

Risk of Stroke in Patients With Chronic Kidney Disease Undergoing Hemodialysis

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Riesgo de Acidente Cerebrovascular em Pacientes com Enfermedad Renal Crónica Sometidos a Hemodiálises

RESUMO

Objetivo: Analisar o risco de Acidente Vascular Cerebral em pacientes com Doença Renal Crônica submetidos à hemodiálise. **Metodologia:** Estudo observacional, analítico e transversal, realizado com 100 pacientes em hemodiálise. A coleta de dados incluiu informações sociais, econômicas e clínicas, por meio de entrevista individual durante as sessões de Terapia Renal Substitutiva. O índice de significância em todas as análises foi de $p < 0,05$. **Resultados:** Dos participantes, 64% eram homens, 46% pardos, 88% de outras cidades do Piauí, 53% casados, 81% com renda de 1 a 2 salários e 54% com ensino fundamental. Observou-se associação negativa e significativa entre o tempo de diálise e os níveis de colesterol total e pressão arterial, indicando que o tratamento reduz e controla esses parâmetros. **Conclusão:** Evidenciou-se que as características sociais, econômicas, estilo de vida e condição de saúde influenciam no risco de AVC em pacientes com Doença Renal Crônica.

DESCRIPTORIOS: Acidente Vascular Cerebral; Insuficiência Renal Crônica; Diálise Renal; Terapia de Substituição Renal.

ABSTRACT

Objective: To analyze the risk of stroke in patients with Chronic Kidney Disease undergoing hemodialysis. **Methodology:** Observational, analytical, and cross-sectional study conducted with 100 hemodialysis patients. Data collection included social, economic, and clinical information obtained through individual interviews during Renal Replacement Therapy sessions. The significance level in all analyses was set at $p < 0.05$. **Results:** Among the participants, 64% were male, 46% were mixed-race, 88% were from other cities in Piauí, 53% were married, 81% had an income of 1 to 2 minimum wages, and 54% had elementary education. A negative and significant association was observed between dialysis duration and total cholesterol and blood pressure levels, indicating that the treatment reduces and controls these parameters. **Conclusion:** Social and economic characteristics, lifestyle, and health conditions were shown to influence the risk of stroke in patients with Chronic Kidney Disease.

DESCRIPTORS: Stroke; Chronic Kidney Failure; Renal Dialysis; Renal Replacement Therapy.

RESUMEN

Objetivo: Analizar el riesgo de accidente cerebrovascular en pacientes con enfermedad renal crónica en hemodiálisis. **Metodología:** Estudio observacional, analítico y transversal con 100 pacientes en hemodiálisis. Los datos sociales, económicos y clínicos se obtuvieron mediante entrevistas durante las sesiones de terapia de reemplazo renal. El nivel de significancia fue $p < 0,05$. **Resultados:** El 64% eran hombres, el 46% mestizos, el 88% de otras ciudades de Piauí, el 53% casados, el 81% con ingresos de 1 a 2 salarios mínimos y el 54% con educación primaria. Se encontró una asociación negativa y significativa entre el tiempo de diálisis y los niveles de colesterol total y presión arterial, indicando que el tratamiento reduce y controla estos parámetros. **Conclusión:** Las características sociales, económicas, el estilo de vida y las condiciones de salud influyen en el riesgo de accidente cerebrovascular en pacientes con enfermedad renal crónica.

DESCRIPTORIOS: Accidente Cerebrovascular; Insuficiencia Renal Crónica; Diálisis Renal; Terapia de Reemplazo Renal.

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INTRODUCTION

The epidemiological transition, marked by a reduction in infectious diseases and an increase in chronic noncommunicable diseases (CNCDs), is linked to population aging, behavioral changes, and modifiable risk factors such as smoking, alcohol consumption, physical inactivity, and poor diet⁽¹⁾. In this context, cardiovascular diseases stand out, with a special emphasis on cerebrovascular diseases⁽²⁾.

