

Mortality from chronic kidney disease secondary to hypertension in Brazil: a study of the "Global Burden of Disease"

Mortalidade por doença renal crônica secundária à hipertensão no Brasil: um estudo do "Global Burden of Disease"

Mortalidad por enfermedad renal crónica secundaria a hipertensión en Brasil: un estudio de la "Global Burden of Disease"

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ABSTRACT

Background and Objectives: Chronic kidney disease (CKD) is one of the main complications resulting from arterial hypertension, and a recent increase in the incidence and prevalence of the disease has been reported, which can lead to an increase in mortality and complications resulting from the disease. Thus, the objective of study is to describe the variations in mortality from CKD secondary to arterial hypertension, in Brazil, between the years 1990 to 2019. **Methods:** Epidemiological study, with a quantitative approach and descriptive character, which analyzed data from the "Global Burden of Disease Study" (GBD) tool. **Results:** In all of Brazil's federative units, the estimate of deaths from CKD secondary to hypertension increased, with the Southeast region having the highest estimates. The States of Rio de Janeiro, Rio Grande do Sul, and Paraíba lead with the highest mortality rates. Regarding sex, in all years, higher rates were observed in males, however, over the years, this difference has been reduced. The age group of ≥ 70 years was the most affected, standing out with the highest death rates. **Conclusion:** the burden of CKD in Brazil has increased in the last 30 years; among the regions of the country, the Southeast recorded the highest estimates of deaths in all the years analyzed, being mainly higher among men.

Keywords: Mortality, Chronic Kidney Disease, Arterial Hypertension, Epidemiology.

RESUMO

Justificativa e objetivos: A doença renal crônica (DRC) é uma das principais complicações decorrentes da hipertensão arterial. Nos últimos anos, tem sido relatado um aumento na incidência e prevalência da doença, o que pode levar ao aumento da mortalidade e das complicações decorrentes da doença. Assim, o objetivo deste estudo

foi descrever as variações da mortalidade por DRC secundária à hipertensão arterial no Brasil entre 1990 e 2019. **Métodos:** Trata-se de um estudo epidemiológico, de abordagem quantitativa e caráter descritivo, que analisou dados da ferramenta *Global Burden of Disease Study* (GBD). **Resultados:** Em todas as unidades da federação, a estimativa de mortes por DRC secundária à hipertensão apresentou aumento, a região Sudeste apresentando as maiores estimativas. Os estados do Rio de Janeiro, Rio Grande do Sul e Paraíba lideram as pesquisas com as maiores taxas de mortalidade. No que diz respeito ao sexo, em todos os anos foram observadas maiores taxas de DRC em indivíduos do sexo masculino; contudo, nota-se que tem ocorrido uma redução dessa diferença. A faixa etária de ≥ 70 anos foi a mais acometida, destacando-se com as maiores taxas de mortes. **Conclusão:** a carga de DRC no Brasil aumentou nos últimos 30 anos. Entre as regiões do país, o Sudeste registrou as maiores estimativas de mortes em todos os anos analisados, principalmente de homens.

Descritores: Mortalidade, Doença renal crônica, Hipertensão Arterial, Epidemiologia.

RESUMEN

Justificación y objetivos: La enfermedad renal crónica (ERC) es una de las principales complicaciones derivadas de la hipertensión arterial, y en los últimos años se ha reportado un aumento en la incidencia y prevalencia de la enfermedad, lo que puede conducir a un aumento de la mortalidad y de las complicaciones derivadas de esta, por lo tanto, el objetivo del estudio es describir las variaciones en la mortalidad por ERC secundaria a la hipertensión arterial en Brasil entre los años 1990 a 2019. **Métodos:** Estudio epidemiológico, con enfoque cuantitativo y carácter descriptivo, que analizó datos de la herramienta *Global Burden of Disease Study* (GBD). **Resultados:** En todas las unidades de la federación, aumentó la estimación de muertes por ERC secundaria a la hipertensión arterial, con la región Sudeste presentando las estimaciones más altas. Los estados de Rio de Janeiro, Rio Grande do Sul y Paraíba lideran con las tasas de mortalidad más altas. Con respecto al sexo, en todos los años se observaron mayores tasas en los varones, sin embargo, con el paso de los años, esta diferencia se ha ido reduciendo. El grupo de edad de ≥ 70 años fue el más afectado, destacándose con las tasas de mortalidad más altas. **Conclusión:** la carga de ERC en Brasil ha aumentado en los últimos 30 años; de las regiones del país, el Sudeste registró las mayores estimaciones de muertes en todos los años registrados entre los analizados, siendo principalmente mayor entre los hombres.

