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EXPLORING NUTRITIONAL STATUS AND LATE POST-TRANSPLANT ANATOMICAL CHANGES IN PATIENTS WITH CHRONIC KIDNEY DISEASE: A COMPREHENSIVE ANALYSIS

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ABSTRACT:

Introduction: Patients undergoing post-transplant chronic kidney disease face a prolonged and challenging journey in adapting to the new organ. Throughout this phase, their nutritional status is directly impacted by various factors, including diet, biochemical measures, lifestyle, and anthropometric assessments. This information plays a crucial role in evaluating the nutritional well-being of these individuals.

Objective: The study aims to analyze the relationship between nutritional status and late post-transplant changes, considering factors such as dietary habits, immunosuppressant usage, and the emergence of chronic diseases post-transplantation.

Method: This retrospective cross-sectional analytical study with prospective aspects was conducted in the late post-transplant period. Data, including clinical, socioeconomic, demographic, anthropometric, and biochemical parameters, were collected from patients at the nutritional clinic of the Professor Fernando Institute of Integral Medicine of Figueira (IMIP/PE).

Results: The sample comprised 32 patients, with hypertension being the most prevalent chronic disease associated with cardiovascular risk, followed by diabetes. While the majority exhibited eutrophic nutritional status, there was an associated risk of cardiovascular disease based on waist-to-hip ratio, waist-to-height ratio, and conicity index methods. Food consumption showed no significant association with the risk of developing cardiovascular diseases.
Conclusion: Nutritional monitoring is crucial for preventing short-term diseases post-transplantation, contributing to improved clinical outcomes and a reduction in complications that may jeopardize the transplanted organ.

KEYWORDS: Anthropometry; Kidney Transplantation; Nutritional Status; Cardiovascular Disease; Chronic Kidney Disease.

INTRODUCTION:

The kidney is an organ that plays a fundamental role in the body's homeostasis, acting mainly on water and electrolyte balance, serum glucose concentration, erythropoietin production, regulation of systemic blood pressure and bone metabolism. Chronic kidney disease (CKD) is defined by structural or functional damage to the kidney for at least three months, regardless of the cause and for which there is no longer any possibility of cure (Chong, Jang, & Kim, 2024; McPherson et al., 2024).

The loss of function of this organ affects the entire functioning of organic systems and is classified into stages, also called groups, numbered from 1 to 5 and which take into account the glomerular filtration rate GFR, where G1 = ≥90 ml/min, G2 = 60 ml/min to 89 ml/min, G3a = 45 ml/min to 59 ml/min, G3b = 30 ml/min to 44 ml/min, G4 = 15 ml/min to 29 ml/min, D5 = <15 ml/min per 1.73 m2, these stages demonstrate the level of severity and impairment of renal function and from there what type of therapy this organ requires. Furthermore, inflammation and increased oxidative stress in CKD further aggravate the situation due to the increased risk of affecting the cardiovascular system (Huck et al., 2024).

Kidney transplant (RT) is a renal replacement therapy (RRT) and is the most recommended for patients with end-stage chronic renal failure (stage 5). Brazil has the second-largest kidney transplant program in the world and currently performs more than 6,000 kidney transplants per year. If only public transplant programs are considered, the country ranks first globally, with over 90% of kidney transplants financed by the Unified Health System (SUS) (Albagieh et al., 2024).

Pernambuco ranks second in the northeastern region for the number of kidney transplants performed in 2020, according to the latest sizing document by state from the Brazilian Organ Transplant Society, with a total of 212 transplants, ranking eighth compared to other Brazilian states (Azzolino et al., 2024).

This type of renal replacement therapy is divided into three phases: pre-RT, immediate post-RT and late post-RT; each of these three moments will have specificities and consequences on the patient's nutritional status. Several factors are known to influence a patient's nutritional status post-RT: their emotions, the stage of life the individual is in, socioeconomic level, education, and the levels of inflammatory mediators that are still present in this organism in large quantities, not only because of the CKD but also because of the new injury suffered and which will disappear from now on need to find the best way to adapt to stress (Lentine et al., 2024).

Furthermore, CKD also involves many dietary restrictions and leads to a loss of quality of life for the individual, who sees in the transplant the possibility of a longer and quality life, despite being aware that RT is not synonymous with a cure for CKD, the transplant patient must adapt to the new reality, both about food and to the assiduous and daily use of immune-suppressants since these can also often hurt the nutritional status (Kazes, Solignac, Lassalle, Mercadal, & Couchoud, 2024).