According to data from the Department of Informatics of the Unified Health System (DATASUS), in 2020, 99,010 deaths from stroke were recorded in Brazil⁽³⁾. This clinical condition is characterized by a sudden onset of neurological deficit, which can progress to death. Stroke manifests itself in two categories: ischemic stroke (IS), resulting from the occlusion of a cerebral artery, and hemorrhagic stroke (HIS), caused by the rupture of an arterial vessel in the brain⁽⁴⁾.

Chronic kidney disease (CKD) is characterized by progressive loss of kidney function for more than three months and, in its terminal stage (when the glomerular filtration rate (GFR) reaches values below 15 ml/min/1.73m²), hemodialysis (HD) is essential as renal replacement therapy⁽⁵⁾.

In this scenario, cardiovascular diseases (CVDs) in patients with CKD are complex and influenced by both traditional risk factors such as hypertension, diabetes mellitus, and dyslipidemia, as well as comorbidities specific to chronic renal failure⁽⁶⁾. The coexistence of CVD and CKD intensifies the deterioration of renal function and favors the worsening of the cardiovascular condition, resulting in a progressive cycle of mutual impairment of these conditions⁽⁷⁾.

This study is justified by the relevance of the topic and for the improvement of nursing care through the early identification of stroke risk in patients with CKD undergoing hemodialysis. Thus, it aims to analyze the risk of stroke in patients with chronic kidney disease undergoing

hemodialysis, according to modifiable and non-modifiable risk factors.

METHOD

This is an observational, analytical, cross-sectional study with a quantitative approach, developed through individual interviews conducted during hemodialysis sessions, as well as analysis of secondary data extracted from medical records and laboratory tests.

The research was conducted at a nephrology clinic located in the municipality of Campo Maior, PI, between August and October 2024. The study population consisted of 100 patients diagnosed with CKD undergoing hemodialysis treatment during the collection period. The sample was composed according to the following inclusion criteria: age ≥ 30 years, medical records with complete data, and formal consent by signing the Free and Informed Consent Form (TCLE) and the Data Use Agreement (TCUD). People with neurological, degenerative, or phonetic

conditions that hindered communication, with severe pain, or who were undergoing hemodialysis in isolation beds were excluded.

Data collection included social, economic, and clinical information obtained in individual interviews lasting thirty minutes. The variables were initially organized in a spreadsheet (Microsoft Office Excel 2016) and later exported to IBM Statistical Package for Social Science (SPSS) software, version 26.0, for statistical analysis.

The significance level in all analyses was $p < 0.05$. Exploratory data analysis was performed to identify the statistical tests that were used. All continuous data were checked for normality using the Kolmogorov-Smirnov test with Lilliefors correction, showing a normal distribution for the variables age and total cholesterol and a non-normal distribution for all other variables.

The descriptive analysis included the calculation of absolute and relative frequencies for the proportions of categorized variables. Pearson's chi-square test was used to compare the observed and expected frequencies in each category of the tables. Fisher's exact test was used in contingency tables to compare groups of two independent samples with counts < 5 . Spearman's correlation was used to verify linear association between continuous variables.

This study was approved by the Research Ethics Committee (CEP) of the Santo Agostinho University Center with CAAE 70709023.2.0000.5602, according to opinion No. 6.270.258, in accordance with the provisions of Resolution No. 466/2012 of the National Health Council.

RESULTS

The results were organized into two sections, describing the social, economic, and clinical characteristics of the sample.

Social and economic characteristics

Of the 100 participants, there was a predominance of males, with 64 (64.0%) individuals. In terms of marital status, the majority were married, totaling 53 (53.0%) participants. Regarding race/color, 46 (46.0%) self-identified

as brown, and in terms of education, 54 (54.0%) participants had only completed elementary school. With regard to religion, Catholicism predominated, practiced by 76 individuals (76.0%) (Table 1).

TABLE 1 – Social and economic characteristics of patients with chronic kidney disease on hemodialysis. (n=100).

