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Factors associated with chronic kidney disease, according to laboratory criteria of the National Health Survey

Fatores associados à doença renal crônica segundo critérios laboratoriais da Pesquisa Nacional de Saúde

Lilian Kelen de Aguiar[I,II], Roberto Marini Ladeira[III], Ísis Eloah Machado[I], Regina Tomei Ivata Bernal[I], Lenildo de Moura[IV], Deborah Carvalho Malta[I]

ABSTRACT: ***Objective:*** To identify the prevalence of glomerular filtration rate (GFR) less than 60 mL/min/1.73 m² in Brazil and the associated factors. ***Methods:*** This is a cross-sectional household-based epidemiological survey. Data were collected from the National Health Survey (PNS), conducted in 2013, by carrying out creatinine blood test and GFR calculation (n = 7,457). The groups of explanatory variables were: sociodemographic characteristics, lifestyles, chronic diseases, anthropometry, and health assessment. The prevalence of GFR < 60 mL/min/1.73 m² and the respective 95% confidence intervals were estimated using the Poisson regression to calculate the crude and adjusted prevalence ratio (PR and adjPR) by age, sex, education level, and region. ***Results:*** The prevalence of GFR < 60 mL/min/1.73 m² was 6.48% (95%CI 5.88 – 7.09). After the adjustment, the following aspects remained associated: women (PR = 1.40; 95%CI 1.16 – 1.68), age of 45–59 years (adjPR = 7.27; 95%CI 3.8 – 14.1), 60 years or older (adjPR = 33.55; 95%CI 17.8 – 63.4), obesity (PR = 1.32 (95%CI 1.1 – 1.7), diabetes (PR = 1.44; 95%CI 1.2 – 1.8), poor/very poor self-rated health (PR = 1.50; 95%CI 1.2 – 1.9); and the lowest adjPR was found for the Northeast and Southeast regions, among smokers with high salt intake. ***Conclusion:*** GFR < 60 mL/min/1.73 m² was higher in women, increased with age, in addition to being associated with obesity, diabetes, and poor self-rated health. Knowing the prevalence of chronic kidney disease through biochemical tests and risk and protective factors are paramount to support public health policies.

Keywords: Renal insufficiency, chronic. Chronic disease. Risk factors. Health surveys. Public health nursing. Health planning.

[I]School of Nursing, Universidade Federal de Minas Gerais – Belo Horizonte (MG), Brazil.
[II]School of Health Sciences, Universidade do Estado do Amazonas – Manaus (AM), Brazil.
[III]Fundação Hospitalar do Estado de Minas Gerais – Belo Horizonte (MG), Brazil.
[IV]Organizacão Pan-Americana da Saúde – La Paz, Bolivia.
Corresponding author: Lilian Kelen de Aguiar. Avenida Amazonas, 3.217, ap. 1, Gutierrez, CEP: 30410-000, Belo Horizonte (MG), Brazil. E-mail: lilian.uea@gmail.com
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RESUMO: ***Objetivo:*** Identificar a prevalência da taxa de filtração glomerular estimada pelo *clearance* da creatinina endógena (estimativa da taxa de filtração glomerular — eTFG) menor que 60 mL/min/1,73 m² no Brasil e os fatores associados. ***Métodos:*** Trata-se de um inquérito epidemiológico transversal de base domiciliar. Os dados foram obtidos em subamostra de participantes da Pesquisa Nacional de Saúde (PNS), realizada em 2013, na qual foi feita coleta de sangue para medida de creatinina plasmática e calculado a eTFG (n = 7.457). Os grupos de variáveis explicativas foram: características sociodemográficas, estilos de vida, doenças crônicas, antropometria e avaliação de saúde. Foram estimadas as prevalências de eTFG < 60 mL/min/1,73 m² e os respectivos intervalos de confiança de 95% (IC95%) utilizando a regressão de Poisson para calcular a razão de prevalência bruta (RPb) e ajustada (RPaj) por idade, sexo, escolaridade e região. ***Resultados:*** A prevalência de eTFG < 60 mL/min/1,73 m² foi de 6,48% (IC95% 5,88 – 7,09). Após ajuste, mantiveram-se associados: sexo feminino (RP = 1,40; IC95% 1,16 – 1,68), idade 45–59 anos (RPaj = 7,27; IC95% 3,8 – 14,1), 60 anos ou mais (RPaj = 33,55; IC95% 17,8 – 63,4), obesidade (RP = 1,32; IC95% 1,1 – 1,7), diabetes (RP = 1,44; IC95% 1,2 – 1,8), autoavaliação de saúde ruim/muito ruim (RP = 1,50; IC95% 1,2 – 1,9); menor RPaj foi encontrado nas regiões Nordeste e Sudeste, entre fumantes e com consumo elevado de sal. ***Conclusão:*** eTFG < 60 mL/min/1,73 m² foi mais elevada no sexo feminino, aumentou com a idade, foi associada com obesidade, diabetes e pior avaliação de saúde. O conhecimento da prevalência da doença renal crônica, por meio de exames bioquímicos e dos fatores de risco e proteção, é essencial para subsidiar políticas públicas de saúde.