Among the various factors that can be cited regarding the impact of this therapy on the patient's life is the fact that he often walks a fine line between the improvement in his quality of life resulting from the greater freedom he now enjoys thanks to independence from dialysis, automatic or restrictive diets, but also due to the high risk of developing cardiovascular diseases (CVD) which affect this

population with a high prevalence, whose main risk factor is the daily use of immune-suppressants (Gai, Lin, Wang, Bian, & Tao, 2024).

The nutritional profile of the population has been one of the most used objects of study in epidemiological research relating to nutritional status, as it aims to understand the food consumption profile of the population and its association with chronic non-communicable diseases (NCDs). It is known that the dietary profile of each individual is influenced by complex environmental, demographic, social, economic and cultural interactions (Yu, Atta, Brennan, & Kant, 2024).

Alterations that can influence nutritional status range from protein-energy malnutrition, anaemia and hypoalbuminemia to chronic comorbidities that can occur after transplantation, such as systemic arterial hypertension (SAH), diabetes mellitus (DM), dyslipidemia and obesity. All these dysfunctions will increase the likelihood of cardiovascular risk and possible transplant rejection, directly compromising food acceptance, allowing the onset of increasingly severe nutritional disorders and thus increasing the risk of mortality for that individual. Therefore, the present research aimed to identify changes in the nutritional status of patients undergoing late RT and the risk of developing cardiovascular disease (Bakthavatsalam et al., 2024; Bellos, Marinaki, Samoli, Boletis, & Benetou, 2024).

METHODOLOGY:

This is a retrospective cross-sectional analytical study with prospective aspects. Data collection will take place at the nutritional clinic of the Instituto de Medicina Integral Professor Fernando Figueira (IMIP) located in the city of Recife, PE. The outpatient visit usually takes place 3 months after the kidney transplant, where eating habits, nutritional assessment and biochemical tests relating to nutritional status are evaluated (Jung et al., 2024).

The data was collected between March and October 2022, subject to acceptance by the ethics committee in IMIP research, under resolution n.466/12 of the National Health Council, 58173322. 9.0000.5201. The inclusion criteria were patients after late renal transplantation, starting six months after RT, adults aged ≥ 18 years, and elderly aged ≥ 60 years, after signing the free and informed consent form (Alebna et al., 2024).

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 13.0. Continuous variables were tested for normality of distribution using the Kolmogorov-Smirnov test; those with a normal distribution were described in the form of means and their standard deviations, and variables with non-Gaussian distribution were presented in the form of medians and respective interquartile intervals (W. Yuan et al., 2024).

Normally distributed variables had their means compared using Student's t-tests (two variables); when normality criteria were not met, Mann-Whitney tests were used. The Chi-square and Fisher's exact tests were used for categorical variables to calculate the p-value and 95% confidence interval (95% CI). Pearson correlation was used for parametric variables, and Spearman correlation was used for nonparametric variables. At the end of the analysis, only variables with a p-value < 0.05 were considered statistically significantly associated with the outcome (Vaishya, Misra, Vaish, Ursino, & D'Ambrosi, 2024).

A convenience sample was considered to develop the sampling plan, and patients who met the inclusion criteria in the period determined for the study were selected. The following were excluded: postpartum women, patients with CVD before RT, patients whose anthropometric measurements were impossible, and those unable to communicate verbally (Xie et al., 2024).

Regarding eating habits, a food frequency questionnaire (FFQ) was used, adapting it to the cultural and regional characteristics of the population served in the research. Physical activity practice was assessed following the recommendations of the Institute of Medicine/Food and Nutrition Board. Biochemical test data were retrieved from the institute's system and tests up to 12 months before consultation was considered without requiring a new test (Laspro et al., 2024).

Nutritional status was classified using the body mass index (BMI) threshold values proposed by the World Health Organization. WC waist circumference was classified as high when a value greater than

80 cm was obtained for women and greater than 94 cm for men. To calculate the waist-to-height ratio (WHtR), the threshold value considered 0.50 from adulthood and in both sexes was used, as it is corrected for height. To calculate the waist-hip ratio (WHR), the values proposed by Bray and Gray were considered. The threshold value considered for the taper index (CI) was 1.25 for men and 1.18 for women, and when indicated = 1.73, a high risk of cardiovascular and metabolic diseases was considered in both. Arm circumference (BC) was classified based on percentile distribution according to Frisancho (Degraeve et al., 2024; Yuan, Yang, Lin, Lin, & Wu, 2024).