Palabras-clave: Mortalidad, Enfermedad renal crónica, Hipertensión arterial, Epidemiología.

INTRODUCTION

Systemic Arterial Hypertension (SAH) is a multifactorial and complex disease, characterized as an important risk factor for the development of cardiovascular and kidney diseases.¹ Several impacts can be generated by the high global burden of hypertension: from individual impacts, evidenced by the reduction of the quality of life of hypertensive patients,² to economic and administrative impacts on society and health systems.^{3,4}

Among the diseases that can be developed due to ineffective control of SAH, one that stands out is chronic renal failure, also known as chronic kidney disease (CKD). This disease is characterized by the occurrence of kidney damage of at least three months that can cause changes and the progressive decline in renal function.⁵ CKD and SAH are important public health problems worldwide, being highly prevalent in low- and middle-income countries, and there is a direct relationship among them: CKD can be the result of uncontrolled SAH, as well as be responsible for the progression and resistance of SAH. Furthermore, the correlation between these two conditions increases the risk of cardiovascular and cerebrovascular outcomes.^{5,6}

Recent estimates have shown that the prevalence and incidence of patients undergoing dialysis treatment in Brazil has been increasing significantly. This event is

possibly related to the aging process of the population and to the demands for improvements in care and access to dialysis services. As the underlying cause, uncontrolled chronic hypertension stands out for continuing to be the main event related to the development of CKD. Additionally, the overall mortality rate due to CKD also showed an significant increase.^{7,8}

Due to the global increase in the number of patients with CKD who are developing end-stage renal disease and require kidney replacement therapy, the implementation of measures aimed at improving awareness and early diagnosis is urgent in order to establish early management and treatment, thus preventing the evolution to terminal stages.³

Studies on the global burden of diseases allow identifying and comparing changes in disease patterns worldwide, as well as understanding variations, neglected conditions, risk factors, and the possible impacts generated by the high burden of diseases in different countries, thus serving as an effective tool to assist in the formulation of health policies, in the decision-making of health professionals and researchers, and in assisting the development of prevention strategies.⁹

In this context, our study aims to describe the variations of mortality rate for CKD secondary to hypertension, in Brazil, between 1990 and 2019.

METHODS

This is an epidemiological study, with a quantitative approach and descriptive character, that analyzed data from the *Global Burden of Disease Study (GBD)*, a software that stores global, national, and regional data on diseases, including prevalence, incidence, deaths, and disability-adjusted life years. The GBD is led and administered by the Institute for Health Metrics and Evaluation at the University of Washington, which enables timely, relevant, and scientifically valid evidence to improve health policies and practices.¹⁰

The information used was collected from January 3 to 8, 2022, and was obtained through the latest available version of GBD, version 2019, its online version is available on the Institute's website (<https://vizhub.healthdata.org/gbd-compare/>). The tool adopts an uncertainty interval of 95% (UI 95%) considering uncertainties arising from the following components: sample size used, adjustments to data sources for the estimation of all-cause mortality, regression model specifications for Gaussian space-time processes, model life table systems, and specifications and estimations of the specific cause model.¹¹

The data presented in this study refer to mortality from chronic kidney disease secondary to hypertension, in Brazil, from 1990 to 2019. The analysis lists the mortality rate per 100,000 inhabitants, adjusted by federative units; the comparison of mortality in Brazil in 1990 and 2019; and the proportional distribution of the number of deaths per region, according to gender and age group.

Additionally, the data were analyzed and expressed

by descriptive statistics, with absolute and relative frequency distribution. This study uses secondary data from GBD – a tool that stores health information from around the world – and is free from identification and rights of use. Thus, it was not necessary to submit the study to the Research Ethics Committee (CEP) involving human beings, as mentioned in Resolution No. 510/2016 of the National Health Council.