Variable	N	%
Sex		
Male	64	64,0
Female	36	36,0
Marital status		
Single	29	29,0
Married	53	53,0
Widowed	10	10,0
Stable union	8	8,00
Race/color		
Brown (Pardo)	46	46,0
Black	40	40,0
White	14	14,0
Other		
Education level		
Elementary school	54	54,0
High school	14	14,0
Higher education	5	5,00
Illiterate	29	29,0
Religion		
Catholic	76	76,0
Evangelical	21	21,0
Place of origin		
C. Piauí	88	88,0
Campo Maior	12	12,0
Monthly income		
<1 minimum wage	10	10,0
1–2 minimum wages	81	81,0
2–3 minimum wages	7	7,00
4 or more	2	2,00

Source: Survey data.

Clinical characteristics

The average age of the 100 participants was 55.04 ± 14.064 years. Regarding household composition, the average number of residents per household was 3.10 ± 1.425 , living alone or with up to seven people. $\pm\pm$ The number of weekly

hemodialysis sessions was 3.01 ± 0.100 , with 3 sessions lasting an average of 3.43 ± 0.590 hours per session.

\pm The average laboratory values observed were 67.96 ± 25.527 mg/dL for LDL, 37.70 ± 13.213 for HDL, and 137.50 ± 31.963 for total cholesterol.

\pm The mean blood pressure measured in participants during dialysis was 135.30 ± 25.681 mmHg for systolic pressure and 72.04 ± 17.556 mmHg for diastolic pressure (Table 2).

TABLE 2 - Clinical characteristics of patients with chronic kidney disease on hemodialysis. (n=100)

Variable	Minimum-Maximum	Mean \pm SD	Median
Age	30-82	55,04 \pm 14,064	57,00
Number of people in the household	1-7	3,10 \pm 1,425	3,00
Hemodialysis sessions	3-4	3,01 \pm 0,100	3,00
Session duration	2-4	3,43 \pm 0,590	3,00
LDL	15-164	67,96 \pm 25,527	61,45
HDL	18-76	37,70 \pm 13,213	35,00
Total cholesterol	73-237	137,50 \pm 31,963	138,50
PAS	80-210	135,30 \pm 25,681	130,00
PAD	10-110	72,04 \pm 17,556	75,00

Source: Research data.

Most participants (64.0%) had been undergoing hemodialysis treatment for less than 10 years. Regarding clinical and behavioral conditions, 88 (88.0%) reported no diagnosis of CVD; 59 (59.0%) had no family history of stroke, and 74 (74.0%) reported

not smoking at the time of data collection. Systemic arterial hypertension was reported by 77 (77.0%) participants and diabetes mellitus by 76 (76.0%). In addition, 89 (89.0%) reported being sedentary. Regarding substance use, 84 (84.0%) denied current use of alcohol or other drugs, 98

(98.0%) did not use oral contraceptives, and 99 (99.0%) did not report having undergone hormone replacement therapy. Regarding body mass index, 76 (76.0%) participants were not obese (Table 3).

TABLE 3 - Clinical characteristics of patients with chronic kidney disease on hemodialysis. (n=100)

Variable	N	%
Dialysis time		
< 10 years	64	64,0
> 10 years	36	36,0
Do you have CVD?		
Yes	12	12,0
No	88	88,0
Do you have a family history of stroke?		
Yes	41	41,0
No	59	59,0
Smoker		
Yes	26	26,0
No	74	74,0
Do you have hypertension?		
Yes	77	77,0

