NUTRIVISA

ORIGINAL ARTICLE

https://doi.org/10.52521/nutrivisa.v11i1.15615

Nutritional risk and its association with anthropometric, clinical and biochemical parameters in patients with chronic kidney disease on hemodialysis

Risco nutricional e sua associação com parâmetros antropométricos, clínicos e bioquímicos em pacientes com doença renal crônica em hemodiálise

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ABSTRACT

To investigate the association between higher nutritional risk and sociodemographic, anthropometric, clinical and biochemical parameters in hemodialysis patients. This is a cross-sectional study of adult and elderly patients with chronic kidney disease undergoing hemodialysis in Western Bahia. For the data collection, the modified subjective global assessment was used, anthropometric measurements were taken and clinical and biochemical data were obtained from the patients' medical records. Multiple linear regression analysis was used to assess the relationship between the highest score on the subjective global assessment and anthropometric, clinical and biochemical parameters. A total of 98 patients were assessed, 64.3% male and 59.2% aged between 35 and 59 years. The mean modified subjective global assessment score was 11,3±3,8. The prevalence of nutritional risk and malnutrition together was 73.3%. A positive association was found between higher nutritional risk and female sex (p=0.014), longer duration of hemodialysis treatment (p=0.010), higher serum potassium concentration (p=0.009) and higher pre-dialysis serum urea concentration (p=0.043). Higher nutritional risk is positively associated with female sex, longer hemodialysis treatment time, hyperpotassemia, and hyperphosphatemia in patients with chronic kidney disease.

Keywords: nutritional assessment; nutritional risk; chronic kidney disease; hemodialysis.

RESUMO

Investigar a associação entre o maior risco nutricional e parâmetros sociodemográficos, antropométricos, clínicos e bioquímicos em pacientes em hemodiálise. Trata-se de um estudo transversal, com pacientes adultos e idosos, com doença renal crônica, em hemodiálise, no Oeste da Bahia. Para a coleta de dados foi aplicada a avaliação subjetiva global modificada, aferida medidas antropométricas e obtidos dados clínicos e bioquímicos dos prontuários dos pacientes. A análise de regressão linear múltipla foi aplicada para avaliar a relação entre a maior pontuação na avaliação subjetiva global e os parâmetros antropométricos, clínicos e bioquímicos. Foram avaliados 98 pacientes, sendo 64,3% homens e 59,2% com idade entre 35 e 59 anos. A média na pontuação da avaliação subjetiva global modificada dos pacientes foi de 11,3±3,8. A prevalência de risco nutricional e desnutrição juntas foi de 73,3%. Foi encontrada associação positiva entre o maior risco nutricional e o sexo feminino (p=0,014), o maior tempo de tratamento de hemodiálise (p=0,010), a maior concentração sérica de potássio (p=0,009) e a maior concentração sérica de ureia pré-diálise (p=0,043). O maior risco nutricional está positivamente associado ao sexo feminino, ao maior tempo de tratamento de hemodiálise, a hiperpotassemia e a hiperfosfatemia em pacientes com doença renal crônica.

Palavras-chave: avaliação nutricional, risco nutricional; doença renal crônica; hemodiálise.

Cite this article as

GUIMARÃES DA SILVA, D. C.; SOUZA, L. M. N. de; MARIANO, D. M.; CORDEIRO, H. L. R.; FERREIRA, F. G. Nutritional risk and its association with anthropometric, clinical and biochemical parameters in patients with chronic kidney disease on hemodialysis. Nutrivisa Revista de Nutrição e Vigilância em Saúde, Fortaleza, v. 12, n. 1, p. e15615, 2025. DOI: 10.52521/nutrivisa.v12i1.15615. Disponível em: https://revistas.uece.br/index.php/nutrivisa/article/view/15615.

INTRODUCTION

Malnutrition is a multifactorial condition characterized by a deficiency of essential nutrients that can lead to changes in body composition, body function, and mental state (Cederholm *et al.*, 2017). It is also associated with adverse clinical outcomes, including increased morbidity, prolonged hospitalization, increased risk of readmission, decreased quality of life, refractory anemia, frailty, and sarcopenia (Peng *et al.*, 2021; Cederholm, Rothenberg, Barazzoni, 2022).

