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Factors associated with chronic kidney disease: epidemiological survey of the National Health Survey

Fatores associados à doença renal crônica: inquérito epidemiológico da Pesquisa Nacional de Saúde

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ABSTRACT: ***Objective:*** To identify the prevalence of chronic kidney disease (CKD) self-reported in Brazil and characterize the factors associated with it. ***Methods:*** This study was a cross-sectional health survey with a household-based, the National Health Survey, performed in 2013. The outcome in the present study was the prevalence of CKD. The groups of explanatory variables were socio-demographic characteristics, lifestyles, chronic self-reported diseases, anthropometry, and health evaluation. The prevalence of CKD, e their 95% respective confidence interval were estimated, univariate analysis and the multiple logistic regression model were calculated, and remained the variables statistically significant ($p < 0.05$). ***Results:*** It noticed that 1.42% (95%CI 1.33 – 1.52) of the 60,202 interviewees self-reported CKD. The OR increased progressively with age, being 2.68 among the elderly with 65 years or more (95%CI 1.75 – 4.09). Having health plans with OR = 1.51 (95%CI 1.28 – 1.78), as well as smoking, hypertension and high cholesterol and poor self-reported health with OR = 1.75 (95%CI 1.45 – 2.12), OR = 1.20 (95%CI 1.02 – 1.42), OR = 1.83 (95%CI 1.56 – 2.15), OR = 4.70 (95%CI 3.75 – 5.88), respectively, showed a higher chance of CKD. ***Conclusions:*** The associated variables were increasing age, health plan coverage, smoking, hypertension, hypercholesterolemia, and regular or poor health status. The knowledge of CKD prevalence in Brazil and risk and protection factors are essential for disease prevention and the establishment of supporting public health policies.

Keywords: Renal Insufficiency, Chronic. Chronic Disease. Risk Factors. Health Surveys. Health Planning. Brazil.

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RESUMO: ***Objetivos:*** Identificar a prevalência da doença renal crônica (DRC) autorreferida no Brasil e caracterizar os fatores associados a essa enfermidade. ***Métodos:*** Trata-se de um inquérito epidemiológico de base domiciliar, a Pesquisa Nacional de Saúde (PNS) realizada em 2013. O desfecho analisado foi a prevalência de DRC. Os grupos de variáveis explicativas foram: características sociodemográficas, estilos de vida, doenças crônicas autorreferidas, antropometria e avaliação de saúde. Foram estimadas as prevalências de DRC e os respectivos intervalos de confiança de 95% e foram realizados a análise univariada e o modelo de regressão logística múltipla, permanecendo as variáveis estatisticamente significativas ($p < 0,05$). ***Resultados:*** Observou-se que 1,42% (intervalo de confiança de 95% — IC95% 1,33 – 1,52) dos 60.202 entrevistados referiram ser portadores de DRC. O *odds ratio* (OR) aumentou com a idade, sendo 2,68 entre os idosos com 65 anos ou mais (IC95% 1,75 – 4,09). Apresentaram chance maior de DRC: possuir planos de saúde, com OR = 1,51 (IC95% 1,28 – 1,78), tabagismo, hipertensão, colesterol elevado e autoavaliação de saúde ruim, com OR = 1,75 (IC95% 1,45 – 2,12), OR = 1,20 (IC95% 1,02 – 1,42), OR = 1,83 (IC95% 1,56 – 2,15), OR = 4,70 (IC95% 3,75 – 5,88), respectivamente. ***Conclusões:*** A prevalência de DRC foi maior em idade mais avançada, baixa escolaridade, possuir plano de saúde, tabagismo, hipertensão, hipercolesterolemia e avaliação regular ou ruim do estado de saúde. O conhecimento da prevalência da DRC e dos fatores de risco e de proteção são essenciais para prevenção da doença e para subsidiar as políticas públicas de saúde.

Palavras-chave: Insuficiência Renal Crônica. Doença Crônica. Fatores de Risco. Inquérito Epidemiológico. Planejamento em Saúde. Brasil.

INTRODUCTION

Chronic kidney disease (CKD) is a public health problem, characterized by a progressive loss of nephron function with a consequent loss of an ability to filter blood and maintain homeostasis. CKD is associated with high rates of morbidity and mortality, and with great socioeconomic impact, making it a public health challenge worldwide[1].

