Estimated glomerular filtration rate in patients with type 2 *diabetes mellitus*

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Summary

Objective: to estimate the glomerular filtration using the Cockcroft-Gault (CG), Modification of Diet in Renal Disease (MDRD), and Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equations, and *serum* creatinine in the screening of reduced renal function in patients with type two diabetes (T2DM) enrolled in the Family Health Strategy (ESF, Brazilian federal healthcare program).
Methods: a cross-sectional descriptive and analytical study was conducted. The protocol consisted of sociodemographics, physical examination and biochemical tests. Renal function was analyzed through *serum* creatinine and glomerular filtration rate (GFR) estimated according to the CG, MDRD and CKD-EPI equations, available on the websites of the Brazilian Nephrology Society (SBN) and the (NKF).
Results: 146 patients aged 60.9±8.9 years were evaluated; 64.4% were women. The prevalence of *serum* creatinine >1.2 mg/dL was 18.5% and GFR <60 mL/min/1.73m² totaled 25.3, 36.3 and 34.2% when evaluated by the equations CG, MDRD and CKD-EPI, respectively. Diabetic patients with reduced renal function were older, had long-term T2DM diagnosis, higher systolic blood pressure and higher levels of fasting glucose, compared to diabetics with normal renal function. Creatinine showed strong negative correlation with the glomerular filtration rate estimated using CG, MDRD and CKD-EPI (-0.64, -0.87, -0.89) equations, respectively.
Conclusion: the prevalence of individuals with reduced renal function based on *serum* creatinine was lower, reinforcing the need to follow the recommendations of the SBN and the National Kidney Disease Education Program (NKDEP) in estimating the value of the glomerular filtration rate as a complement to the results of *serum* creatinine to better assess the renal function of patients.

Keywords: type 2 *diabetes mellitus*, kidney function tests, kidney failure, chronic, public health.

Study conducted at the Regional University of the Northwest of the State of Rio Grande do Sul, Ijuí, RS.

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Conflict of interest: none

Introduction

Assessment of renal function in individuals with *diabetes mellitus* (DM) is extremely important since diabetic nephropathy (DN) constitutes a major cause of chronic kidney disease in the world, which makes DM the most frequent cause of end-stage renal disease.[1,2] Approximately 40% of all diabetic patients develop DN,[3] which is the most common diagnosis among individuals in renal replacement programs, accounting for up to 44% of cases.[4] In Brazil, in 2010, 27.5% of patients on dialysis had DN, and it is likely that in the coming years a significant increase in the number of diabetic patients undergoing dialysis therapy occurs.[5]

Early identification and appropriate management of chronic kidney disease (CKD) are important measures to slow its progression. In clinical practice, measurement of plasma creatinine has been the method most often used

to assess renal function. However, it has been demonstrated that "apparently normal" *serum* creatinine levels may be accompanied by loss of renal function, making this a relatively late parameter for lesion detection.[6] Although the measurement of the calculated creatinine clearance is considered the reference standard for determining the glomerular filtration, its methods are laborious, expensive and require specialized equipment and personnel, making them impractical in daily practice.[7] Therefore, some formulas to estimate GFR were developed, and the most employed and analyzed equations are Cockcroft and Gault (CG),[8] Modification of Diet in Renal Disease (MDRD)[9] and Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI).[10]

The SBN and the NKDEP have recommended informing the amount of estimated glomerular filtration rate as a complement to results of *serum* creatinine.[11] Currently, the American Diabetes Association (ADA) recommends annual screening of DN with evaluation of the urinary excretion of albumin and GFR estimated using equations that include *serum* creatinine,[12] while the NKF recommends that the MDRD equation should be used to estimate GFR.[13]

That said, the present study aimed at estimating the filtration rate by using the CG, MDRD and CKD-EPI equations, and *serum* creatinine as methods for screening reduced renal function in patients with T2DM enrolled in the ESF program.

Methods

A cross-sectional descriptive and analytical study was conducted, including a sample of patients with type 2 *diabetes mellitus*, enrolled in the Family Health Strategy and living in the urban area of the municipality of Ijuí, state of Rio Grande do Sul (Brazil). The exclusion criteria were: individuals older than 75 years, difficulty understanding the proposed procedures, bedridden individuals, or impairments during ambulation.

