# ASSESSMENT OF GLOMERULAR FILTRATION RATE AS AN INDICATOR OF LOSS OF RENAL FUNCTION IN PATIENTS WITH HYPERTENSION AND DIABETES

*AVALIAÇÃO DA TAXA DE FILTRAÇÃO GLOMERULAR COMO INDICADORA DA PERDA DE FUNÇÃO RENAL EM PACIENTES COM HIPERTENSÃO E DIABETESS*

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## ABSTRACT

**Introduction:** The glomerular filtration rate (GFR) assesses kidney function and the extent of a chronic dysfunction. The GFR changes over the years, allows early recognition of dysfunctions, and determines its severity. Thus, the determination of GFR supports clinical decisions, such as prognosis, treatment, and possible complications. **Objectives:** This study aimed to assess the GFR in patients with type 2 diabetes mellitus and systemic arterial hypertension to determine their cardiovascular and nephrological risk due to the pattern of loss of renal function. **Methods:** Patients selected were aged ≥ 45 years and from the clinical school Dr. Carlos Brandt, at the Faculdade de Medicina de Olinda. The GFR was determined using the CKD-EPI equation, recommended by the National Kidney Foundation of the USA.

**Keywords:** Diabetes mellitus; Glomerular filtration rate; Systemic arterial hypertension,

## RESUMO

**Introdução:** A determinação da taxa de filtração glomerular é uma maneira de avaliar a função renal, que pode estabelecer a extensão de disfunção renal crônica. É uma determinação que se modifica ao longo dos anos, pois permite reconhecer disfunções ainda em fase precoce determinando o grau de severidade da disfunção, e assim auxilia na tomada de decisão clínica, podendo influenciar o tratamento, estabelecendo o prognóstico e antecipando complicações futuras. **Objetivos:** O intuito desse trabalho foi avaliar a taxa de filtração glomerular em pacientes da clínica escola Dr. Carlos Brandt da Faculdade de Medicina de Olinda portadores de diabetes mellitus e hipertensos com idades igual ou superior a quarenta e cinco anos pela equação CKD-EPI, atualmente recomendada pela Fundação Nacional de Rins dos EUA, com o objetivo de avaliar os riscos cardiovasculares e nefrológicos em decorrência do padrão de perda da função renal.

**Palavras-chave:** Diabetes mellitus; Hipertensão arterial sistêmica; Taxa de filtração glomerular

## INTRODUCTION

The glomerular filtration rate (GFR) is used to assess kidney function and the extent of chronic kidney disease (CKD). The determination of GFR changes over the years, allows early recognition of dysfunctions, and determines its severity. Thus, aids clinical decision-making, influences treatment, and establishes a prognosis and possible complications.[1]

The Kidney Disease (KDIGO) recommends the CKD-EPI equation from 2021 to estimate GFR (ml/min/1.73 $m^2$). Healthy individuals show a GRF ≥ 90, which is considered normal. Values between 60 and 89 without kidney damage are considered normal, particularly in older individuals and children. These values are associated with kidney damage (e.g., proteinuria) for three or more months, suggesting an initial kidney disease. A GFR < 60 for three or more months already indicates CKD.[1]

CKD is defined by its cause and abnor-

malities of function or morphology persisting for more than three months, with implications for health. In addition, CKD is characterized as an estimated GFR (eGRF) < 60 mL/min or alterations in the urine test, especially albuminuria (30 mg/ 24h or albuminuria and creatinuria ratio of 30 mg/g), or renal morphology (GR: I; NE: C).[2] The classification and prognosis of CKD is based on eGFR and albuminuria values. Systemic arterial hypertension (SAH) is a cause and consequence of CKD and progressively increases together with the decline in kidney function, affecting 90% of patients in stage five (GR: I; NE: A).[3,4]

The classification or staging of CKD allows stratification of the progression risk and complications. The KDIGO guidelines from 2012 state that when patients are diagnosed with the described criteria, staging should follow the cause of the disease, eGFR (in six categories or G stages), and albuminuria (three categories or A stages).[5]