The prevalence and incidence of CKD is still unknown in many countries[1,2]. The United States estimates a prevalence of 14.8% of CKD in the adult population from 2011 to 2014, and 703,243 cases. There was an estimated number of 124,114 new cases in 2015, with an incidence rate of 378 patients per 1,000,000 people (pmp), with 87.3% of those undergoing renal replacement therapy[2]. In Latin America, the incidence was 167.8 pmp in 2005[3] and, in Brazil, 431 pmp in 2004[4]. Still, according to the National Health Survey (*Pesquisa Nacional de Saúde* - PNS), the prevalence of self-reported CKD is 1.42%, that is, approximately two million individuals in the country, which reveals the dimension of the disease in Brazil[5].

A study monitoring end-stage renal disease (ESRD) in Brazil, using the High Complexity Procedures Authorization (*Autorização de Procedimentos de Alta Complexidade* - APAC) subsystem, analyzed, in the period from 2000 to 2006, the epidemiological profile of individuals who started renal replacement therapy (RRT) and identified 148,284 dialysis patients, with an estimated incidence of 119.8/million people per year[6].

The Brazilian Census of Chronic Dialysis in Brazil estimated that the country spends 1.4 billion reais a year on dialysis and transplantation. In 2016, 122,825 CKD patients were on RRT, and the prevalence of CKD was 596 pmp, with an incidence of 193 pmp[7].

It has been observed that many countries, including Brazil, have carried out studies on CKD, mainly on the stage after starting dialysis treatment or after transplantation. They have shown that monitoring is done only after the ESRD has started, as shown through the records of dialysis and transplants[6-8].

Epidemiological surveys that address the risk factors for CKD before renal replacement therapies are still scarce. Among these surveys, the CKD Study[9], the National Health and Nutrition Examination Survey (NHANES)[10] and the United States Renal Data System (USRDS)2 report pointed to an increase in the prevalence of CKD in people aged over 70 years old, corroborating other studies[11-13]. They also showed that the disease was associated with hypertension in the United States and with diabetes in Mexico[14].

In Brazil, until 2013, with the implementation of the PNS, the National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios* - PNAD) was the only study that sought to carry out surveillance of chronic non-communicable diseases (NCDs). It was a pioneer for monitoring, through self-report and diagnosis of chronic diseases[11,15]. The surveys currently conducted that address CKD are the Longitudinal Study of Adult Health (*Estudo longitudinal da Saúde do Adulto* - ELSA/Brasil) and the PNS. ELSA/Brasil studied chronic diseases, including CKD, however, only in a population that included public servants in teaching and research units. It showed an increase in CKD among the elderly, individuals with lower socioeconomic conditions and among blacks or indigenous people[16]. Moura et al. performed a descriptive analysis of PNS data and found a higher prevalence of CKD in individuals over 60 years old and with a lower level of education[17].

Studies evaluating the association of risk factors with CKD in Brazil were conducted with small samples or with patients on RRT. There is international research on CKD prior to ESRD and it has shown factors associated with kidney damage and the consequent loss of filtration, diabetes, hypertension, hypercholesterolemia, smoking, alcohol consumption, overweight/obesity, diet and old age[12-14]. It is believed that in Brazil, as in international studies, CKD is associated with risk factors, such as sociodemographic conditions, unhealthy behaviors/lifestyles and chronic diseases.

It is important that these surveys are carried out more frequently and that the analysis and dissemination of the results can be used to better plan for health actions, enabling early diagnoses and avoiding the evolution to CKD and the need for RRT[12]. Thus, the objectives of this study were to identify the prevalence of self-reported chronic kidney disease in Brazil and to characterize the factors associated with this disease, according to PNS data.

METHODS

This is a cross-sectional, home-based epidemiological survey, the PNS, conducted by the Brazilian Institute of Geography and Statistics (IBGE) in partnership with the Ministry of Health. The study was carried out in 2013, and was representative of the country, its large regions, its federative states (FS), its capital cities and other municipalities of each FS.

Three-stage conglomerate sampling was used. The first stage consisted of the census tracts, which formed the primary units, the second stage consisted of households, and the third stage of residents aged 18 or over. One resident of each household was selected to answer the questionnaire, by simple random sampling.