The sample size was calculated according to population data from 2009, in which the city of Ijuí had a total of 819 diabetics enrolled in nine ESF centers, in urban areas. The StatCalc application of Epi Info 3.5.3 software was used; considering a prevalence of nonspecific outcome of 50%, 95% confidence interval, and 5% alpha-type error, we obtained a sample size of 269 patients, including 5% for possible losses, leaving a sample size of 283 patients. Later, we contacted the head nurse of each ESF center to conduct a meeting with the community health workers to present the project and decide which patients would be evaluated, which was done randomly by sortition.

The invitation to participate in the study was done to patients during home visits in the company of community health workers, whenever possible. On these occasions, the research project was explained to the patients, and the clinical and laboratory evaluations of the patients who agreed to participate were scheduled. The evaluations were performed, in the Physiotherapy Clinic at the Regional University of the Northwest of the State of Rio Grande do Sul (Unijuí), and the clinical analyses laboratory of Unijuí (Unilab), respectively, being performed by health professionals properly trained to standardize the assessments.

To analyze the social habits and health status of patients with T2DM a structured interview that sought to identify cardiovascular risk factors was performed. Every patient who claimed to be a smoker at the time of the evaluation, regardless of the number of cigarettes, was classified as a smoker; likewise, those who reported drinking alcohol during the study period in any quantity and frequency were classified as drinkers. Excessive salt intake and stress were considered according to the patient's own perception. Individuals who reported exercising at least three times per week, each session lasting 30 minutes, were classified as physically active. The others were considered sedentary.

At the same time, systolic (SBP) and diastolic blood pressure (DBP) were measured in millimeters of mercury (mmHg),[14] using aneroid sphygmomanometer with the patient seated; blood pressure measurement was standardized in the right upper limb. The evaluation of anthropometric data was also performed. Weight (in kilograms) was measured using a digital scale (Toledo®), and height (in meters) using a stadiometer (Toledo®), according to recommended techniques.[15] The ideal body weight for each patient was calculated using the CG and Lorenz' formulas, which estimate the ideal weight in terms of the individual's height in centimeters. The Body Mass Index (BMI) was calculated using the ratio of body weight and height squared (Kg/m^2) and classified according to the criteria used by the World Health Organization (WHO).[16] Waist circumference (WC) was measured at the midpoint between the last rib and the iliac crest, whereas hip circumference (HC) was measured over the iliac crest, using standard measuring tape, flexible and non-extensible, accurate to 1 mm.[17]

Date and time of lab test appointments were scheduled at the end of the interview and clinical evaluation. Patients were personally informed about the procedures for sample collection, and instructed to fast for at least eight

hours before blood collection, in addition to receiving written instructions and containers for collection of first morning urine.

Renal function was assessed based on the result of *serum* creatinine, obtained from biochemical test, and GFR estimated using CG, MDRD and CKI-EPI equations, calculated using the formulas provided in the SBN and NKF websites. Values above 1.2 mg/dL for *serum* creatinine[18] and below 60 mL/min/1.73m^2 for GFR estimated by CG, MDRD and CKI-EPI,[19,20] were regarded as impaired renal function, since aglomerular filtration rate below 60 mL/min/1.73m² represents a decrease of approximately 50% in normal renal function, which, below this level, increases the prevalence of complications of CKD.[21]

For data processing, we used the statistical Package for Social Science – SPSS software (18.0 version, Chicago, IL, USA). In the statistical analysis, all variables were tested for normality using the test Kolmogorov-Smirnov (K-S). Qualitative variables are presented as frequencies and percentages, and quantitative variables as mean and standard deviation (mean ± SD). We used Mann-Whitney test for comparison of two independent groups with non-normal distribution and the Student's *t* test for variables with normal distribution in order to verify variable differences per gender, and between individuals with normal and reduced renal function. The Spearman correlation coefficient was used to evaluate the correlation between clinical/biochemical parameters and GFR estimated using CG, MDRD and CKD-EPI equations. We considered statistically significant p <0.05. All tests were applied with a confidence interval (CI) of 95%.

The research project was approved by the Research Ethics Committee (CEP) at Unijuí, after consolidated opinion nº 91/2010.

Results

283 patients with T2DM who met the study's criteria were selected for a home visit and invitation to participate, based on information collected by ESF health workers or gathered from medical records kept at nine ESF centers in the urban area of the municipality of Ijuí, state of Rio Grande do Sul. Out of this total, 64 patients were excluded from the study because they either did not attend the visit, did not accept the invitation to join the study, did not identify the address provided, or did not sign the Free and Informed Consent form. Of the 219 diabetic participants, we excluded 73 (33.33%) due to insufficient data to assess renal function, since they did not perform biochemical tests for *serum* creatinine; this led to a total sample of 146 patients with T2DM in the present study.