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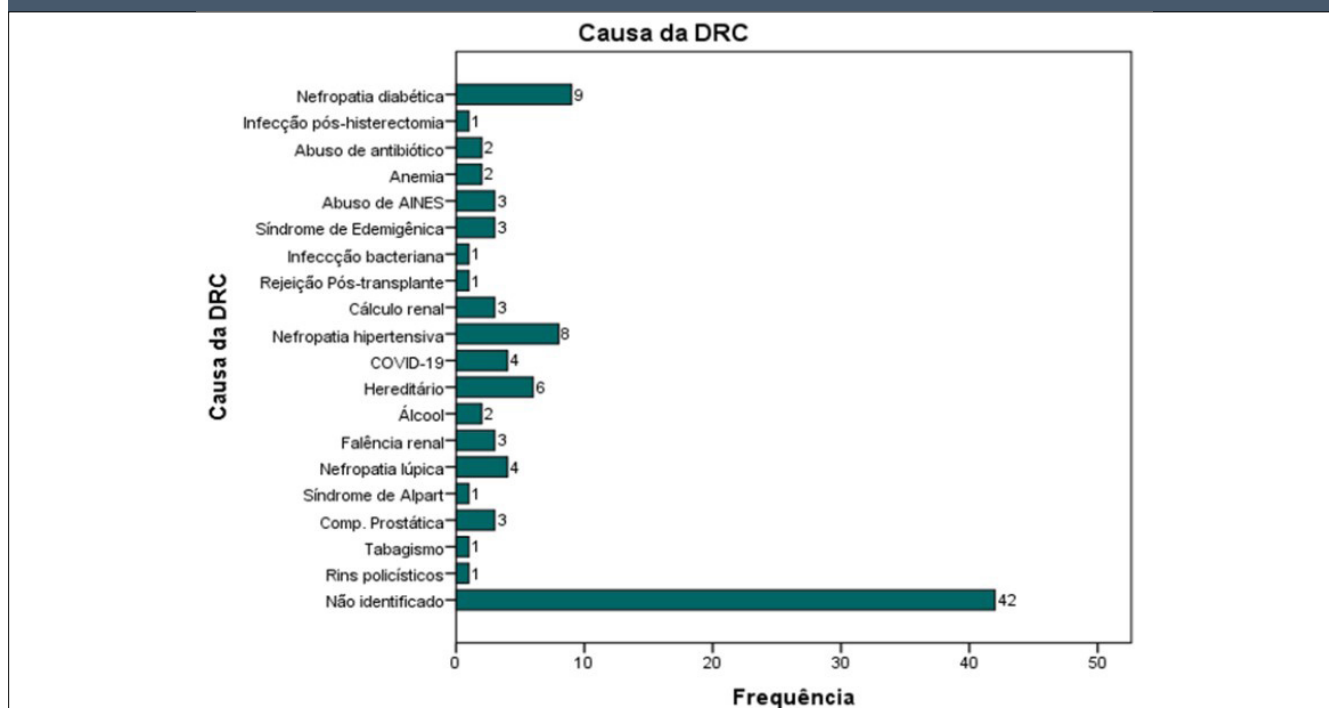
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No	23	23,0
Do you have diabetes?		
Yes	24	24,0
No	76	76,0
Sedentary		
Yes	89	89,0
No	11	11,0
Alcohol and drug user		
Yes	16	16,0
No	84	84,0
Use of contraceptives Oral		
Yes	2	2,00
No	98	98,0
Undergoes/underwent hormone replacement therapy		
Yes	1	1,00
No	99	99,0
Obesity		
Yes	24	24,0
No	76	76,0

Source: Survey data.

Of those interviewed, 42 (42%) did not know the cause of their chronic kidney disease, 9 (9%) said it was caused by diabetic nephropathy, 8 (8%) said it was caused by hypertensive nephropathy, and 6 (6%) said it was hereditary, as shown in Graph 1.

GRAPH 1 – Clinical characterization of patients with chronic kidney disease on hemodialysis. (n=100)



Fisher's exact test showed that CVD is linked to and depends on a family history of stroke and obesity. Pearson's chi-square test showed that

there is a significant association between smoking and CVD [$X^2(1) = 0.94$; $p = 0.004$].

the approach adopted for this intrinsically linked population, both in dialysis centers in Brazil and on a global scale.

In view of the conclusions reached and in line with the objective of the study, the discussion will be structured into topics: Social, economic, and clinical characteristics of CKD patients on hemodialysis and risk of stroke in CKD patients on hemodialysis based on modifiable and non-modifiable risk factors.