The sample consisted of 60,202 individuals who underwent specific interviews about NCDs. The interviews were conducted using Personal Digital Assistance (PDAs), handheld computers programmed appropriately for the processing of variables. Detailed information on the methodology can be found in a specific publication[18].

The PNS data collection questionnaire included several topics and is available online at http://www.pns.icict.fiocruz.br/arquivos/Novos/Questionario%20PNS.pdf, the database also can be found at the electronic address https://sidra.ibge.gov.br/pesquisa/pns.

The outcome analyzed in the present study was the prevalence of CKD, as measured by the question: "Has any doctor ever given you a diagnosis of chronic renal failure?", with the answer options being yes and no.

NCDs are associated with demographic factors, such as age, sex, socioeconomic status, diabetes, arterial hypertension (AH), hypercholesterolemia and unhealthy lifestyles, such as tobacco use and excess salt, and are also related to poor self-rated health[19]. Thus, four groups of explanatory variables were considered:

- sociodemographic characteristics and anthropometry;
- health assessment;
- life styles;
- self-reported chronic diseases.

The selected sociodemographic characteristics were: sex (male and female), age group, education, race/color and affiliation with a private health plan. The age groups established were 18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64 and 65 years old. Education level, on the other hand, was divided into four levels: no instruction/incomplete elementary school, completed elementary school/incomplete high school, completed high school/incomplete higher education and completed higher education. An anthropometry assessment was carried out by means of classification regarding body mass, according to the individual's perception, with the following classifications: eutrophic, overweight and obese. The health status assessment was considered in three strata: very good/good, normal and poor/very bad.

Among the risk and protection factors that are considered to be lifestyle indicators are smoking (non-smoker, ex-smoker and smoker) and dichotomous variables related to food consumption and physical activity. For food consumption, the following are considered: consumption of fruits and vegetables (FV), defined as a daily intake of 5 or more servings, at least 400 grams of fruits and vegetables, an amount recommended by the World Health Organization; consumption of red meat with apparent 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, in the last 30 days); high salt consumption (based on people's perception of salt intake, when considering both freshly prepared and industrialized food). For physical activity, activities with a minimum duration of 150 minutes in four domains, leisure,

work, commuting and domestic activities, and being active in free time (practice of physical activity in free time for 150 minutes or more).

The variables in the self-reported chronic disease group that were also assessed with dichotomous responses were: AH, diabetes and high cholesterol.

The prevalence of CKD and the respective 95% confidence intervals (95% CI) were estimated according to the studied explanatory variables. Subsequently, univariate analysis was performed by calculating the crude odds ratios (OR) with the respective confidence intervals. Then the multiple logistic regression model was performed, inserting the variables with $p<0.20$. In the final adjusted model, the statistically significant variables remained with $p<0.05$.

For all analyzes, the sample structure and weights were considered in order to obtain population estimates. The data were analyzed with the aid of the Statistical Package for the Social Science (SPSS), version 20.

The study was approved by the National Commission for Ethics in Research, of the National Health Council, with the identification number 328.159. All individuals participating in the study were made aware, and they signed a Free and Informed Consent Form.

RESULTS

The analysis of data collected from the PNS (2013) showed that 1.42% (95%CI 1.33 - 1.52) of the 60,202 respondents, aged 18 or over, reported having CKD.

The proportion of self-reported CKD patients in women was 1.48% and in men, it was 1.35%. The prevalence of CKD was higher in those individuals aged 65 years or older (3.13%) and in those who rated their health status as poor/very poor (4.77%) (Table 1).

In relation to lifestyle, the prevalence of CKD was higher among smokers and ex-smokers and among those who reported physical inactivity. The prevalence of CKD in patients with self-reported chronic diseases was 2.85% among those who reported being hypertensive, 3.49% in diabetics and 3.60% in those with hypercholesteremia (Table 2).