RESULTS

The mortality rate for CKD secondary to hypertension showed an increase over the years and in a heterogeneous manner among all units of the Brazilian federation (Figure 1). Among the States, in 1990, Paraíba led with a rate of 3.2 deaths per 100,000 inhabitants, followed by Rio de Janeiro and Minas Gerais, with 2.91 and 2.88, respectively. From 1996, Rio de Janeiro surpassed Paraíba and came to occupy first place, with the mortality rate estimated at 3.79 in the following years. The most recent data available – 2019 – shows the State of Rio de Janeiro with the highest mortality rates. In 2019, the states of Rio de Janeiro, Rio Grande do Sul, and Paraíba recorded the highest mortality rates: 7.44, 6.65, and 5.97, respectively.

Table 1 shows the comparison of the mortality rate of CKD due to hypertension in Brazil, between 1990 and 2019. For all age groups and both sexes, it is possible to observe the increase in the mortality rate in the country. In 1990, the mortality rate per 100,000 inhabitants was 2.41 deaths; whereas in 2019, the estimate was 5.38.

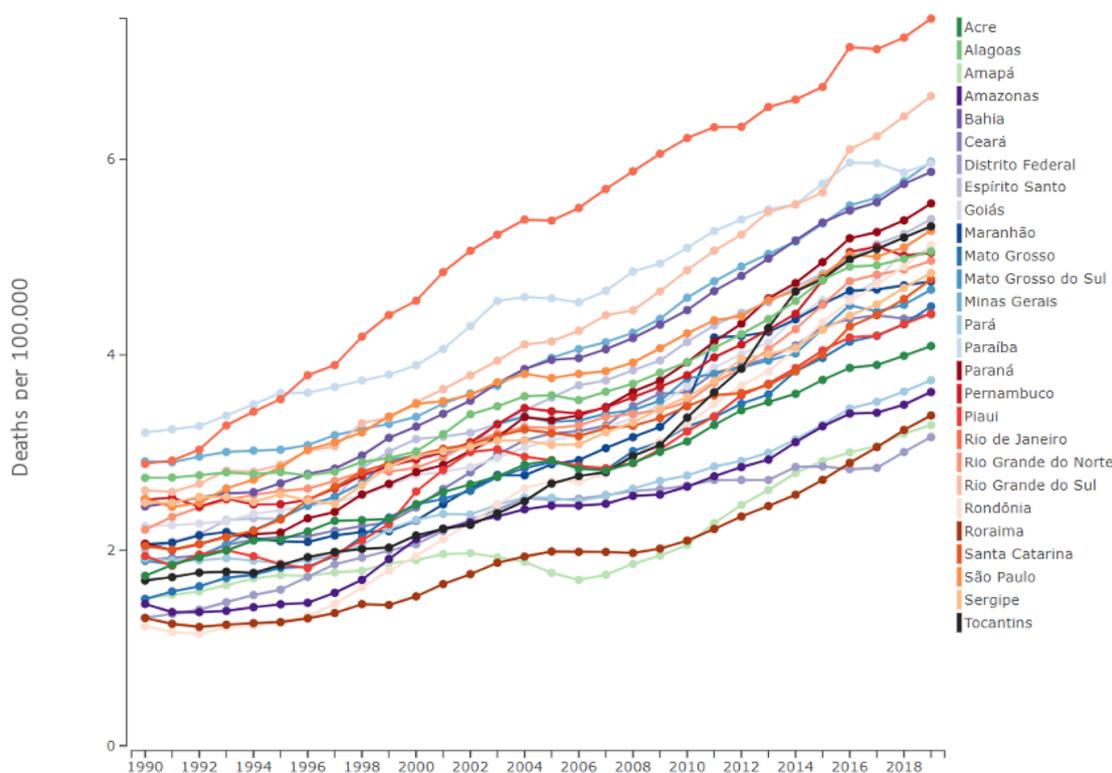


Figure 1. Mortality rate due to chronic kidney disease secondary to hypertension over time (1990-2019), in all ages and both sexes.

Table 1. Comparison of mortality due to chronic kidney disease secondary to hypertension in the 1990s.

Country	MR 1990	MR 2019
Brazil	2.41	5.38

Note: MR 1990: Mortality rate per 100,000 inhabitants in 1990; MR 2019: Mortality rate per 100,000 inhabitants in 2019.