Palavras-chave: Insuficiência renal crônica. Doença crônica. Fatores de risco. Inquérito epidemiológico. Enfermagem em saúde pública. Planejamento em saúde.

INTRODUCTION

Chronic kidney disease (CKD) is characterized by the progressive loss of the function of nephrons, which consequently leads to the loss of their ability to filter blood and maintain homeostasis. It is associated with high rates of morbidity and mortality with major socioeconomic impact, thus consisting in a public health challenge worldwide[1].

CKD can be classified into six stages depending on anatomical or structural and functional changes, and the latter is based on the estimate of the glomerular filtration rate (GFR). GFR and the presence of a marker of kidney damage, such as proteinuria, characterize the evolution of CKD. GFR is a general measurement of the kidney function, more easily understood by healthcare professionals, which enables them to recommend preventive measures and to refer patients to specialists[2,3]. Therefore, CKD is classified as stage 1 when GFR is higher than or equal to 90 mL/min/1.73 m², in the presence of proteinuria or glomerular hematuria or with alteration in the imaging test. In stage 2, GFR varies between 60 and 89 mL/min/1.73 m². In stage 3A, GFR ranges from 45 to 59 mL/min/1.73 m²; and in stage 3B, it ranges from 30 to 44 mL/min/1.73 m² with mild to moderate kidney damage. Stages 4 and 5 indicate severe kidney damage with GFR of 15-29 and below 15, respectively[2].

The progressive decrease in GFR is initially manifested by a persistent increase in plasma levels of products that are normally excreted by the kidneys such as urea and creatinine[4].

According to *Kidney Disease: Improving Global Outcomes*[5], kidney damage is recognized in the presence of urine sediment (albuminuria) and/or decreased GFR (< 60 mL/min/1.73 m^2). Over time, the progressive deterioration produces an accumulation of toxic substances with a variety of biochemical disorders and multiple symptoms depending on the stage of CKD until the recommendation of dialysis or transplantation[6,7].

CKD has a frequency of 10 to 20% of the adult population in all countries worldwide. The surveillance and monitoring of CKD in the population has been the subject of several studies[8-12].

Increase in the prevalence of CKD was verified by the study on the subsystem for authorization of highly-complex medical procedures (*Autorização de Procedimentos de Alta Complexidade* – APAC), in the period from 2000 to 2012, accounting for 0.03% in 2000, with 336.3 people per million of the population (pmp); and for 0.05% in 2012, with 538.3 pmp[11]. The increase in the number of people on dialysis may be associated with difficulties in early diagnosis and access to healthcare services[9,13].

There are few studies on CKD at early stage and the factors associated with kidney damage in the Brazilian population. The prevalence of CKD among participants of the Longitudinal Study of Adult Health (ELSA-Brasil), conducted in six research institutions in Brazilian capitals, was 8.9%[10]. Data from the National Health Survey (*Pesquisa Nacional de Saúde* – PNS) estimated the prevalence of self-reported CKD in 1.4% of the population, that is, approximately two million people[14].

The *United States Renal Data System Report* showed that, in 2016, 35.4% of CKD patients referred to dialysis received little or no prior health care from a nephrologist[9]. The international literature discusses the need for monitoring individuals with risk factors for CKD and early detection in order to postpone kidney failure and minimize complications[9,15,16]. Diabetes, hypertension, old age, obesity, cardiovascular diseases, and smoking habits are some of the risk factors associated with kidney damage and the consequent loss of glomerular filtration[1,6,17]. Authors point to the lack of knowledge on the part of healthcare professionals concerning the need to perform diagnostic tests for CKD and the difficulty of previous follow-up of users with risk factors associated with the onset of kidney damage, with inappropriate management of CKD patients as a consequence[16,18].