The result of the univariate analysis indicated that older individuals (≥ 65 years; OR = 8.55; 95%CI 6.01 - 12.16), with private health plans (OR = 1.20; 95%CI 1.04 - 1.38), self-reported obesity (OR = 1.26; 95%CI 1.02 - 1.54), who reported poor/very poor health status (OR = 7.07; 95% CI 5.81 - 8, 60), smokers (OR = 1.85; 95% CI 1.55 - 2.20) and ex-smokers (OR = 2.20; 95%CI 1.88 - 2.58) and patients with self-reported chronic diseases, such as hypertension (OR = 2.81; 95%CI 2.45 - 3.22), diabetes (OR = 2.78; 95%CI 2.30 - 3.36) and hypercholesterolemia (OR = 3.07; 95%CI 2.65 - 3.56), were significantly more likely to be diagnosed with CKD. It was found that race/color and level of education were protective factors for CKD. Individuals with a self-reported brown skin color (OR = 0.77; 95%CI 0.67 - 0.89), completed high school (OR = 0.45; 95%CI 0.38 - 0.53) and completed higher education (OR = 0.46; 95%CI 0.36 - 0.59 had a lower chance of being diagnosed with CKD. It was also found that the abusive alcohol consumption (OR = 0.59; 95%CI 0.41 - 0.85) and physical activity during free time (OR = 0.67; 95%CI 0.56 - 0.81) reduced the chance of CKD (Tables 3 and 4).

Table 1. Characteristics of the individuals with self-reported chronic kidney disease (CKD): sociodemographic characteristics, body mass and health assessment. Brazil, National Health Survey (PNS), 2013.

Variable	%	95%CI
Total	1.42	1.33 – 1.52
Sex		
Male	1.35	1.18 – 1.55
Female	1.48	1.36 – 1.62
Age range (years)		
18 to 24	0.38	0.26 – 0.53
25 to 34	0.75	0.59 – 0.95
35 to 44	1.02	0.82 – 1.27
45 to 54	1.88	1.55 – 2.26
55 to 64	2.18	1.79 – 2.64
65 or older	3.13	2.75 – 3.55
Education level		
No education and incomplete elementary education	2.08	1.63 – 2.64
Completed elementary education / incomplete high school	1.16	0.86 – 1.55
Completed high school education and incomplete higher education	0.95	0.72 – 1.24
Completed higher education	0.97	0.77 – 1.22
Race/Color		
White	1.58	1.37 – 1.82
Black	1.48	1.17 – 1.89
Brown	1.22	1.09 – 1.36
Health insurance		
No	1.34	1.17 – 1.55
Yes	1.60	1.43 – 1.79
Classification of body mass		
Eutrophic	1.45	1.19 – 1.77
Overweight	1.45	1.17 – 1.79
Obese	1.81	1.54 – 2.13
Health status assessment		
Good/very good	0.70	0.58 – 0.85
Normal	2.54	2.12 – 3.05
Poor/very poor	4.77	4.10 – 5.53

95%CI: 95% Confidence Interval.

Table 2. Descriptive analysis of risk factors associated with self-reported chronic kidney disease (CKD): lifestyle and self-reported chronic diseases. Brazil, National Health Survey (PNS), 2013.

Variable	%	95%CI
Total	1.42	1.33 – 1.52
Smoking		
Non-smoker	1.07	0.90 – 1.28
Ex-smoker	2.33	1.92 – 2.82
Smoker	1.96	1.69 – 2.27
Recommended consumption of fruits and vegetables		
No	1.41	1.23 – 1.62
Yes	1.44	1.29 – 1.60
Consumption of red meat with fat		
No	1.27	1.10 – 1.48
Yes	1.28	1.14 – 1.44
Abusive consumption of alcoholic beverages		
No	1.46	1.02 – 2.08
Yes	0.87	0.61 – 1.23
High salt intake		
No	1.42	1.18 – 1.72
Yes	1.41	1.18 – 1.68
Physical activity in the 4 domains <150 minutes		
No	1.28	1.12 – 1.46
Yes	1.59	1.45 –1.75
Active in free time		
No	1.53	1.28 – 1.83
Yes	1.04	0.88 – 1.22
Hypertension		
No	1.03	0.90 – 1.18
Yes	2.85	2.57 – 3.15
Diabetes		
No	1.28	1.07 – 1.55
Yes	3.49	2.95 – 4.13
High cholesterol		
No	1.20	1.04 – 1.39
Yes	3.60	3.20 – 4.04

95%CI: 95% Confidence Interval.

Table 3. Univariate analysis of factors associated with self-reported chronic kidney disease (CKD): sociodemographic characteristics, body mass and health assessment. Brazil, National Health Survey (PNS), 2013.