Malnutrition is highly prevalent in hemodialysis patients, according to a global meta-analysis of observational studies, with 65 studies from 10 geographical regions estimating a prevalence of malnutrition ranging from 28 to 54% (Carrero *et al.*, 2018). In China, a study of patients admitted to the Nephrology Department of Wannan Medical College showed an incidence of malnutrition of 85.7% among 426 patients with CKD (Xi *et al.*, 2023). In Brazil, a study carried out in the Federal District by Bousquet-Santos *et al.* (2019), with adults over 18 years of age on hemodialysis, a convenience sample, showed that 14.6% of the study participants were malnourished.

Several methods are used to identify patients at increased nutritional risk (Ferrel *et al.*, 2024). Among these methods, the Subjective Global Assessment (SGA) is widely used to analyze the nutritional status of patients with chronic kidney disease. This approach integrates aspects of the clinical history and physical examination to provide a complete assessment of the individual's nutritional status (Steiber *et al.*, 2004).

The Kidney Disease Outcomes Quality Initiative (KDOQI) recommends that a complete nutritional assessment be performed at dialysis initiation (first 90 days of treatment) when indicated by nutritional screening and clinical judgment (Ikizler *et al.*, 2021). Thus, early identification of individuals at nutritional risk is necessary to improve clinical outcomes in patients with CKD (Ferrel *et al.*, 2024), as malnutrition is associated with higher rates of hospitalization, susceptibility to infection, and all-cause mortality in this group (Iorember, 2018).

Therefore, the aim of this study was to investigate the association between higher nutritional risk and sociodemographic, anthropometric, clinical and biochemical parameters in hemodialysis patients.

MATERIALS AND METHODS

This is a cross-sectional study, a subproject of a larger study entitled "Sociodemographic, behavioral, clinical, anthropometric and dietary profile of hemodialysis patients in Western Bahia," conducted in a nephrology clinic in a municipality in Western Bahia. All patients, except pregnant women, aged 18 years or older, who underwent hemodialysis in a health unit in Bahia from June 2018 to August 2019 were invited to participate in the study. All participants signed an informed consent form. The research protocol was approved by the Human Research Ethics Committee of the Federal University of Western Bahia (CAAE: 83803418.3.0000.8060, 2.607.252).

The data collection consisted of a structured questionnaire, a modified subjective global assessment, anthropometric measurements, and clinical and biochemical data obtained from the patients' medical records. All stages of the data collection were carried out by previously trained interviewers to ensure the reliability of the data obtained.

Sociodemographic information was collected such as sex, marital status, age group, educational level, categorized as non-literate, primary school, high school, vocational school or higher education, and socioeconomic level according to the Brazilian Association of Research Companies (ABEP, 2016).

Nutritional risk was assessed using the Modified Subjective Global Assessment (SGAm), a form proposed in 1999 specifically for renal patients that consists of two parts: history and physical examination. Up to a score of 8 points, the patient was considered to have an adequate nutritional status; above this score, the patient was considered to be at nutritional risk (Koehnlein, Yamada, Giannasi, 2008).

Anthropometric measurements of neck circumference (NC) and waist circumference (WC) were performed after the hemodialysis session. NC was measured with the patient in a sitting position using an inelastic tape measure with an accuracy of 1 mm (Sanny®, São Paulo, SP, Brazil), positioned above the cricoid cartilage and perpendicular to the length of the neck (Ben-noun, Laor, 2006). In male patients with an Adam's apple, the measurement was taken below the laryngeal prominence. Waist circumference (WC) was

measured at the midpoint between the iliac crest and the last rib (ABESO, 2016).

Clinical and biochemical data such as phase angle, hemodialysis time (months), serum albumin (mg/dL), serum potassium (mg/dL), pre-dialysis serum urea (mg/dL), and serum creatinine (mg/dL) were obtained from the patients' medical records. Phase angle and body composition information were obtained using electrical bioimpedance (A-310, Biodynamics Corporation, USA). During the assessment, patients were asked to remove all metal objects from their bodies. The electrodes were then placed on the patients' feet and hands, which were positioned horizontally. Body composition analysis was performed after the hemodialysis session with a fasting period of around 4 hours.