Taking this into consideration, the study aims to identify the prevalence of GFR below 60 mL/min/1.73 m^2 in Brazil and the factors associated with it.

METHODS

This is a cross-sectional study using laboratory information and data from the PNS collected between 2014 and 2015. PNS is an epidemiological survey with national coverage that addressed CKD in its questionnaire in 2013 and included laboratory data, such as creatinine, that enabled the GFR calculation.

The collection and analysis of biological material were carried out by a consortium of private laboratories that met the quality control criteria of the Brazilian Ministry of Health

and the Brazilian Institute for Geography and Statistics (IBGE). The subsample comprised approximately 16 thousand individuals. A total of 8,952 people were visited and had their blood and urine tests collected; however, due to the loss of biological material, creatinine tests were done in 8,535 participants. Due to the lack of information, such as age, GFR was calculated in 7,457 individuals aged 18 years or older. In order to reduce the bias of sample losses, stratification was performed with the variables sex, age, education level, and region (federative units).

Creatinine was collected in a blood sample regardless of fasting, in a gel tube, after 30 min for clot retraction; centrifugation was performed at 3,200 rotations per minute (RPM) for 12 minutes. The analysis was performed using the Jaffe method without deproteinization. To estimate GFR, the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation was used, which considers age, sex, ethnicity, and weight[5]. Results from Brazilian validation studies do not recommend the application of ethnicity correction in the GFR estimate, considering that the use of this factor could overestimate the values for Afro-descendants[19-21]. Thus, only the differential equations according to sex, as previously highlighted[21], age (years), weight (kg), and creatinine (mg/dL) were used.

If participants were women: (175 * ((1/serum creatinine result) ^ 1.154) * ((1/agePatientYears) ^ 0.203) * 0.0742).

If participants were men: 175 * ((1/serum creatinine result) ^ 1.154) * ((1/agePatientYears) ^ 0.203).

Chronic diseases are associated with several factors considered determinants of health according to the Model of Social Determinants of Health developed in the 1990s. Accordingly, the following groups of explanatory variables for CKD were considered:

- sociodemographic characteristics and anthropometry;
- lifestyles, self-reported chronic diseases, and self-rated health.

The sociodemographic characteristics analyzed in the study were: sex (men and women), age group (18 to 29; 30 to 44; 45 to 59; and 60 years of age or over), education level (no education, elementary school, and high school) and ethnicity/skin color (Afro-descendant and non-Afro-descendant).

Lifestyle indicators were: smoking habits (smoker) and food consumption – soft drinks (five or more glasses per week); red meat with visible fat; abusive consumption of alcoholic beverages (ingestion of four or more doses, in the case of women; or five or more doses, in the case of men, on a single occasion in the last 30 days); high salt intake (urinary salt excretion greater than or equal to 10.56 g/day).

The evaluated *chronic diseases* were: hypertension measured at the time of the study (greater than or equal to 140/90 mm Hg), diabetes mellitus (glycated hemoglobin above 6.5%), and high cholesterol (greater than or equal to 220 mg/dL). The anthropometry assessment, calculated based on height and weight, was performed according to the classification of body mass index (BMI) in low weight/normal weight, overweight, and obesity. In turn, self-rated health was performed according to three strata: very good/good, fair, poor/very poor.

The prevalence of GFR < 60 and the respective 95% confidence intervals (95%CI) were estimated according to the studied explanatory variables. Subsequently, a bivariate analysis was carried out, calculating the crude (PR) and adjusted (adjPR) prevalence ratios with their respective confidence intervals. For calculating the adjPR, the Poisson logistic regression model adjusted for age, sex, education level, and region was considered. The Data Analysis and Statistical Software (Stata) version 14.0 was used.

Participants were informed about the procedure to be performed, and were asked to fill out the Informed Consent Form. The collection kit was presented, and participants were instructed on how to receive the medical report containing the results. The study was approved by the National Ethics and Research Commission under No. 328.159.