Source: Global Burden of Disease Study, 2019. Adapted by the authors

Regarding the average estimate of the number of deaths due to CKD secondary to hypertension in the studied period, we observed that in all units of the federation there was an increase in the number of deaths (Table 2). In the North region, the state of Pará had the highest values for both years: 93, in 1990, and 345, in 2019. In the Northeast, the state of Bahia had the highest number of deaths, with 296, in 1990, and 937, in 2019; followed by the state of Pernambuco: 183 and 511, in 1990 and 2019, respectively. In the Midwest region, the state of Goiás had 93 deaths, in 1990, and 363 deaths, in 2019, making it

the State with the highest number of deaths. In the South and Southeast regions, the highest numbers of deaths were observed in the states of São Paulo and Rio Grande do Sul – São Paulo with 809, in 1990, and 2,486, in 2019; and Rio Grande do Sul with 242, in 1990, and 751, in 2019. We identified an increase in the number of mortality in all regions, with the Southeast region presenting the highest percentage – 1,684 (47.24%), in 1990, and 5,313 (45.55%), in 2019 – followed by the Northeast region, with 1,020 (28.78%), in 1990, and 3,199 (27.43%), in 2019 (Table 3).

Regarding the distribution of mortality by sex, we found that mortality was higher among males for both years, with a proportional distribution of 53.2%, in 1990, and 50.6%, in 2019. Thus, we can observe that there was a reduction in the difference in the number of deaths between the sexes (Table 4).

According to the deaths distributed by age group, the highest number was observed among individuals in the age group of ≥70 years, with 2,045 and 8,123 deaths,

Table 2. Average estimate of deaths and mortality rate due to chronic kidney disease secondary to hypertension, in 1990 and 2019, according to the federative units.

Region/FU	1990	UI 95%	MR	2019	UI 95%	MR
North						
Acre	7	5 - 8	1.74	38	30 - 46	4.09
Amapá	4	3 - 4	1.51	28	22 - 33	3.28
Amazonas	30	24 - 36	1.45	153	122 - 189	3.62
Pará	93	73 - 115	1.92	345	277 - 426	3.74
Rondônia	13	10 - 17	1.22	91	73 - 111	5.12
Roraima	2	2 - 3	1.31	20	16 - 24	3.38
Tocantins	15	12 - 19	1.69	87	70 - 107	5.32
Northeast						
Alagoas	70	56- 86	2.74	185	147 - 227	5.06
Bahia	296	239 - 363	2.45	937	733 - 1178	5.87
Ceará	123	96 - 154	1.9	442	344 - 562	4.41
Maranhão	104	77 - 135	2.06	397	314 - 498	4.75
Paraíba	104	83 - 130	3.2	261	205 - 319	5.96
Pernambuco	183	149 - 222	2.52	511	413 - 623	5.04
Piauí	51	40 - 64	1.94	163	131 - 199	4.42
Rio Grande do Norte	54	43 - 66	2.21	185	144 - 232	4.96
Sergipe	37	29 - 45	2.49	116	91 - 145	4.84
Midwest						
Brasília	21	16 - 26	1.31	95	76 - 119	3.16
Goiás	93	73 - 116	2.25	363	285 - 455	5.29
Mato Grosso	30	23 - 36	1.5	162	129 - 199	4.5
Mato Grosso do Sul	34	27 - 40	1.89	132	105 - 162	4.67
Southeast						
Espírito Santo	52	42 - 63	2.01	214	169 - 263	5.39
Minas Gerais	465	373 - 560	2.91	1296	1047 - 1590	5.97
Rio de Janeiro	377	305 - 448	2.88	1315	1064 - 1593	7.44
São Paulo	809	653 - 972	2.53	2486	1945 - 2953	5.27
South						
Paraná	177	143 - 211	2.07	632	509 - 777	5.55
Rio Grande do Sul	242	196 - 288	2.61	751	601 - 919	6.65
Santa Catarina	93	74 - 111	2.04	342	269 - 423	4.77
TOTAL	3565			11664		

Note: FU: Federative Unit. UI 95%: Uncertainty Interval 95%. MR Mortality rate per 100,000 inhabitants.

Source: Global Burden of Disease Study, 2019. Adapted by the authors

Table 3. Average estimate of deaths and mortality rate due to chronic kidney disease secondary to hypertension, in 1990 and 2019, according to the federative units.