Data analysis was performed using Stata 13.1 software. Normality of variables was assessed using the Shapiro-Wilk test. Variables that were not normally distributed were log-transformed for statistical analysis. The absolute and relative frequencies, means, standard deviations, and amplitudes of the variables were obtained. The association between the independent variables and the phase angle was tested using linear regression models. In the multiple model, variables with $p<0.20$ in the bivariate analysis were considered, and only those with $p<0.05$ remained in the model.

RESULTS AND DISCUSSION

The hemodialysis unit had 156 registered patients, 140 of whom were eligible for the study. After analysis of discharges, deaths and study variables, the final sample size was 98 patients. Of these, the majority were male, were married or with a partner, between 35 and 59 years of age, with only primary school education and belonging to the lower socioeconomic class, as shown in Table 1.

The mean SGAm score was 11,3±3,8. The prevalence of nutritional risk and malnutrition together was 73.3%. Table 2 shows the means, standard deviations and ranges of the anthropometric, clinical and biochemical data of the study participants.

Table 3 shows the determinants of higher nutritional risk identified by the patients' SGAm score, as assessed by multiple linear regression analysis. Positive associations were found between patients with higher SGAm scores and female sex ($p = 0.014$), duration of hemodialysis treatment ($p = 0.010$), serum potassium concentration ($p = 0.009$), and pre-dialysis serum urea concentration ($p = 0.043$).

In this study, we sought to verify the association between higher nutritional risk and sociodemographic, anthropometric, clinical and biochemical parameters in patients with CKD. As main results, we found a positive association between the highest score on the SGAm and female sex, longer hemodialysis treatment time, higher serum potassium concentration, and higher pre-dialysis serum urea concentration.

We found an overall prevalence of nutritional risk and malnutrition of 73.3%. Studies conducted in Taiwan in hemodialysis patients identified a general malnutrition rate of 45% using a subjective global assessment (Tsai *et al.*, 2021) in China, the prevalence of malnutrition reached 68% (Chen *et al.*, 2013). In Brazil, a study conducted in a hemodialysis (HD) unit in the state of Rio de Janeiro found that, according to the SGA, 80% of patients had some degree of malnutrition, with 73.3% having mild to moderate malnutrition and 6.7% having severe malnutrition. It is noteworthy that the SGA was the method that, by itself, was able to detect the largest number of patients with energy--protein malnutrition (Vegine *et al.*, 2011).

A cohort study conducted by Avesani *et al.* (2022) in two populations, Italy and Brazil, found a prevalence of malnutrition of 25.6% and 59.8%, respectively, among hemodialysis patients using the SGA. The disparity in the prevalence of malnutrition observed in different studies can be attributed to various factors, such as dietary diversity in different locations, duration of treatment, socioeconomic conditions, access to health care, and environmental variations that affect the etiology of an individual's nutritional status (Andrade *et al.*, 2019).

The subjective global assessment is a practical, accessible, inexpensive and easy-to-use method and is recommended by the National Kidney Foundation/ Kidney Disease Outcome Quality Initiative 2020 Nutrition Guidelines for routine nutrition assessment (Ikizler *et al.*, 2021). Screening tools such as the SGA are useful for monitoring nutritional status, and it is a validated method for assessing and identifying nutritional status in patients on maintenance

Table 1 - Sociodemographic characteristics of patients with chronic kidney disease (N = 98) undergoing hemodialysis in Western Bahia, 2018-2019.

Variables	N	%
Sex		
Male	63	64.3
Female	35	35.7
Marital status		
Married/Partner	64	63.3
Single/Separated/Widowed	34	34.7
Age group (years)		
<35	22	22.4
≥35-59	58	59.2
≥60	18	18.4
Educational level		
Non-literate	7	7.1
Primary school	86	87.8
High school/Vocational school/ Higher education	5	5.1
Socioeconomic level		
High (A and B)	13	13.3
Intermediate (C)	41	41.8
Low (D and E)	44	44.9

Table 2 - Anthropometric, clinical and biochemical characteristics of patients with chronic kidney disease (N = 98) undergoing hemodialysis in Western Bahia, Brazil, 2018-2019.