RESULTS

Of the 7,457 adults who underwent laboratory tests, 6.48% (95%CI 5.88 – 7.09) had GFR lower than 60 mL/min/1.73 m² (GFR < 60). The sociodemographic characteristics of these individuals are shown in Table 1. A higher proportion (7.76%) of GFR < 60

Table 1. Prevalence of glomerular filtration rate below 60 mL/min/1.73 m², according to sociodemographic characteristics, National Health Survey (PNS), 2014 and 2015, Brazil.

Variables/Glomerular Filtration < 60*	%	95%CI	
Total (n = 7,457)	6.48	5.88	7.09
Men	5.05	4.24	5.86
Women	7.76	6.87	8.65
18 to 29 years	0.74	0.28	1.20
30 to 44 years	1.20	0.70	1.69
45 to 59 years	5.40	4.29	6.51
60 years or older	25.25	22.78	27.73
No education	11.14	9.94	12.34
Elementary school	3.65	2.52	4.79
High school	3.45	2.72	4.17
Afro-descendant	5.63	4.93	6.34
Non-Afro-descendant	7.39	6.38	8.39
North region	6.39	5.37	7.42
Northeast region	5.32	4.55	6.08

Continue...

Table 1. Continuation.

Variables/Glomerular Filtration < 60*	%	95%CI	
Southeast region	6.44	5.29	7.58
South region	8.72	7.07	10.36
Midwest region	6.62	5.07	8.18
Low weight/Normal**	5.10	4.27	5.94
Overweight**	6.89	5.86	7.92
Obesity**	8.71	7.16	10.26

*Chronic Kidney Disease Epidemiology Collaboration equation; **classification according to body mass index (BMI); 95%CI: 95% confidence interval.

was found among women (95%CI 6.87 – 8.65) when compared with 5.05% among men (95%CI 4.24 – 5.86). A higher prevalence of GFR < 60 was observed with increasing age, accounting for 25.25% (95%CI 22.78 – 27.73) among individuals aged 60 years or older. There was also a reduction in the prevalence of GFR < 60 with higher education level: for individuals with no education, it was 11.14% (95%CI 9.94 – 12.34); for those with elementary school, 3.65% (95%CI 2.52 – 4.79); and for those with high school, 3.45% (95%CI 2.72 – 4.17). The prevalence of GFR < 60 among Afro-descendants was 5.63% (95%CI 4.93 – 6.34) and among non-Afro-descendants, 7.39% (95%CI 6.38 – 8.39). The South region had a higher prevalence of GFR < 60, accounting for 8.72% (95%CI 7.07 – 10.36), and the Northeast region had the lowest prevalence, 5.32% (95%CI 4.55 – 6.08). It was observed that the higher the BMI, the greater the prevalence of GFR < 60, accounting for 8.71% (95%CI 7.16 – 10.26) among obese people.

The prevalence of GFR < 60 among those who consume soft drinks was 4.21% (95%CI 3.08 – 5.34); for red meat with fat, 4.21% (95%CI 3.34 – 5.09); for high salt intake, 4.21% (95%CI 3.15 – 5.26); and for alcoholic beverages (five days or more), 7.54% (95%CI 6.80 – 8.29). There was a higher prevalence of GFR < 60 among patients with other chronic diseases and participants with poor self-rated health (Table 2).

The proportion of GFR < 60 found among patients with hypertension and diabetes (with altered glycated hemoglobin) was 9.05% (95%CI 6.87 – 11.24) and 17.06% (95%CI 13.40 – 20.73), respectively. Among individuals with hypercholesterolemia, the proportion was 7.92% (95%CI 6.79 – 9.04). Moreover, there was an increase in the frequency of GFR < 60 with the worsening of self-rated health, as follows: 4.47% (95%CI 3.82 – 5.13) of those who reported a good and very good self-rated health; 8.85% (95%CI 7.58 – 10.12) of those who reported fair health status; and 16.60% (95%CI 13.16 – 20.03) of those who reported poor or very poor self-rated health had GFR < 60 (Table 2).

Crude PR and PR adjusted for age, sex, education level, and region are described in Tables 3 and 4. According to Table 3, the adjPR was higher for women, accounting for

Table 2. Prevalence of glomerular filtration rate below 60 mL/min/1.73 m^2 according to lifestyle, chronic diseases, and self-rated health, National Health Survey (PNS), 2014 and 2015.

