioelétrica em pacientes em diálise. *J Bras Nefrol*. 2000;22:249-56.
- Panzetta G, Maschio G. Dietary problems of the dialysis patient. *Blood*. 1985;3:63-74.
- Soreide R, Dracup B, Svarstad E, Iversen BM. Increased total body fat during PD treatment. *Adv Perit Dial*. 1992;8:173-6.
- Valenzuela RGV, Giffoni AG, Cuppari L, Canziani MEF. Estado nutricional pacientes com insuficiência renal crônica em hemodiálise no Amazonas. *Rev Med Bras*. 2003;49:72-8.
- Avesani CM, Kamimura MA, Draibe SA, Cuppari L. Is energy intake underestimated in nondialyzed chronic kidney disease patients? *J Ren Nutr*. 2005 Jan;15(1):159-65.

23. Rocco MV, Dwyer JT, Larive B, Greene T, Cockram DB, Chumlea WC, et al. The effect of dialysis dose and membrane flux on nutritional parameters in hemodialysis patients. Results of the HEMO study. *Kidney Int.* 2004;65:2321-24.
24. Dwyer JT, Larive B, Leung J, Rocco M, Burrowes JD, Chumlea WC, et al. Nutritional status affects quality of life in hemodialysis (HEMO) study patients at baseline. *J Ren Nutr.* 2002;12:213-23.
25. King K. Multidisciplinary contributions to rehabilitation: a National Foundation survey of the dialysis health care team. *Adv Ren Replace Ther.* 2003;10:78-83.
26. Chumlea WC, Dwyer J, Bergen C, Burkart J, Paranandi L, Frydrych A, et al. Nutritional status assessed from anthropometric measures in the HEMO study. *J Ren Nutr.* 2003;13:31-8.
27. Qureshi AR, Alvestrand A, Danielsson A, Divino-Filho JC, Gutierrez A, Lindholm B, et al. Factors predicting malnutrition in hemodialysis patients: a cross-sectional study. *Kidney Int.* 1998;53:773-82.
28. Santos NS, Draibe SA, Kamimura MA, Canziani ME, Cendoroglo M, Junior AG, et al. Is serum albumin a marker of nutritional status in hemodialysis patients without evidence of inflammation? *Artif Organs.* 2003;27:681-6.
29. Fernandez-Reyes MJ, Alvarez-Ude F, Sanchez R, Mon C, Iglesias P, Vazquez A. Estado nutricional, comorbilidad y inflamacion en hemodialisis. *Nefrologia.* 2000;20:540-9.
30. Don BR, Kaysen GA. Assessment of inflammation and nutrition in patients with end stage renal disease. *J Nephrol.* 2000;13:249-59.
31. Kalantar-Zadeh K, Rodriguez RA, Humphreys MH. Association between serum ferritin and measures of inflammation, nutrition and iron in haemodialysis patients. *Nephrol Dial Transplant.* 2004;19:141-9.
32. Zimmermann J, Herrlinger S, Pruy A, Metzger T, Wanner C. Inflammation enhances cardiovascular risk and mortality in hemodialysis patients. *Kidney Int.* 1999;55:648-58.
33. Kaysen GA. Serum albumin concentration in dialysis patients: Why does it remain resistant to therapy? *Kidney Int.* 2003;64 (Suppl 87):S92-S98.