Variable	Mean	Standard deviation	P25, P75
SGAm score	11.32	3.84	9, 13
Waist circumference (cm)	88.07	12.33	79, 97
Neck circumference (cm)	36.10	3.75	34, 38
Phase angle (°)	6.85	1.61	5.9, 7.6
Hemodialysis duration (months)	28.80	38.73	7, 35
Albumin (mg/dL)	3.56	0.55	3.26, 3.94
Serum potassium (mg/dL)	4.95	0.77	4.3, 5.6
Pre-dialysis serum urea (mg/dL)	151.16	49.01	119, 190
Creatinine (mg/dL)	8.37	3.41	6.02, 10.41

SGAm: Modified subjective global assessment.
P25: 25th percentile; P75: 75th percentile.

Table 3 - Multiple linear regression coefficients, 95% confidence intervals (CI), and *p*-values for nutritional risk in patients with chronic kidney disease (N = 98) undergoing hemodialysis in Western Bahia, Brazil, 2018-2019.

Variables	β_A	95% CI	P
Sex	1.97	0.40; 3.53	**0.014**
Hemodialysis duration (months)	0.02	0.01; 0.04	**0.010**
Serum potassium	1.30	0.33; 2.26	**0.009**
Pre-dialysis serum urea	0.015	0.04; 0.29	**0.043**

* *P*value: Linear regression assuming significance at p < 0.05.
β_A, covariate adjusted β value.
Model fitted. Values with a significant p are in bold.

dialysis (Steiber *et al.*, 2007). This tool assesses recent changes in weight, oral intake, bowel habits, functional capacity, and stress caused by current illness, and classifies the patient into 3 states: well nourished, at risk of malnutrition, or moderately malnourished and severely malnourished.

The highest nutritional risk estimated by the SGAm was positively associated with females. In contrast to our study, Peng *et al.* (2021), Aziz *et al.* (2024) and Rodriguéz-Chávez *et al.* (2025) found a similar prevalence of malnutrition in men and women undergoing hemodialysis treatment. However, there is evidence that women tend to have a higher prevalence of CKD than men, especially in the early stages of the disease; worldwide, they are around 30% more likely to develop CKD before requiring dialysis (Wyld *et al.*, 2022). CKD is often associated with systemic inflammation, with increases in inflammatory biomarkers such as CRP, IL-6 and TNF, and is associated with cardiovascular disease, a condition that is more prevalent in

women because they are often have more inflammation than men, which may be associated with a higher risk of dialysis. In addition, men have higher risk factors for CKD, such as hypertension and diabetes, compared to women (Balafa *et al.*, 2024).

Longer hemodialysis treatment time was also associated with a higher SGAm score. This supports the studies by Alvarenga *et al.* (2017) and Lemos *et al.* (2024), which concluded that increased time on HD may promote muscle mass loss in renal patients, indicating a worsening of the malnutrition-inflammation process and nutritional status. The most common consequence of hemodialysis is protein-energy malnutrition (PEM), and as time on HD increases, body composition decreases because hemodialysis is a catabolic event resulting from inflammation, metabolic acidosis, and loss of nutrients to the dialysis bath, while PEM decreases albumin synthesis. And when combined with inadequate dietary intake, they contribute to a worsening of nutritional status as HD treatment continues (Alvarenga, Andrade, Moreira, 2017).

We found a positive association between a higher SGAm score and an increase in serum potassium concentration. A meta-analysis showed that hyperkalemia increases the risk of all-cause mortality, cardiovascular mortality, and end-stage renal disease in the general population and in CKD (Kovesdy *et al.*, 2018). Severe and rapidly progressing hyperkalemia can cause numbness, muscle weakness in the limbs, and arrhythmias (Yamada, Inaba, 2021). This condition increases the risk of mortality because there is a greater likelihood of cardiovascular complications in advanced kidney disease, as decreased kidney function is a risk factor for hyperkalemia (Picard *et al.*, 2023). A decline in nutritional status is often observed as the loss of renal function progresses (Bousquet-Santos, Costa, Andrade, 2019), which is often evidenced by excessive use of protein in the diet and hyperkalemia.