Variables/Glomerular Filtration < 60*	%	95%CI	
Smoker	4.76	3.52	6.00
Nonsmoker	6.78	6.10	7.46
Consumption of soft drinks ≥ 5 glasses/week	4.21	3.08	5.34
Consumption of soft drinks < 5 glasses/week	7.16	6.44	7.87
Red meat with visible fat	4.21	3.34	5.09
Red meat with no visible fat	7.22	6.42	8.03
High salt intake	4.21	3.15	5.26
Low salt intake	7.04	6.26	7.82
Abusive consumption of alcoholic beverages	7.54	6.80	8.29
Non-abusive consumption of alcoholic beverages	3.21	2.30	4.13
Arterial hypertension	9.05	6.87	11.24
Absence of arterial hypertension	6.18	5.55	6.81
Diabetes mellitus**	17.06	13.40	20.73
Non-diabetic	5.75	5.14	6.36
High cholesterol	7.92	6.79	9.04
Normal cholesterol	6.06	5.31	6.81
Very good/good self-rated health	4.47	3.82	5.13
Fair self-rated health	8.85	7.58	10.12
Very poor/poor self-rated health	16.60	13.16	20.03

*Chronic Kidney Disease Epidemiology Collaboration equation; **glycated hemoglobin; 95%CI: 95% confidence interval.

1.40 (95%CI 1.16 – 1.68), and increased with age, being 7.27 (95%CI 3.76 – 14.06) in the age group of 45 to 59 years, and 33.55 (95%CI 17.77 – 63.36) for those aging over 60 years. The opposite was observed among study participants from the Northeast and Southeast regions, with adjPR of 0.67 (95%CI 0.54 – 0.83) and 0.72 (95%CI 0.57 – 0.90), respectively. Regarding the education level variable, it consisted in a protective factor for GFR < 60, with a crude PR of 0.33 (95%CI 0.24 – 0.46) for individuals with elementary school and 0.31 (95%CI 0.24 – 0.39) for individuals with high school; however, after the adjustment, it was no longer significant. Obesity had an adjPR of 1.32 (95%CI 1.05 – 1.65), associated with GFR < 60.

Table 3. Crude and adjusted prevalence ratio of factors associated with glomerular filtration rate < 60 mL/min/1.73 m^2: sociodemographic characteristics and body mass index (BMI).

Variables	PR_{crude}*	95%CI		adjPR*	95%CI	
Men	1.00			1.00		
Women	1.54	1.26	1.87	1.40	1.16	1.68
18 to 29 years	1.00			1.00		
30 to 44 years	1.62	0.77	3.44	1.61	0.76	3.41
45 to 59 years	7.32	3.78	14.16	7.27	3.76	14.06
60 years or older	34.22	18.14	64.57	33.55	17.77	63.36
No education	1.00			1.00		
Elementary school	0.33	0.24	0.46	0.79	0.58	1.09
High school	0.31	0.24	0.39	0.79	0.63	1.00
Afro-descendant	0.76	0.63	0.92	0.93	0.78	1.10
Non-Afro-descendant	1.00			1.00		
North region	1.00			1.00		
Northeast region	0.83	0.67	1.03	0.67	0.54	0.83
Southeast region	1.01	0.79	1.28	0.72	0.57	0.90
South region	1.36	1.06	1.75	1.02	0.81	1.29
Midwest region	1.04	0.78	1.38	0.88	0.68	1.14
Low weight/Normal**	1.00			1.00		
Overweight**	1.35	1.08	1.68	1.12	0.92	1.37
Obesity**	1.71	1.34	2.17	1.32	1.05	1.65

PR_{crude}: crude prevalence ratio; adjPR: adjusted prevalence ratio; *calculated Chronic Kidney Disease Epidemiology Collaboration equation; **classification according to BMI; 95%CI: 95% confidence interval.

In the analyses of lifestyle, chronic diseases, and self-rated health (Table 4), diabetes was also associated with GFR < 60, with adjPR of 1.44 (95%CI 1.15 – 1.80). A reduction in adjPR was found among individuals with GFR < 60 who reported to be smokers and with high salt intake, accounting for 0.71 (95%CI 0.55 – 0.93) and 0.68 (95%CI 0.53 – 0.88), respectively. The adjPR for fair and poor and very poor self-rated health was 1.06 (95%CI 0.87 – 1.30) and 1.5 (95%CI 1.20 – 1.90), respectively.