Patients had a mean age of 60.9 ± 8.9 years; 64.4% (94/146) were female. Time of T2DM diagnosis, body mass, height, systolic blood pressure, *serum* creatinine and GFR by CG, MDRD and CKD-EPI equations were greater on average among men, while among women body mass index, waist circumference, hip circumference, *serum* blood glucose, total cholesterol and triglycerides were higher. Waist circumference, time of type 2 diabetes' diagnosis, diastolic blood pressure, fasting blood glucose, total cholesterol and GFR according to the CG equation were variables that did not differ statistically (p>0.05) (Table 1).

TABLE 1 Clinical profile of patients with type 2 *diabetes mellitus*

Variables	F (n=94)	M (n=52)	p
	M±DP	M±DP	
Age (years)	59.7±9.2	63.3±8.1	0.04*£
Body mass (Kg)	78.3±16.1	81.9±12.2	0.04*£
Height (cm)	155.0±5.7	169.2±6.3	0.000**£
BMI (Kg/m²)	32.5±6.3	28.7±4.1	0.000**£
WC (cm)	105.8±14.5	103.8±10.2	0.18£
HC (cm)	108.9±13.3	101.9±10.2	0.001**£
TD-T2DM (years)	6.9±7.2	8.2±7.4	0.21£
SBP (mmHg)	132.0±16.6	138.9±15.3	0.005**£
DBP (mmHg)	82.7±10.8	82.5±14.8	0.45£
Fasting blood glucose (mg/dL)	127.1±53.8	122.2±48.2	0.78£
Total cholesterol (mg/dL)	179.6±44.1	169.9±52.2	0.23?
Triglycerides (mg/dL)	196.9±105.6	165.2±95.2	0.04*£
Serum creatinine (mg/dL)	1.0±0.29	1.1±0.35	0.03*£
CG (mL/min/1.73 m^2)	80.6±32.0	85.7±30.5	0.16£
MDRD (mL/min/1.73 m^2)	66.2±22.1	79.3±26.4	0.001**£
CKD-EPI (mL/min/1.73 m^2)	66.5±20.4	74.5±20.5	0.01**£

*: p<0.05; **: p<0.01; F: female; M: male; M±DP: mean±standard deviation; £: Mann-Whitney test; ?: Student's t test; kg: kilogram; cm: centimeters; Kg/m^2: kilograms per square meter; WC: waist circumference; HC: hip circumference; TD-T2DM: time of diagnosis of T2DM; SBP: systolic blood pressure; mmHg: millimeters of mercury; DBP: diastolic blood pressure; mg: milligrams; dL: deciliter; CG: Cockcroft-Gault; mL: milliliter; min: minute; m^2: square meter; MDRD: Modification of Diet in Renal Disease; CKD-EPI: Chronic Kidney Disease Epidemiology Collaboration.

With regard to the social habits and medical history of the patients with T2DM, we observed that most diabetics were older (58.2%), considered overweight (35%) or class I obese (30.1%), referred the absence of hypersodic diet (82.9%) and had high blood pressure (73.3%) associated with T2DM. The prevalence of smoking and drinking habits in the population studied was 15.8% and 6.8%, respectively. Almost ¾ of the sample (73.1%) said that they did not exercise regularly.

The assessment of renal function, according to *serum* creatinine and GFR calculated using GC MDRD and CKD-EPI equations, shows that the prevalence of *serum*

creatinine above 1.2 mg/dL was 18.5%. In the case of GFR below 60 mL/min/1.73m², one can observe a decrease in renal function of 25.3, 36.3 and 34.2% when assessed by CG, MDRD and CKD-EPI equations, respectively. This classification was used to categorize individuals according to demographic, anthropometric, clinical and laboratory characteristics of T2DM patients (Table 2).

According to the screening methods for reduced renal function in patients with T2DM used in this study, patients with impaired renal function are older, have diagnosed their condition for longer times, and show higher values for SBP and fasting blood glucose (Table 2).