A positive association has also been found between a higher SGAm score and uremia. Uremic malnutrition is common among patients with end-stage renal disease, affecting 20% to 50% of patients on dialysis (pupim, ikizler, 2003; chung *et al.*, 2012). This condition is manifested by a gradual loss of somatic proteins, leading to a reduction in lean body mass, as well as changes in serum levels of visceral proteins such as albumin, prealbumin, transferrin, and cholesterol. Patients with CKD often have reduced protein and energy intake due to dietary restrictions, decreased appetite, and anorexia associated with uremia (chung *et al.*, 2012). The narrative review conducted by Sahathevan *et al.* (2020) suggests that iatrogenic factors that may be involved in malnutrition may be poor adequacy of dialysis resulting in poor correction of uremia and metabolic acidosis and/or low serum albumin levels for patients when they are on dialysis on highly permeable membranes or dialysis techniques that result in greater losses of amino acids.

Some limitations of the study should be considered, such as the small sample size, due to the fact that biochemical measurements are rarely performed in the health unit, and the cross-sectional design of the study, which does not allow us to conclude a cause and effect relationship. One of the strengths of this study is its originality, being the first to associate the SGAm score with anthropometric, clinical and biochemical indicators in dialysis patients in Western Bahia.

Regarding anthropometry, Dahl *et al.* (2021) demonstrate that anthropometric and body composition measurements are important and should be part of the nutritional risk assessment of hemodialysis patients. Although no association was found between increased nutritional risk and anthropometric measurements in this study, the study by Silva *et al.* (2017) demonstrated that the group classified as malnourished according to the SGA had lower values for anthropometric parameters, such as BMI and waist circumference, when compared to the well-nourished group.

Furthermore, although no direct association was identified between nutritional risk and phase angle, the latter can be considered a valid marker of body mass. The phase angle proves to be a significant indicator of the ratio between intracellular and extracellular water, being relevant for estimating clinical outcomes and monitoring critically ill patients. Thus, the phase angle has shown correlation with instruments used in the assessment of malnutrition and nutritional risk, since this indicator tends to decrease as nutritional risk increases (stuqui *et al.*, 2022). The study by Ferrel *et al.* (2025) identified a positive correlation between higher phase angle values and SGA scores.

CONCLUSION

In conclusion, the prevalence of nutritional risk and malnutrition together was 73.3%. The highest subjective global assessment score is positively associated with female sex, longer hemodialysis treatment time, higher serum potassium concentration, and higher pre-dialysis serum urea concentration. The importance of the subjective global assessment in this group is emphasized to reduce the risk of mortality and associated comorbidities.

REFERENCES

ASSOCIAÇÃO BRASILEIRA PARA O ESTUDO DA OBESIDADE E DA SÍNDROME METABÓLICA - ABESO. Diretrizes brasileiras de obesidade 2016. 4th ed. São Paulo: ABESO; p. 17, 2016.

AVESANI, C.M.; SABATINO, A.; GUERRA, A.; RODRIGUES, J.; CARRERO, J.J.; ROSSI, G.M.; GARIBOTTO, G.; STENVINKEL, P.; FIACCADORI, E.; LINDHOLM, B.A. A Comparative Analysis of Nutritional Assessment Using Global Leadership Initiative on Malnutrition Versus Subjective Global Assessment and Malnutrition Inflammation Score in Maintenance Hemodialysis Patients. J Ren Nutr. v. 32, n. 4, p. 476-482, 2022. Disponível em: https://doi.org/10.1053/j.jrn.2021.06.008

AZIZ, G.; EBRAHIM, Z.; ESAU, N.; BAZEZEW, M.M. Assessment Criteria to Diagnose

Malnutrition (Undernutrition and Overnutrition) in Hemodialysis Patients. J Ren Nutr. v. 22, n. S1051-2276(24)00194-8, 2024. Disponível em: https://doi.org/10.1053/j.jrn.2024.08.003

BALAFA, O.; FERNANDEZ-FERNANDEZ, B.; ORTIZ, A.; DOUNOUSI, E.; EKART, R.; FERRO, C.J.; MARK, P.B.; VALDIVIELSO, J.M.; DEL VECCHIO, L.; MALLAMACI, F. Sex disparities in mortality and cardiovascular outcomes in chronic kidney disease. Clin Kidney J., v. 21, n. 3, p. sfae044, 2024. Disponível em: https://doi.org/10.1093/ckj/sfae044