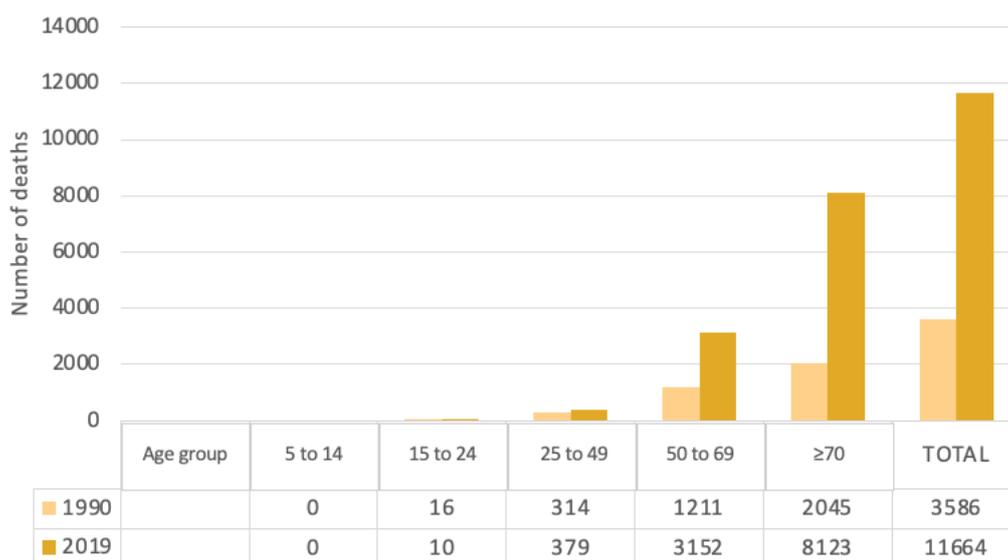
Region	1990 NOD* 1990	PD**(%)	NOD 2019	PD (%)
North	166	4.66	675	5.79
Northeast	1 026	28.78	3199	27.43
Midwest	177	4.96	753	6.46
Southeast	1684	47.24	5313	45.55
South	512	14.36	1724	14.78
Total	3565	100	11664	100

Note:*NOD: Number of deaths per region. **PD: Proportional distribution (NOD*/TOTAL)×100. Source: Global Burden of Disease Study, 2019. Adapted by the authors.

Table 4. Average estimate of deaths and mortality rate due to chronic kidney disease secondary to hypertension, in 1990 and 2019, according to the federative units.

Sex	ND (1990)	PD**(%)	ND 2019	PD (%)
Male	1897	53.2	5902	50.6
Female	1668	46.8	5762	49.4
TOTAL	3565	100	11.664	100

Note:*ND: Number of deaths. **PD: Proportional distribution (ND*/TOTAL)×100. Source: Global Burden of Disease Study, 2019. Adapted by the authors.



Graph 1. Distribution of deaths from chronic kidney disease secondary to hypertension in Brazil, according to age group.

Source: Global Burden of Disease Study, 2019. Adapted by the authors.

in 1990 and 2019, respectively. Followed by the age range of 50 to 69, with 1,211 deaths, in 1990, and 3,152, in 2019. In the range of 5 to 14, for both years, no death was identified by the disease (Graph 1).

DISCUSSION

CKD affects, approximately, 10% of the world's population and every year there has been an increase in the prevalence of CKD, both in Brazil and worldwide. The development of the disease is mainly related to diseases such as diabetes and SAH.^{12,13} Accordingly, this study showed, indirectly, that the prevalence of CKD in Brazil

has been increasing, since the mortality rate showed a significant increase in all federative units, between 1990 and 2019 (Figure 1). This increase can be explained by the high prevalence of nocturnal hypertension, a resistant and uncontrolled asymptomatic hypertension, which causes long-term hypertensive nephroangiosclerosis.¹⁴

Kidney disease, in many cases, is asymptomatic or oligosymptomatic, expressing signs only when progressing to further stages of severity, which makes early diagnosis difficult.¹⁵ A study conducted with hypertensive patients in the state of Santa Catarina pointed out that 45% of these patients surveyed already had stage 2 CKD, which shows the importance of early detection

of the disease for a proper management focused on its control.¹⁵ An important parameter used for the detection, evaluation, treatment, and prognosis of CKD is the glomerular filtration rate (GFR), since it helps to understand the number of functional nephrons.¹⁶

CKD can be defined by the presence of the following factors: sustained reduction of GFR below 60 mL/min/1.73m²; proteinuria, with presence of albumin in urine ≥ 30 mg for 24 hours; abnormalities in urinary sediment; hematuria; or a histology suggestive of injury.^{5,6}