In Table 3, the correlations between clinical and biochemical parameters and GFR estimated based on the equations were negative for *serum* creatinine, age and time of diagnosis of T2DM, and positive between body/mass BMI and GFR estimated using CG equation. In spite of having achieved statistical significance, we point out that the correlations found between GFR, according to the equations, and the clinical pa-

TABLE 2 Evaluation of demographic, anthropometric, clinical and laboratory characteristics according to the criteria adopted for assessment of renal function in T2DM

Variables	*Serum* creatinine		CG		MDRD		CKD-EPI	
	Normal (n=119)	Impaired (n=27)	Normal (n=109)	Impaired (n=37)	Normal (n=93)	Impaired (n=53)	Normal (n=96)	Impaired (n=50)
Gender (F¨M)	83¨36	11¨16	68¨41	26¨11	53¨40	41¨12*	57¨39	37¨13
Age (years)	60.4±9.3	63.8±6.7*	58.9±8.4	67.1±7.8**	59.9±9.3	62.9±8.1*	59.2±9.4	64.4±6.9**
TD-T2DM (years)	6.8±6.7	9.8±9.1	6.7±6.5	9.6±8.5*	6.4±6.1	9.0±8.7*	6.4±6.0	9.2±9.0
BMI (Kg/m²)	31.3±6.0	30.3±5.0	32.3±5.7	27.7±4.8**	30.6±5.3	32.0±6.8	30.7±5.5	32.0±6.4
WC (cm)	104.8±13.3	106.4±12.7	107.5±11.8	98.1±14.3**	104.5±10.9	106.3±16.3	104.3±11.7	106.7±15.5
HC (cm)	106.8±13.2	104.9±10.2	108.8±12.0	99.2±12.2**	105.9±12.7	107.3±12.8	105.8±13.2	107.6±11.7
SBP (mmHg)	132.7±15.2	142.2±19.5*	134.1±16.3	135.6±17.3	133.0±16.1	137.0±17.1	132.6±15.9	138.0±17.0*
DBP (mmHg)	81.7±11.2	86.7±15.9	82.8±12.8	82.4±10.7	82.1±13.0	83.7±11.1	81.9±12.8	84.1±11.2
TC (mg/dL)	175.6±45.5	178.4±55.1	178.7±47.1	168.7±47.3	178.1±45.7	172.8±49.9	178.3±46.6	172.1±48.5
Trig. (mg/dL)	186.2±104.9	183.0±94.4	188.1±98.3	178.2±116.1	182.8±95.7	190.5±115.0	185.1±105.5	186.5±98.4
FG (mg/dL)	120.0±45.0	148.7±71.3	124.9±48.3	126.4±61.6	121.2±43.8	132.5±63.3	123.7±46.5	128.5±61.1

Mann-Whitney test. *: p<0,05; **: p<0,01; F: female; M: male; CG: Cockcroft-Gault; MDRD: Modification of Diet in Renal Disease; CKD-EPI: Chronic Kidney Disease Epidemiology Collaboration; TD-T2DM: Time of diagnosis of T2DM; BMI: body mass index; Kg/m²: kilograms per square meter; WC: waist circumference; cm: centimeters; HC: hip circumference; SBP: systolic blood pressure; mmHg: millimeters of mercury; DBP: diastolic blood pressure; TC: total cholesterol; mg: milligrams; dL: deciliter; Trig.: triglycerides; FG: fasting blood glucose.

TABLE 3 Correlation coefficients between clinical/biochemical parameters and glomerular filtration rate, estimated by the CG, MDRD, CKD-EPI equations for patients with T2DM enrolled in the ESF program

	GFR CG	GFR MDRD	GFR CKD-EPI
	r	r	r
Age (years)	-0.57***	-0.20*	-0.30***
TD-T2DM (years)	-0.29***	-0.18*	-0.21**
Body mass (Kg)	0.44***	0.16	-0.02
Body mass index (kg/m²)	0.38***	-0.07	-0.08
Fasting blood glucose (mg/dL)	0.07	-0.04	-0.02
Total cholesterol (mg/dL)	-0.01	-0.02	-0.00
Triglycerides (mg/dL)	-0.05	-0.14	-0.11
Serum creatinine (mg/dL)	-0.64***	-0.87***	-0.89***

Spearman Correlation Test; *: p=0.05; **: p<0.01; ***: p<0.001; ; CG: Cockcroft-Gault; MDRD: Modification of Diet in Renal Disease; CKD-EPI: Chronic Kidney Disease Epidemiology Collaboration; TD-T2DM: Time of diagnosis of T2DM; BMI: body mass index; Kg/m2: kilograms per square meter;WC: waist circumference; cm: centimeters; HC: hip circumference; SBP: systolic blood pressure; mmHg: millimeters of mercury; DBP: diastolic blood pressure; TC: total cholesterol; mg: milligrams; dL: deciliter; Trig.: triglycerides; FG: fasting blood glucose.

rameters were not considered strong, unlike that observed with *serum* creatinine.