BEN-NOUN, L.; LAOR, A. Relationship of neck circumference to cardiovascular risk factors. Obes Res. v. 11, n. 2. p. 226-231, 2006. Disponível em: https://doi.org/10.1038/oby.2003.3

BOUSQUET-SANTOS, K.; COSTA, L.D.G.D.; ANDRADE, J.M.L. Estado nutricional de portadores de doença renal crônica em hemodiálise no Sistema Único de Saúde [Nutritional status of individuals with chronic renal failure in hemodialysis in the Unified Health System]. Cien Saude Colet. v. 24, n. 3, p. 1189-1199, 2019. Disponível em: https://doi.org/10.1590/1413-81232018243

CARRERO, J.J.; THOMAS, F.; NAGY, K.; AROGUNDADE, F.; AVESANI, C.M.; CHAN, M.; CHMIELEWSKI, M.; CORDEIRO, A.C.; ESPINOSA-CUEVAS, A.; FIACCADORI, E.; GUEBRE-EGZIABHER, F.; HAND, R.K.; HUNG, A.M.; IKIZLER, T.A.; JOHANSSON, L.R.; KALANTAR-ZADEH, K.; KARUPAIAH, T.; LINDHOLM, B.; MARCKMANN, P.; MAFRA, D.; PAREKH, R.S.; PARK, J.; RUSSO, S.; SAXENA, A.; SEZER, S.; TETA, D.; TER WEE, P.M.; VERSEPUT, C.; WANG, A.Y.M.; XU, H.; LU, Y.; MOLNAR, M.Z.; KOVESDY, C.P. Global Prevalence of Protein-Energy Wasting in Kidney Disease: A Meta-analysis of Contemporary Observational Studies From the International Society of Renal Nutrition and Metabolism. J Ren Nutr. v. 28, n. 6, p. 380-392, 2018. Disponível em: https://doi.org/10.1053/j.jrn.2018.08.006

CEDERHOLM, T.; BARAZZONI, R.; AUSTIN, P.; BALLMER, P.; BIOLO, G.; BISCHOFF, S.C.; COMPHER, C.; CORREIA, I.; HIGASHIGUCHI, T.; HOLST, M.; JENSEN, G.L.; MALONE, A.; MUSCARITOLI, M.; NYULASI, I.; PIRLICH, M.; ROTHENBERG, E.; SCHINDLER, K.; SCHNEIDER, S.M.; DE VAN DER SCHUEREN, M.A.; SIEBER, C.; VALENTINI, L.; YU, J.C.; VAN GOSSUM, A.; SINGER, P. ESPEN guidelines on definitions and terminology of clinical nutrition. Clin Nutr. v. 36, n. 1, p. 49-64, 2017. Disponível em: https://doi.org/10.1016/j.clnu.2016.09.004

CEDERHOLM, T.; ROTHENBERG, E.; BARAZZONI, R. Editorial: A Clinically Relevant Diagnosis Code for "Malnutrition in Adults" Is Needed in ICD-11. J Nutr Health Aging. v. 26, n. 4, p. 314-315, 2022. Disponível em: https://doi.org/10.1007/s12603-022-1774-z

CHEN, J.; PENG, H.; YUAN, Z.; ZHANG, K.; XIAO, L.; HUANG, J.; WANG, J.; HUANG, H. Combination with anthropometric measurements and MQSGA to assess nutritional status in Chinese hemodialysis population. Int J Med Sci. v. 13, n. 10, p. 974-980, 2013. Disponível em: https://doi.org/10.7150/ijms.5811

CHUNG, S.; KOH, E.S.; SHIN, S.J.; PARK, C.W. Malnutrition in patients with chronic kidney disease. Open J Intern Med. v. 2, p. 89-99, 2012. Disponível em: https://doi.org/10.4236/ojim.2012.22018

DAHL, H.; WARZ, S.I.; WELLAND, N.L.; ARNESEN, I.; MARTI, H.P.; DIERKES, J. Factors associated with nutritional risk in patients receiving haemodialysis assessed by Nutritional Risk Screening 2002 (NRS2002). Journal Of Renal Care, [S.L.], v. 48, n. 2, p. 112-