Social, economic, and clinical characterization of CKD patients on hemodialysis

The social and economic characterization of the participants in this study shows partial similarities with the findings of the study conducted in São Carlos, in the interior of São Paulo. In that study, most patients with CKD undergoing hemodialysis were male (63.7%), married (60%), and had low levels of education and monthly income. However, there were discrepancies in self-reported color/race, with a predominance of the white population (44%), and in income, with an average equivalent to one minimum wage, which differs from the reality observed in the current sample⁽⁸⁾. These discrepancies can be attributed to the ethnic and socio-economic specificities of the region of the patients involved in the study.

Low educational attainment and limited financial resources hinder health education and create barriers to professional strategies. The predominance of males, associated with gender patterns that discourage prevention, favors the progression of CKD⁽⁹⁾. The predominance of married people may be related to the age group, which is mainly composed of middle-aged or elderly individuals⁽¹⁰⁾. The existence of a partner or family support network has been shown to be a favorable factor in the health management of these individuals, as the presence of a partner and/or family support plays a mediating role in disease control, promoting self-care practices and healthy relationships in their daily activities.

The age group over 40 years was identi-

TABELA 4 – Associação entre o DCV e os fatores de risco modificáveis e não modificáveis para AVC: histórico de AVC na família, obesidade e tabagismo. (n=100)

Variable	CVB		p-value
	YES	NO	
History of stroke in the family			
Yes	9 (22,0)	32 (78,0)	0,001 ^a
No	3 (5,1)	56 (94,9)	
Smoking			
Yes	6 (23,1)	20 (76,9)	0,004 ^b
No	6 (8,1)	68 (91,9)	
Obesity			
Yes	4 (16,7)	20 (83,3)	0,001 ^a
No	8 (10,5)	68 (89,5)	

^a Fisher's exact test ^b Pearson's chi-square
Source: Research data.

Spearman's correlation showed a moderate, negative, and significant association between total cholesterol and dialysis time, showing that the longer the dialysis treatment time, the

lower the cholesterol levels, confirming the effectiveness of the treatment. Similarly, the longer the dialysis time, the lower and more controlled the SBP and DBP levels were. There was no statistically significant association between age and dialysis duration.

TABELA 5 – Associação entre tempo de diálise e os fatores de risco modificáveis para AVC: colesterol total e pressão arterial sistólica, diastólica e o fator de risco não modificáveis: idade. (n=100)

Variável	Correlation coefficient		p-value
	Dialysis duration		
Age	0,260	1,000	0,034a
Total cholesterol	-0,086	1,000	0,001 ^a
PAS/PAD	-0,008	1,000	0,004 ^a

^a Spearman correlation
Source: Research data.

DISCUSSION

This study addresses a relevant topic for CKD patients undergoing hemodialysis treatment, considering the risk of stroke in this population. The investigation is equally relevant for professionals and researchers working in the field, as it aims to identify the risk of stroke based on modifiable and non-modifiable risk

factors in individuals undergoing hemodialysis therapy.

Although relevant, this topic is still little addressed in the national literature. There are numerous manuals, guidelines, and studies on chronic kidney disease (CKD) and renal replacement therapy (RRT), with a strong focus on hemodialysis; however, the analysis of stroke risk in these patients is still treated in a summarized manner. The data presented in this context are likely to generate reflection on

fied as a significant predisposing factor for CKD, a finding that is supported by the literature. With advancing age, a gradual decline in glomerular filtration rate (GFR) is expected, reflecting impaired renal function associated with the natural aging process or exposure to diseases with potential renal damage⁽¹¹⁾. The annual decrease of approximately 0.08 ml in the glomerular filtration rate from the age of 40 contributes to increased renal vulnerability, resulting in the loss of the system's ability to maintain renal homeostasis⁽¹²⁾. This evidence strengthens the present study, considering the average of 55.04 ± 14.064 , which identifies the age group of 55 years as the average age of patients undergoing hemodialysis treatment at the aforementioned clinic.

Regarding the religion of the participants, the Catholic religion was predominant. The impact of spirituality has shown a marked influence on health; it is considered a protective factor, with preventive potential in the onset of diseases, as well as a possible reduction in deaths or effects of various health conditions, in addition to positively influencing the adaptation and resilience of patients with diseases⁽¹³⁾.