According to the results of this research, the mortality rate and the overall number of deaths due to CKD increased in Brazil. This finding is similar to that seen in another study that revealed a growth in the number of patients of the Unified Health System (SUS) with CKD, undergoing dialysis treatment, along with high numbers of deaths from treatment abandonment.¹³ The results are also in agreement with the increase in prevalence and death from CKD in other parts of the world.¹⁷

Regarding the regions of the country, the Southeast region had the highest mortality rates due to CKD, followed by the Northeast region. A study that analyzed the situation of CKD in Brazil found that the highest prevalence of CKD was in the Southeast and Northeast region of Brazil, which can be explained by the high population density of these regions. Additionally, the high rates of death in the region can also be explained by the process of population aging, the epidemiological and demographic transition, and the increase in diseases such as SAH.^{18,19}

Mortality due to CKD secondary to SAH in males was higher than in females for all the analyzed years. Similarly, a previous study evaluating patients treated in a hemodialysis service showed that men are the most affected by CKD due to hypertension than women, as shown in another study that observed that men had higher blood pressure values, lower GFR, and higher serum creatinine levels in relation to women, suggesting a greater risk.²⁰ Older women, however, presented events contrary to those observed in younger women, a relationship that did not occur in the analysis among men. This shows that differences in gender and age should be considered.²¹⁻²³ Such differences are possibly related to the protective effects of estrogen in women and/or the deleterious effects of testosterone in association with bad life habits in men, which causes a faster decrease in GFR in the male population.²⁴

Regarding age groups, the vast majority of deaths were observed at ages above 50 years, specially in patients over 70 years of age, which corroborates other studies that showed that the highest mortality rate due to CKD was present in the age group above 60 years.²⁵ Moreover, it was observed that individuals aged 45 years are among the most prevalent population in dialysis treatment centers.^{7,8}

In this sense, aging is an important risk factor, since, in this process, events such as arteriosclerosis with concomitant progressive loss of renal function, evidenced by the reduction of GFR with advancing age, may further

compromise renal function in the presence of diseases such as SAH, which presents itself as one of the most prevalent diseases in the elderly, generating direct stress on the renal system.²⁶

In the context of the detection and prevention of CKD and SAH, primary health care stands out as an important measure, which, with programs such as *HiperDia*, can perform follow-up and request tests during consultations, in order to identify and reduce early diseases related to SAH and diabetes, which are the main risk factors for the development of CKD.²⁷

Annually, billions of money is directed to the treatment of CKD patients worldwide, which generates a direct impact on the economy and local development of countries, showing the importance of prevention strategies for the main risk factors for CKD, such as SAH, as well as a timely diagnosis.²⁸

This study has limitations, regarding not only those inherent to the *Global Burden of Disease Study* but also those of the data sources, which depend on the accuracy with which the underlying cause of death is attributed, which can be complicated when multimorbidities are present. Nonetheless, this study showed the importance of describing mortality from CKD secondary to hypertension in Brazil, and may, in the future, support not only new policies but also comparative and intervention studies that monitor the transitions in trends of prevalence, incidence, and mortality of SAH and CKD.

With this study, we observed that the burden of CKD in Brazil increased in the last 30 years along with its mortality, which increased in all regions and federative units of the country; the Southeast being the region with the highest estimates of deaths in all years analyzed. Mortality was mainly higher among males but showed a tendency toward the inversion of this reality. Regarding the age group, deaths were higher in individuals over 70 years of age.

Thus, with SAH being an important risk factor for the development of CKD, we would like to draw attention to strategies and efforts aimed at the early identification and prevention of the disease, in concomitance with the strengthening of strategies for early detection of CKD, so that adequate management and treatment is carried out in a timely manner, in order to mitigate the risk of evolution to the terminal stage of the disease.

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AUTHORS' CONTRIBUTIONS

Matheus Vinicius Barbosa da Silva and **Viviane de Araújo Gouveia** contributed to the conception, design, analysis, and writing of the article. **Matheus Vinicius Barbosa da Silva**, **Carlos Antonio de Lima Filho**, **Amanda de Oliveira Bernardino**, and **Viviane de Araújo Gouveia** contributed to the planning and design of the article and the review and final approval of the article.

All authors approved the final version of the manuscript and declare themselves responsible for all its aspects, guaranteeing their accuracy and integrity.