118, 11 maio 2021. Disponível em: https://doi.org/10.1111/jorc.12374

FERRELL, C.; BYHAM-GRAY, L.; SAMAVAT, H.; HAMDAN, M. Potential Determinants of Subjective Global Assessment Among Patients on Maintenance Hemodialysis. J Ren Nutr. v. 15, p. S1051-2276(24)00064-5, 2024. Disponível em: https://doi.org/10.1053/j.jrn.2024.04.003

IKIZLER, T.A.; BURROWES, J.D.; BYHAM-GRAY, L.D.; CAMPBELL, K.L.; CARRERO, J.J.; CHAN, W.; Fouque, D.; Friedman, A.N.; Ghaddar, S.; Goldstein-Fuchs, D.J.; Kaysen, G.A.; Kopple, J.D.; Teta, D.; Yee-Moon Wang, A.; Cuppari, L. KDOQI Clinical Practice Guideline for Nutrition in CKD: 2020 Update. Am J Kidney Dis. v. 76, n. 3 Suppl 1, p. S1-S107, 2021. Erratum in: Am J Kidney Dis. V. 77, n. 2, p. 308, 2021. Disponível em: https://doi.org/10.1053/j.ajkd.2020.11.004

IOREMBER, F.M. Malnutrition in Chronic Kidney Disease. Front Pediatr. n. 20, n. 6, p. 161, 2018. Disponível em: https://doi.org/10.3389/fped.2018.00161

KOEHNLEIN, E.A.; YAMADA, N.A.; GIANNASI, A.C.B. Avaliação do estudo nutricional de pacientes em hemodiálise. Acta Sci Health Sci. v. 30; p. 65-71, 2008. Disponível em: https://doi.org/10.4025/actascihealthsci.v30i1.4397

KOVESDY, C.P.; MATSUSHITA, K.; SANG, Y.; BRUNSKILL, N.J.; CARRERO, J.J.; CHODICK, G.; HASEGAWA, T.; HEERSPINK, H.L.; HIRAYAMA, A.; LANDMAN, G.W.D.; LEVIN, A.; NITSCH, D.; WHEELER, D.C.; CORESH, J.; HALLAN, S.I.; SHALEV, V.; GRAMS, M.E.; CKD PROGNOSIS CONSORTIUM. Serum potassium and adverse outcomes across the range of kidney function: a CKD Prognosis Consortium meta-analysis. Eur Heart J. v. 1, n. 39, p. 1535-1542, 2018. Disponível em: https://doi.org/10.1093/eurheartj/ehy100

LEMOS, K.C.R.; GARCIA, A.N.M.; SANTOS, T.O.C.D.; VIEIRA, N.F.L.; SANTOS, A.C.O.D. Association between malnutrition-inflammation score (MIS) and quality of life in elderly hemodyalisis patients. J Bras Nefrol. v. 46, n. 4, p. e20230171, 2024. Disponível em: https://doi.org/10.1590/2175-8239-JBN-2023-0171en

PENG, H.; AOIEONG, C.; TOU, T.; TSAI, T.; WU, J. Clinical assessment of nutritional status using the modified quantified subjective global assessment and anthropometric and biochemical parameters in patients undergoing hemodialysis in Macao. J Int Med Res. v. 49, n. 9, p. 3000605211045517, 2021. Disponível em: https://doi.org/10.1177/03000605211045517

PICARD, K.; BARRETO SILVA, M.I.; MAGER, D.; RICHARD. C. Dietary Potassium Intake and Risk of Chronic Kidney Disease Progression in Predialysis Patients with Chronic Kidney Disease: A Systematic Review. Adv Nutr. v. 11, n. 4, p. 1002-1015, 2020. Erratum in: Adv Nutr. v. 14, n. 6, p. 1657, 2023. Disponível em: https://doi.org/10.1016/j.advnut.2023.09.014

PUPIM, L.B.; IKIZLER, T.A. Uremic malnutrition: new insights into an old problem. Semin Dial. v. 16, n. 3, p. 224-232., 2003. Disponível em: https://doi.org/10.1046/j.1525-139x.2003.16046.x