Discussion

From the results of this study, we highlight the lower prevalence of impaired renal function observed through *serum* creatinine. This supports the literature findings that indicate that *serum* creatinine alone is not a sensitive method to assess renal function in asymptomatic CKD patients.[22]

Following the recommendations of the SBN and the NKDEP, the value of GFR is estimated as a complement to the results of *serum* creatinine to better assess a patient's renal function. In this study, the prevalence of impaired renal function estimated by GFR calculation, using the CG, MDRD and CKD-EPI equations, was homogeneous (25.3, 36.3 and 34.2%). There is, however, greater similarity between the results of the MDRD and CKD-EPI equations, and a more marked difference (11%) compared to the CG equation, which resulted in prevalence almost twice greater than the change in renal function estimated through *serum* creatinine.

The literature reports that both equations show excellent correlation with the calculated GFR.[21] However, studies indicate that the MDRD equation proves more effective in detecting changes in patients with early renal disease,[23] as seen in the present study, where the prevalence of decreased renal function was greater in diabetic patients assessed by MDRD.

In this context, we draw attention to the fact that the formulas most commonly used and known to estimate GFR were validated in studies with target populations, thus presenting singularities. The CG formula was the first of these equations to gain acceptance, estimating creatinine clearance. When originally described, the CG equation was based on urinary creatinine excretion of hospitalized Caucasian men, aged 18-92 years and with normal renal function. The calculation was not standardized for a body surface area of 1.73m² and a correction was necessary for women.[8] It systematically overestimates the GFR, because tubular creatinine secretion and the increase in weight due to obesity or fluid overload are not taken into consideration.[24]

The MDRD equation to estimate GFR was originally developed based on data from a study entitled *Modification of Diet in Renal Disease,* which included CKD patients and not healthy individuals. The gold standard used to develop the MDRD equation was that of 125I-iothalamate clearence, which estimates GFR in mL/min/1.73m², and not creatinine clearance.[9] In its original version, the MDRD equation requires the determination of *serum* albumin and *urea* nitrogen. Currently, the abbreviated MDRD formula with four variables has been recommended, because its performance is as good as the initial equation's.[25] GFR as calculated using MDRD and the actual GFR are very close to each other for results below 60 mL/min/1.73m², while the GFR exceeds the estimated rate by a small difference when the result is greater than 60 mL/min/1.73m².[26]

The Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) group has recently developed, based on a cohort study that included individuals with and without CKD, a new equation which is a variation of the MDRD formula.[10] The equation, called CKD-EPI, uses the same four variables adopted by the MDRD equation, but comparatively has better performance and risk prediction.

Using the results of this practical study to calculate GFR estimated by MDRD, which is considered more effective,[23] 36.3% of the patients were found to present levels below 60 mL/min/1.73m². This represents an approximate decrease of 50% in normal kidney function.[21] Of these patients 77.4% (41/53) were women. According to the literature, levels of glomerular filtration rate below that show increased prevalence of complications of CKD. The minimum value found in this study was 20, 21 and 25.40 mL/min/1.73m², estimated using the CKD-EPI, MDRD and CG equations, respectively. When the GFR reaches very low values, less than 15 mL/min/1.73m², the so-called functional renal failure occurs, that is, the most advanced stage of progressive functional loss observed in CKD, which was never observed in the present study.

The mean estimated GFR according to CG equation for men and women in this study (85.7±30.5 and 80.6±32.0mL/min, respectively) had similar results to those found in the study by Guimarães et al.[27] that also assessed a population of diabetic patients, finding the estimated creatinine clearence at 71.67±30.85 mL/min/1.73m², using the CG calculation. The latter also compared the GFR results determined by radioisotope methods and equivalent levels for GFR estimated using creatinine clearence. They came to the conclusion that the creatinine clearence underestimates the clearence of DTPA-Tc99m, particularly when the values for GFR are higher. Nevertheless, they claim that the CG formula is useful when GFR is below 100 mL/min/1.73m², phase in which it is more accurate since the repeated use of a radioisotope method becomes impractical.[27]

It is possible, therefore, to observe that the use of formulas to determine GFR has been widely adopted and correlated well with radioisotope methods to measure glomerular filtration, especially when it is decreased

(< 60 mL/min/1.73m²).[9] Using these equations to estimate GFR has lower cost and greater convenience in clinical practice,[8,9] facilitating early screening and diagnosis of CKD in diabetics in primary care.