The other variables, education level, African descent, consumption of soft drinks, red meat, and alcoholic beverages, hypercholesterolemia, and systemic arterial hypertension, were no longer significant in the adjusted PR.

Table 4. Crude and adjusted prevalence ratio of factors associated with glomerular filtration rate < 60 mL/min/1.73 m^2: lifestyle, chronic diseases, and self-rated health, National Health Survey (PNS), Brazil.

Variables/Glomerular Filtration < 60*	PR_{crude}	95%CI		adjPR	95%CI	
Smoker	0.70	0.53	0.93	0.71	0.55	0.93
Consumption of soft drinks ≥ 5 glasses	0.59	0.44	0.78	1.06	0.82	1.38
Red meat: visible fat	0.58	0.46	0.74	0.86	0.68	1.08
High salt intake	0.60	0.45	0.79	0.68	0.53	0.88
Abusive consumption of alcoholic beverages	2.35	1.74	3.17	1.24	0.92	1.68
Arterial hypertension	1.46	1.13	1.90	1.06	0.82	1.37
Diabetes mellitus (**)	2.97	2.33	3.77	1.44	1.15	1.80
High cholesterol	0.13	1.58		0.88	0.74	1.05
Fair self-rated health	1,98	1.61	2.43	1.06	0.87	1.29
Very poor/poor self-rated health	3.71	2.88	4.78	1.50	1.19	1.90

PR_{crude}: crude prevalence ratio; adjPR: adjusted prevalence ratio, respectively, according to age, sex, education level, and region; *calculated Chronic Kidney Disease Epidemiology Collaboration equation; **glycated hemoglobin; 95%CI: 95% confidence interval.

DISCUSSION

The prevalence of GFR < 60, calculated by using the CKD-EPI equation, verified by PNS (2014/2015) in individuals aged 18 years or older, was 6.48%. Renal albumin loss was not measured. The associated factors were being a woman, increasing age and aging, obesity, diabetes, and poor/very poor self-rated health. Report of smoking habit and high salt intake, as well as living in the Northeast and Southeast regions, when compared with the North region, had a lower prevalence ratio.

The prevalence of self-reported CKD in individuals aged 18 years or older estimated by PNS in 2013 was 1.42%, and the prevalence of GFR < 60 was 6.48%[21], demonstrating a high percentage of unknown cases of the disease. Unawareness of the disease can be explained by the insidious and asymptomatic loss of renal function, consisting in a major public health issue associated with increased morbidity and mortality[2].

In both PNS surveys, self-reported and laboratory, the factor most strongly associated with loss of renal function was aging, corroborating the international literature. According to the annual report of CKD in the USA, age is the major predictor of low GFR (GFR < 60)[9]. It is known that morphofunctional changes in the kidneys of older people are complex and different from those of young people. Among them, the reduction in renal mass and in the

number of renal tubules, and changes in intrarenal vessels are mentioned, for instance[17,22]. Currently, the impact of nephrosclerosis associated with other clinical conditions on older people is discussed, reinforcing the greater need to monitor glomerular filtration with advancing age[17,22,23].

In this study, an association between women and GFR < 60 was observed, but the literature points to an association between men and the increased prevalence of chronic diseases, including hypertension and diabetes, causes of CKD[24-26]. The higher prevalence of noncommunicable chronic diseases (NCDs) among women is not a consensus in the literature; however, it is known that women seek for healthcare services more, and thus have greater access to diagnoses of diseases[27]. The PNS survey, which addressed self-report NCDs, indicated a higher frequency of diabetes mellitus (DM), hypertension, and hypercholesterolemia among women[14]. In the Longitudinal Study of Adult Health (ELSA-Brasil), a higher prevalence of CKD was also found among women[10]. Nevertheless, although studies have sought to analyze the association between women and NCDs, the results have not yet converged to a clear pattern of association.