In clinical practice, the qualitative assessment of the excretory capacity of the kidney uses the plasmatic concentration of creatinine.[6] A simpler method compared with the endogenous creatinine clearance test with 24-hour urine collection, which is more accurate but with laborious execution and prone to errors. The GFR is determined using calculations based on age and sex, factors known to affect the result.[7,8]

Albuminuria or proteinuria (expressed in mg/g of creatinine) was categorized as A1 (normal or slightly increased, < 30 mg/g), A2 (moderately increased, between 30 and 300 mg/g) and A3 (markedly increased, > 300 mg/g), replacing the terms normoalbuminuria, microalbuminuria, and macroalbuminuria.[9]

Therefore, this study aimed to assess the GFR in patients with type 2 diabetes mellitus (DM) and SAH to establish a correlation and investigate future consequences on quality of life.

## METHODS

A quantitative epidemiological, cross-sectional, and analytical study was conducted to assess the GFR using the CKD-EPI equation of patients with type 2 DM and SAH. The study was performed with patients from the clinical school Dr. Carlos Brandt at the Faculdade de Medicina de Olinda, Pernambuco, Brazil.

The study included patients of both sexes and aged ≥ 45 years. Patients with known advanced kidney disease (GFR < 30 ml/ min/1.73m$^2$) and on dialysis were excluded from the study.

A clinical file was created with information on age, sex, race, levels of blood pressure, urea, creatinine, fasting blood glucose, glycated hemoglobin, and anthropometric data (weight and height) to calculate body mass index (BMI).

The GFR was calculated in the National Kidney Foundation application, with values expressed as ml/min/1.73m$^2$, and categorized according to the degree of reduction in kidney function following the criteria of updated guidelines.

The data was compiled for statistical analysis to identify the prevalence of patients with reduced GFR, correlating with the main risk factors.

The statistical analysis was performed using the Predictive Analytics Software (PASW® STATISTIC, version 17.0). Initially, a descriptive analysis was used for the maximum and minimum values, mean, and standard deviation for quantitative variables. For the qualitative variables, the absolute and relative values were described. Pearson's Chi-squared test was used to verify the association between variables. The confidence interval established was 95%.

The study was approved by the institutional review board of the Faculdade de Medicina de Olinda (no. 4.789.832).

## RESULTS

A total of 99 patients were included in the final sample. Ages ranged from 45 to 86 years (mean age 66 ± 10.3 years); 69.7% (n = 70) were women and 30.3% (n = 30) were men. Regarding race, 53.5% (n = 54) were white, 44.4% (n = 44) black, and 2.0% (n = 2) brown. Among them, 55.6% (n = 56) had type 2 DM, 92.9% (n = 93) had SAH, and 37% had both comorbidities. In addition, 9.1% (n = 9) had an acute myocardial infarction, and 5.1% (n = 5) had undergone a cardiac procedure, surgical or percutaneous

revascularization.

Concerning medication, 8.1% (n = 8) used sulfonylureas, 34.3% (n = 34) metformin, 4.0% (n = 4) Hagedorn neutral protamine insulin, and 1.0% (n = 1) regular insulin. In addition, 33.3% (n = 33) used beta-blockers, 34.3% (n = 34) calcium channel blockers, 54.5% (n = 54) diuretics, 15.2% (n = 15) angiotensin-converting enzyme inhibitors, 62.6% (n = 62) angiotensin receptor blockers, and 3.0% (n = 3) direct vasodilators.

The anthropometric assessment showed that weight ranged from 49 to 109 kg (73± 14.1), and based on BMI, 37% were obese, 24% were grade I, 7% were grade II, and 6% were grade III. Laboratory tests showed urea levels between 17 and 108 (39.18 ± 15.15), creatinine levels between 0.50 and 2.11 (0.98 ± 0.27); glucose levels between 9.30 and 296 (123.85 ± 49.84), and glycated hemoglobin levels between 4.20 and 10.80 (6.41 ± 1.50).