RESULTS:

The sample consisted of 32 patients, with a mean age of 47.38 ± 11.95 years, 50% for both sexes, who received kidneys from deceased donors. Regarding the characteristics of the population studied and their lifestyle, 93.75% were adults, 3.1% smoked and used alcoholic beverages, and 56.3% did not practice physical activity (Table I) (Wang et al., 2024).

According to the aetiology of CKD, indeterminate prevailed at 53.2%, glomerulonephritis at 21.9%, followed by autosomal polycystic kidney disease at 12.5%. About the clinical data relating to the transplanted kidney, the average ischemia time in hours was 23.50±7.15 (Sándor, Katics, Varga, Kalmár Nagy, & Szakály, 2024).

Table I. Demographic and lifestyle characteristics of kidney transplant patients treated at the nutrition clinic of the Instituto de Medicina Integral Professor Fernando Figueira, 2022

VARIABLE	n	%
AGE		
Adult	30	93,75
Elderly	2	6,25
SEX		
Masculine	16	50%
Feminine	16	50%
PHYSICAL ACTIVITY		
Yes	14	43,8
No	18	56,3
SMOKER		
Yes	1	3,1
No	31	96,9
DRINKER		
Yes	1	3,1
No	31	96,9

Regarding nutritional status, 46.9% were eutrophic, according to BMI and WC (Table II). Regarding BMI, the sample had an average BMI of 23.47±4.45 kg/m2 pre-transplant and 23.56±4.57 kg/m2 post-transplant and the time in months after transplant late kidney was 30.4±39.8 (Matus Gonzalez et al., 2024)

When assessing the risk of cardiovascular disease, according to the indicators WHtR, WHR and HF, 62.5%, 71.9% and 65.6% were at risk, respectively (Table III). Considering comorbidities developed after late kidney transplantation, we observed an incidence of 62.5% for hypertension, 28.1% for dyslipidemia, and 9.4% for DM (Charles, Lewis, Montgomery, & Reid, 2024).

Table II. Classification of the nutritional status of kidney transplant patients treated at the nutritional clinic of the Instituto de Medicina Integral Professor Fernando Figueira, 2022.

VARIABLE	n	%
BMI		
Eutrophy	15	46,9
Overweight	10	31,3
Low weight	7	21,9

CB		
Eutrophy	15	46,9
Overweight	5	15,6
Malnutrition	12	37,5

Table III. CVR of kidney transplant patients treated at the Instituto de Medicina Integral Professor Fernando Figueira nutrition clinic, 2022.

VARIABLE	**n**	**%**
RCE		
Adequate	12	37,5
At risk of CVD	20	62,5
WHR		
Adequate	9	28,1
At risk of CVD	23	71,9
IC		
Adequate	11	34,4
At risk of CVD	21	65,6

Regarding medications, all patients used two or more types of immunosuppressants, namely mycophenolate, tacrolimus, or cyclosporine. Regarding steroids, 100% of the sample used prednisone, and approximately 65.6% used antihypertensive drugs (Tacyildiz et al., 2024).
The biochemical data did not show any significant changes. Still, compared to the reference values recommended for the healthy population, the values of glycated haemoglobin (HbA1c), creatinine, urea and low-density lipoprotein (LDL) were increased (Table IV) (Zhu, 2024).

Table IV. Biochemical markers of kidney transplant patients treated at the nutritional clinic of the Instituto de Medicina Integral Professor Fernando Figueira, 2022.

BOOKMARKS	**Media ± DP**
Fasting blood glucose	84.49 ± 12.75
glycated haemoglobin	5.80 ± 0.87
Creatinine	1.83 ± 0.87
Urea	77.78 ± 37.03
Sodium	137.6 ± 5.34
Potassium	4.37 ± 0.48
Phosphor	3.4±0.55
Haemoglobin	12.21 ± 1.7
Hematocrit	38.28±5.29
Total cholesterol	190.0 ± 53.01
LDL	178.95±198.67
HDL	51.0±13.66
Triglycerides	172.33 ± 78.24
Total proteins	7,91± 1,70
Albumin	4,41±0,21

As regards the FFQ, consumption of the following groups prevails fruit (62.5%), tubers (56.3%), vegetables (53.1) and meat and eggs, 50%, while the consumption of sugars and processed foods (X. Chen et al., 2024).

DISCUSSION:

In the present study, a homogeneous population was observed, matched in terms of sex and significantly represented by adults, similar findings to the study by David et al., where the average age was 50 years and who had arterial hypertension as an underlying disease, corroborating the current study which showed the continuity of hypertension after transplantation (Sun et al., 2024).