RODRÍGUEZ-CHÁVEZ, L.A.; RAMÍREZ-PACHAMANGO, S.; RODRÍGUEZ-MENDOZA, C.R.E. Frequency of malnutrition in adult patients with stage V chronic kidney disease on hemodialysis. Rev Peru Med Exp Salud Publica. v. 31, n. 41, p. 399-404, 2025. Disponível em: https://doi.org/10.17843/rpmesp.2024.414.13638

SAHATHEVAN, S.; KHOR, B.H.; NG, H.M.; GAFOR, A.H.A.; MAT DAUD Z.A.; MAFRA, D.; KARUPAIAH, T. Understanding Development

of Malnutrition in Hemodialysis Patients: A Narrative Review. Nutrients. V. 12, v. 10, p. 3147, 2020. Disponível em: https://doi.org/10.3390/nu12103147

SILVA, A.M.; SOUTO, T.C.; FONSECA, F.; MORAIS, C.N.; SOUZA, B.S. Estado nutricional de pacientes renais crônicos submetidos a tratamento hemodiálitico em um hospital de referência de Pernambuco. Nutricíon Clinica, v.37, n. 3, p 58-65, 2017.

STEIBER, A.; LEON, J.B.; SECKER, D.; MCCARTHY, M.; MCCANN, L.; SERRA, M.; Sehgal, A.R.; Kalantar-Zadeh, K. Multicenter study of the validity and reliability of subjective global assessment in the hemodialysis population. J Ren Nutr. v. 17, n. 5, p. 336-342, 2007. Disponível em: https://doi.org/10.1053/j.jrn.2007.05.004

STEIBER, A.L.; KALANTAR-ZADEH, K.; SECKER, D.; MCCARTHY, M.; SEHGAL, A.; MCCANN, L. Subjective Global Assessment in chronic kidney disease: a review. J Ren Nutr. v. 14, n. 4, p. 191-200, 2004.

STUQUI, M.; BECCARIA, L.M.; ALBERTINI, S.M.; GODOY, M.F. Ângulo de fase como potencial marcador do estado nutricional de pacientes em terapia intensiva. Cogitare Enfermagem, [S.L.], n. 27, p. 1-11, 18 nov. 2022. Disponível em: https://doi.org/10.5380/ce.v27i0.81947.

TSAI, M.T.; TSENG, W.C.; OU, S.M.; LEE, K.H.; YANG, C.Y.; TARNG, D.C. Comparison of Simplified Creatinine Index and Systemic Inflammatory Markers for Nutritional Evaluation of Hemodialysis Patients. Nutrients. v. 30, n. 6, p. 1870, 2021. Disponível em: https://doi.org/10.3390/nu13061870

VEGINE, P.M.; PACKNESS, A.C.; SIMAS, M.R.; TORRES, G.; BARRETO, M.I.; AVESANI, C.M. Avaliação de métodos para identificar desnutrição energético proteica de pacientes em hemodiálise. J Bras Nefrol. v. 33, n. 1, p. 55-61, 2011. Disponível em: https://doi.org/10.1590/S0101-28002011000100008

WYLD, M.L.R.; MATA, N.L.; VIECELLI, A.; SWAMINATHAN, R.; O'SULLIVAN, K.M.; O'LONE, E.; ROWLANDSON, M.; FRANCIS, A.; WYBURN, K.; WEBSTER, A.C. Sex-Based Differences in Risk Factors and Complications of Chronic Kidney Disease. Semin Nephrol. v. 42, n. 2, p. 153-169, 2022. Disponível em: https://doi.org/10.1016/j.semnephrol.2022.04.006

XI, W.Z.; WU, C.; LIANG, Y.L.; WANG, L.L.; CAO, Y.H. Analysis of malnutrition factors for inpatients with chronic kidney disease. Front Nutr. v. 6, n. 9, p. 1002498, 2023. Disponível em: https://doi.org/10.3389/fnut.2022.1002498

YAMADA, S.; INABA, M. Potassium Metabolism and Management in Patients with CKD. Nutrients. v. 13, n. 6, p. 1751, 2021. Disponível em: https://doi.org/10.3390/nu13061751

RECEBIDO: 25/5/2025
ACEITO: 14/7/2025
PUBLICADO: 16/7/2025