Based on the eGFR application, the CKD-EPI equation ranged between 32 and 130.20 (72.45 ± 19.58), and the Cockcroft-Gault equation ranged between 27.48 and 206.1(74.42 ± 28.18). The CDK-EPI equation showed 20% (n = 20) of patients classified as G1 (GFR ≥ 90) with 11% (n = 11) women and 9% (n = 9) men, 55% (n = 51) as G2 (89 ≤ GFR ≤ 60) with 42% (n = 42) women and 13% (n = 13) men, and 25% as G3 (59 ≤ GFR ≤ 30) with 18% (n = 18) women and 7% (n = 7) men, without patients as G4 (29 ≤ GFR ≤ 15) or G5 (GFR < 15).

This study investigated the association between sociodemographic (age, sex, and BMI), morbidity variables (SAH and DM), and outcomes in the reduction of GFR. A significant association was not observed between SAH and reduction in GFR (p = 0.099) and between DM and reduction in GFR (p = 0.288) and BMI (p = 0.454). In contrast, G2 and G3 were significantly associated with age > 60 years (61.4%, p = 0.032), and the best GFR rates (G1) were related to age < 60 years.

## DISCUSSION

This quantitative epidemiological, cross-sectional, and analytical study assessed the GFR in patients with type 2 DM and SAH using the CKD-EPI equation to evaluate cardiovascular and nephrological risks related to the loss of renal function. The National Kidney Foundation of the United States of America recommends the CKD-EPI equation to estimate the GFR using the values of serum creatinine, age, and sex[1]. This study associated sociodemographic and morbidity variables with the reduction in GFR. However, only age > 60 years was significantly associated with the different stages of GFR, which helps to identify vulnerable patients that require monitoring and treatment targets.

SAH was correlated with GFR to investigate consequences in the quality of life of the patients since it is the most important risk factor for the progression of kidney damage.[10] The impact of uncontrolled blood pressure in the glomerular hemodynamics has a direct effect on factors associated with kidney damage, such as the activation of the renin-angiotensin system and proteinuria, which require appropriate pressure adjustments to be controlled.[11]

Type 2 DM is independently associated with a significant increase in mortality due to cardiovascular and renal causes. Diabetes kidney disease is a complication of DM characterized by impaired kidney function, with high morbidity and mortality rates, and the leading cause of kidney failure worldwide. Between 20% and 50% of patients with DM are estimated to develop kidney disease, affecting around 30% of patients with type 1 DM and being the main cause of death, while the prevalence ranges from 20% to 50% in patients with type 2 DM.[12]

Regarding sociodemographic variables, BMI is an important indicator of CKD risk factors, especially associated with increased abdominal circumference, although independent of GRF decline.[13] Moreover, the association of increased GFR with age is widely documented in relation to other risk factors for CKD. Kidney function is stable between childhood and adulthood, and GFR declines one mL/min/1.73 m² per year after 30 years old in healthy people.[14] Decreased kidney function occurs due to changes in the structure of the kidney associated with aging.

Thus, although this study only significantly associated age with decreased GFR, the lit-

erature confirms that other variables assessed are related to the decline in GFR. A potential limitation of this study was that the patients assessed may not represent the total population in the routine clinical setting.

## CONCLUSION

The study assessed the GFR in patients with type 2DM and SAH using the CKD-EPI equation. The data showed an association between the decrease in GFR and age. Thus, anthropometric data and comorbidities were not associated with GFR, showing that these variables did not influence the decline in kidney function. This data shows the importance of monitoring and assessing GFR in patients with DM and SAH along with aging.

The association of SAH and DM was more frequent with increased age, especially over 60years, an important consideration given the relevance of these factors in the progression of CKD and increased cardiovascular risk. Furthermore, levels of glycemia, glycated hemoglobin, and blood pressure were not within target for most patients.

In conclusion, monitoring renal function in older patients is essential to reduce the risk of total kidney failure and to establish conservative approaches to control this function. In addition, the referral of patients to services could delay the progressive loss of renal function and the need for renal replacement therapy, dialysis, and transplantation.

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