Another factor associated with GFR < 60 was obesity, observed by several authors as a modifiable risk factor for CKD[28,29]. Increase in BMI is related to metabolic and hormonal changes that lead to cardiovascular diseases, atherosclerosis, insulin resistance, diabetes, and hypertension, which are risk factors for kidney damage. The pathophysiology of CKD, associated with weight gain and obesity, has been related to factors, such as renal vasodilation and glomerular hyperfiltration, that lead to glomerulosclerosis, increased production of adipokines, and others, generating lipotoxicity, increased fatty acid metabolism with consequent apoptosis and fibrosis, which in turn cause CKD[28-30].

DM consisted in another factor associated with GFR < 60. In this study, diabetes was considered based on the laboratory result of glycated hemoglobin. It is known that the frequency of DM has been increasing worldwide, being associated with obesity and the aging of the population[31], and that diabetic kidney disease, also known as diabetic nephropathy, is the main isolated cause of CKD in the world. Approximately 40% of people with diabetes will develop nephropathy, but nephropathy is usually diagnosed about ten years or over after the evolution of DM[31]. Data based on the Brazilian Chronic Dialysis Survey show the incidence of 31% of diabetic nephropathy patients among the population on dialysis[32]. The pathophysiology of CKD caused by diabetes includes a sequence of events leading to a reduction in the glomerular filtration rate. All DM patients will develop anatomic-structural changes in the kidney and other physiological and pathological changes that involve mesangial thickening and glomerulosclerosis over time. These, in turn, will consequently result in albuminuria and reduced GFR if early diagnosis and follow-up are not carried out with specific interventions by healthcare professionals. Identifying kidney damage in these individuals with a care planning have proved to slow the progression of CKD[31].

The poor and very poor self-rated health were associated with GFR < 60. Reduction in GFR leads to a set of symptoms associated with social issues, such as loss of job and productivity and low quality of life, as well as psychological impacts, including family pressures,

loss of autonomy, and mental disorders that impact the quality of life[3,33]. In stage 2, kidney damage with mild renal failure can be already observed. The damage becomes more severe with the progressive decrease in secondary GFR until the irreversible loss of functioning nephrons[4]. Over time, the progressive deterioration produces an accumulation of toxic substances with a variety of biochemical disorders and multiple symptoms depending on the stage of CKD until the recommendation of dialysis or transplantation[6,7].

The lowest adjPR was found among study participants who reported to be smokers and with excessive salt intake, which may be a reverse causality due to medical guidelines and healthcare professionals aiming to control kidney function. Strategies for preventing the progression of CKD include a series of dietary restrictions and guidelines for preserving the kidney function, such as salt restriction and smoking cessation, as recommended in the manual for clinical guidelines for providing care for patients with CKD of the Brazilian Unified Health System[2].

Differences between regions may be related to specific characteristics such as epidemiological profile, access to and organization of healthcare services, among others.

Moreover, it is worth highlighting that the variables education level, hypertension, and hypercholesterolemia did not remain significant, although there are numerous studies that demonstrate the relationship between these variables and the loss of kidney function[12,28,34,35].

Furthermore, the international recommendation to evaluate the history of people with GFR < 60 and verify previous measurements of kidney function markers every three months is emphasized. Thus, the aim is to determine the chronicity of kidney disease for its possible confirmation or prevention[5].

As a limitation of the study, the cross-sectional design is mentioned, which can lead to a reverse causality bias resulting from simultaneous measurements of risk or protective factors, thus making it difficult to analyze the association of variables. The study performed a single creatinine measurement to estimate GFR and did not collect albuminuria, a component factor of the CKD diagnostic algorithm and staging.

The importance of conducting regular population surveys is emphasized, considering that they show the prevalence of CKD in the population based on biochemical tests and the associated risk factors. The advantages of this study outstand, such as: the methodological design of the research, which used biochemical results from a representative sample of the population; and the use of the GFR estimation equation without correction for Afro-descendants, following the latest updates on the topic, in order to reduce study bias.

CKD is a public health issue worldwide that remains neglected, especially in its early stages. CKD screening through laboratory tests is deemed low-cost and effective, and can be carried out by assessing the glomerular filtration rate. The PNS laboratory results are representative of the Brazilian population and enable to identify and follow up patients with kidney damage, as well as to act in the surveillance and control of risk factors, providing support to discuss possibilities for improving the healthcare processes aimed at people with CKD through strategies in order to formulate policies on health promotion and prevention.

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