It is extremely important to note that many patients from other cities depend on public transportation or even private means of transportation to reach the clinic where they undergo RRT. Older individuals who need transportation back to their cities after hours of travel have reported discomfort, weakness, and nausea, which intensified during the trip after the hemodialysis session⁽¹⁴⁾. This is a concern, given that in the present study, of the 100 patients undergoing hemodialysis at the nephrology clinic in the city of Campo Maior, 88% reside in other cities in Piauí.

Diabetes mellitus and high blood pressure are common in patients with chronic kidney disease on RRT, and strict blood pressure control is essential to slow the progression of CKD due to its association with hypertensive nephrosclerosis⁽¹⁵⁾. As for cholesterol, differences between the sexes are attributed to female hormones, which raise HDL and lower LDL during

the reproductive phase; after menopause, LDL increases in women, raising the risk of coronary artery disease⁽¹⁶⁾.

Risk of stroke in CKD patients on hemodialysis based on modifiable and non-modifiable risk factors

SHA is a chronic, usually silent disease that affects a large proportion of Brazilian adults and is characterized by blood pressure levels above 140/90 mmHg. The study showed that longer dialysis, combined with appropriate treatment and lifestyle changes, reduces blood pressure and controls hypertension⁽¹⁷⁾. In addition, although smoking has declined in the country, there is still a high prevalence of associated diseases, especially among former smokers who quit after receiving guidance on the risks⁽¹⁸⁾.

It was observed that, despite their clinical conditions, most hemodialysis patients had an acceptable lipid profile. Hemodialysis has been shown to be effective in improving survival and quality of life⁽¹⁹⁾, which in this study is related to advances in medical knowledge about cardiovascular risks and the evolution of treatments.

Studies show an intrinsic relationship between obesity and an increased risk of cardiovascular disease, given the association between physiological and metabolic changes and obesity that may contribute to this risk. Added to this is a sedentary lifestyle, recognized as an independent risk factor for cardiovascular disease⁽²⁰⁾. Given this, weight reduction combined with dietary re-education and increased physical activity in daily life can significantly influence the reduction of risk factors associated with obesity⁽²¹⁾.

Many patients undergoing renal replacement therapy have cardiovascular disease, often due to ventricular hypertrophy, chronic volume overload, oxidative stress, inflammation, and anemia. A better understanding of the impact of these factors related to cardiovascular disease, with an emphasis on stroke, is needed for prevention and treatment⁽²²⁾.

The study corroborates other evidence⁽²³⁾, in which several factors act comple-

mentarily in the association between renal failure and cardiovascular risk. Among the main factors, direct vascular damage due to hypertension and hyperglycemia, endothelial dysfunction, inflammation, vascular stiffness, dyslipidemia, calcium and phosphate imbalances, and changes in the renal glomerulus and heart muscle were highlighted. Modifiable risk factors such as physical inactivity, obesity, dyslipidemia, and smoking were also observed.

CONCLUSION

Data analysis identified significant associations between the risk of stroke and socioeconomic, demographic, and clinical variables in patients with chronic kidney disease (CKD) undergoing hemodialysis. Family history of stroke and the presence of cardiovascular diseases stood out as non-modifiable risk factors, suggesting a predisposition that requires continuous monitoring.

Among the modifiable factors, an association was observed between smoking and obesity with the occurrence of cardiovascular diseases, reinforcing the need for interventions aimed at lifestyle changes. In addition, it was found that adequate adherence to hemodialysis treatment is related to improved blood pressure levels and reduced total cholesterol, indicating that clinical control can mitigate some of the cardiovascular risks in this population.

The findings confirm the hypothesis that the risk of stroke in patients with CKD is influenced by multiple interdependent factors, involving both clinical conditions and lifestyle habits and socioeconomic aspects. Thus, the study contributes to the construction of a practical hierarchy of risk factors, which can support individualized care strategies and more effective preventive actions in the context of nursing and public health. Therefore, the importance of a multidisciplinary approach in the early identification and monitoring of these factors is emphasized, with a view to improving the prognosis and quality of life of these patients.

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