SAH is prevalent in renal transplant recipients (RTR) and is a risk factor for the development of cardiovascular disease and chronic graft dysfunction. Current immunosuppressive agents also increase the incidence of hypertension in this population, both through the use of prednisone and cyclosporine, this being the most prevalent comorbidity solution in the present research as well as in other studies conducted by Brandão and collaborators in the city of Recife (Mascherini et al., 2024).

This comorbidity, when associated with anthropometric indicators, presented a significant association with BMI; even if this indicator is the most widespread in epidemiological studies, its use in situations of edema or cases of different body composition is limited, since it is also It is important to know the location of this fat and that its presence in the abdominal region is a strong indicator of risk of non-communicable diseases (You et al., 2024).

In this context, the relationship between weight gain and blood pressure increase is already well described in the literature; however, in RTR, these studies are still scarce. Studies highlight this relationship in patients with chronic renal failure and state that for every 1 kg/m2 increase in BMI, there is an increased risk of cardiovascular events (Gutierrez-Mariscal et al., 2024).

In the present study, we also found a positive association between physical activity and CVR, assessed by WHR ($p = 0.022$). In a randomized controlled experimental study, Shakoor and collaborators demonstrated this association since a sedentary lifestyle is a joint event in patients undergoing RT. The comparison between the groups that performed physical activity and the control group indicated that the intervention had a significant effect on the adequacy of BMI, i.e. those who are active have a reduction in fat accumulation in the regions of the body that promote cardiovascular risk as in the case of RCQ (Hayer & Dasgupta, 2024).

As also found by Loureiro and collaborators, the WHR has good applicability in cardiovascular risk screening. Still, it is essential to highlight that this indicator must be carefully evaluated since, when considering body composition, it may not be the most recommended due to the difference in body composition between females and males (Koukounas et al., 2024).

Regarding nutritional status, most of the population had an adequate classification, but in the literature, most patients evaluated became overweight in the first year after RT and developed CVR. On the other hand, in the present study, it was seen that, although the patients maintained a nutritional status that was considered adequate, CVR was also found. Lienert and collaborators found in their study an increase in weight after the first year of RT and changes in the BMI classification of patients in both sexes, differing from our results, whose sample maintained an adequate BMI classification for a period of equal time in our study, after the first year (Nucci et al., 2024).

The study in question still reports the association of the development of DM, but in this case, already after 5 years of RT, this is a more extended period for the emergence of DM; in our study, the emergence of DM occurred in fewer patients, which may be justified by the fact that the post-RT time was not as long as before. According to Aksoy, weight gain generally appears in the first year after transplantation and is described in the literature as a common problem for patients in the first 6 months. Over the years, this increase varies between 6 and 10 kg, and the change in Body mass index varies between 2 and 3.8 kg/m2 after kidney transplant (Abbood & Dahash, 2024).

Another association was the relationship between WHtR and Hb1Ac and HbA1c and Urea. It is known that body composition markers appear to be associated with biochemistry and that increased serum urea levels are often related to an inflammatory process and consequently influence glycemic

levels; Hb1Ac may suggest CVR in certain situations, such as nephropathic patients, which would justify it if combined with WHtR (Tang et al., 2024).

Furthermore, nutrition is a relevant factor when talking about biochemistry; by verifying, through the FFQ, the diet of the patients treated, it was verified that these patients were aware of the importance of following the instructions received and that the use of what the sources of simple sugar were was not relevant, this would justify the absence of significant changes in the biochemical test results (McClung, Frishman, & Aronow, 2024).

It is essential to highlight that the present study had some significant limitations, such as the medical record and outpatient follow-up sheets, which are manual, which made data collection difficult; laboratory tests were often incomplete and without lipid profile data and fractions, such as triglycerides (Barzilay, Farag, & Durthaler, 2024).

Given these results and the importance that cardiovascular events and comorbidities that promote this CVR have in this population, it is essential that outpatient nutritional monitoring is permanent in the life of these patients since it reflects on the nutritional and general status, as well as being associated with the prognosis that this patient will have. Satisfactory nutritional monitoring will work together with other professionals, and this depends on variables such as adequate use of immunosuppressant treatment, and good anthropometric, biochemical and lifestyle assessment (H.-f. Chen et al., 2024).

CONCLUSION:

The results demonstrated that RCV was also found in a population considered eutrophic, which justifies the importance of carrying out further studies on the matter since RCV can be found in this population, causing severe consequences for the health of these individuals.

Furthermore, the results reinforce the importance of not using only BMI to diagnose the nutritional status of renal patients after late transplantation since the population studied has different specificities, having different factors that can influence an unfavourable prognosis in the development of non-communicable diseases and consequently increased cardiovascular events after RT.

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