The various formulas were created to calculate the GFR more accurately, and they include not only the *serum* concentration of creatinine, but also correction factors, which allow for a greater individualization of the results, increasing the test's sensitivity aiming at detecting deficits in renal function.[28] But we cannot forget that, in elderly patients, glomerular filtration may decrease as part of the body's aging process, and it can be difficult to differentiate the age-related decrease in glomerular filtration from that seen in renal dysfunction in the elderly. Therefore, for purposes of stratification and intervention, the diagnosis of renal dysfunction should not be solely based on the estimate of GFR, but also the presence of other markers of kidney disease.[29]

The present study did not use any gold standard marker (insulin or iothalamate clearance) for comparison due to high cost, extended time for the procedure, and difficult access for patients followed in primary care. Given this bias, *serum* creatinine is the most widely used method because of its low cost and accessibility to users of public services. Another limitation of the study is the lack of association between the drugs taken by the patients and their GFR, since the drug therapy may interfere with the glomerular filtration rate and lipid profile.

But more than the comparison of formulas, we stress the importance of early diagnosis to improve the health and enhance the quality of life of diabetic patients. From routine screening and the application of calculations to estimate the GFR, it is possible to determine the renal function in these individuals earlier, and thus try to reduce the prevalence and incidence of renal failure through the adoption of intervention measures. This is most relevant since, currently, CKD is considered a global public health problem, DM being the most common cause of CKD in the world and the second most common etiology among dialysis patients in Brazil.

Also important forms of intervention are actions guided to change the patients' lifestyle, which is crucial to halt the progression of CKD. Dieting, exercising, controlling blood pressure and blood glucose, controlling dyslipidemia and obesity are all measures more effective than oral hypoglycemic agents.

After analyzing the results, we conclude that the prevalence of individuals with reduced renal function based on serum creatinine was lower, reinforcing the need to follow the recommendations of the SBN and the NKDEP, which is estimating the value of glomerular filtration as a complement to the results of *serum* creatinine to better assess the patients' renal function. Diabetic patients with reduced renal function were older, had their T2DM diagnosis for a longer time, higher systolic blood pressure and higher levels of fasting blood glucose, compared to diabetics with normal renal function.

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Resumo

Estimativa da taxa de filtração glomerular em pacientes com *diabetes mellitus* tipo 2.

Objetivo: estimar a taxa de filtração glomerular por meio das equações Cockcroft e Gault (CG), Modification of Diet in Renal Disease (MDRD), Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) e da creatinina sérica na triagem da função renal reduzida em pacientes com *diabetes mellitus* tipo 2 (DM2), adscritos em estratégia de saúde da família (ESF).
Métodos: foi realizado um estudo transversal, descritivo e analítico. O protocolo foi constituído de dados sociodemográficos, exame físico e dosagens bioquímicas. A função renal foi analisada pela creatinina sérica e pela taxa de filtração glomerular (TFG) estimada segundo as equações CG, MDRD e CKD-EPI, disponibilizadas nos *websites* da Sociedade Brasileira de Nefrologia (SBN) e da National Kidney Foundation (NKF).
Resultados: foram avaliados 146 pacientes com média de idade de 60,9±8,9 anos; 64,4% eram mulheres. A prevalência de creatinina sérica >1,2 mg/dL foi de 18,5%, e a TFG < 60 mL/min/1,73 m² foi de 25,3%, 36,3% e 34,2% quando avaliadas pelas equações CG, MDRD e CKD-EPI, respectivamente. Os pacientes diabéticos com função renal reduzida eram idosos, apresentavam maior tempo de diagnóstico de DM2, pressão arterial sistólica mais elevada e níveis superiores de glicemia de jejum, quando comparados a diabéticos com função renal normal. A creatinina apresentou correlação negativa e forte com a taxa de filtração glomerular estimada pelas equações CG, MDRD e CKD-EPI (-0,64; -0,87; -0,89, respectivamente).
Conclusão: a prevalência de indivíduos com função renal reduzida a partir dos valores de creatinina sérica foi infe-

rior, reforçando a necessidade de seguir as recomendações da SBN e do National Kidney Disease Education Program (NKDEP) em estimar o valor do ritmo de filtração glomerular como complemento ao resultado da creatinina sérica para melhor avaliar a função renal dos pacientes.

Palavras-chave: *diabetes mellitus* tipo 2; testes de função renal; falência renal crônica; saúde pública.

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