Variable	OR	95%CI	p
Sex			
Male	1.00		
Female	1.10	0.96 – 1.26	0.184
Age range (years)			
18 to 24	1.00		
25 to 34	1.99	1.36 – 2.92	< 0.001
35 to 44	2.72	1.87 – 3.95	< 0.001
45 to 54	5.06	3.54 – 7.22	< 0.001
55 to 64	5.89	4.11 – 8.44	< 0.001
65 or older	8.55	6.01 – 12.16	< 0.001
Education level			
No education and incomplete elementary education	1.00		
Completed elementary education / incomplete high school	0.55	0.45 – 0.68	< 0.001
Completed high school education and incomplete higher education	0.45	0.38 – 0.53	<0.001
Completed higher education	0.46	0.36 – 0.59	< 0.001
Race/Color			
White	1.00		
Black	0.94	0.74 – 1.19	0.608
Brown	0.77	0.67 – 0.89	<0.001
Health insurance			
No	1.00		
Yes	1.20	1.04 – 1.38	0.014
Classification of body mass			
Eutrophic	1.00		
Overweight	1.00	0.84 – 1.19	0.986
Obese	1.26	1.02 – 1.54	0.028
Health status assessment			
Good/very good	1.00		
Normal	3.68	3.16 – 4.29	< 0.001
Poor/very poor	7.07	5.81 – 8.60	< 0.001

OR: Odds Ratio; 95%CI: 95% confidence interval.

Table 4. Univariate analysis of factors associated with self-reported chronic kidney disease (CKD). Brazil, National Health Survey (PNS), 2013.

Variable	OR	95%CI	p
Smoking			
Non-smoker	1.00		
Ex-smoker	2.20	1.88 – 2.58	< 0.001
Smoker	1.85	1.55 – 2.20	< 0.001
Recommended consumption of fruits and vegetables			
No	1.00		
Yes	1.02	0.89 – 1.17	0.765
Consumption of red meat with fat			
No	1.00		
Yes	1.01	0.86 – 1.17	0.941
Abusive consumption of alcoholic beverages			
No	1.00		
Yes	0.59	0.41 – 0.85	0.004
High salt intake			
No	1.00		
Yes	0.99	0.82 – 1.20	0.926
Physical activity in the 4 domains <150 minutes			
No	1.00		
Yes	1.25	1.09 – 1.43	0.001
Active in free time			
No	1.00		
Yes	0.67	0.56 – 0.81	< 0.001
Hypertension			
No	1.00		
Yes	2.81	2.45 – 3.22	< 0.001
Diabetes			
No	1.00		
Yes	2.78	2.30 – 3.36	< 0.001
High cholesterol			
No	1.00		
Yes	3.07	2.65 – 3.56	< 0.001

OR: Odds Ratio; 95%CI: 95% confidence interval.

The multivariate analysis (Table 5), controlled by sociodemographic variables, chronic health conditions, lifestyle and self-rated health, showed that the highest chance of having CKD was associated with an age greater than or equal to 65 years, private health insurance, smoking, hypertension, hypercholesterolemia and normal and poor self-rated health. On the other hand, the increase in education and the self-reported race/color as brown were protective factors for CKD.

Table 5. Multivariate model of factors associated with self-reported chronic kidney disease (CKD). Brazil, National Health Survey (PNS), 2013.

Variable	OR	95%CI	p
Age range (years)			
18 to 24	1.00		
25 to 34	1.67	1.09 – 2.55	0.018
35 to 44	1.71	1.13 – 2.60	0.012
45 to 54	2.21	1.47 – 3.33	< 0.001
55 to 64	1.92	1.26 – 2.93	0.002
65 or older	2.68	1.75 – 4.09	< 0.001
Education level			
No education and incomplete elementary education	1.00		
Completed elementary education / incomplete high school	0.87	0.69 – 1.11	0.262
Completed high school education and incomplete higher education	0.83	0.67 – 1.02	0.069
Completed higher education	0.67	0.50 – 0.89	0.006
Race/Color			
White	1.00		
Black	0.86	0.67 – 1.10	0.225
Brown	0.73	0.62 – 0.86	< 0.001
Health insurance			
No	1.00		
Yes	1.51	1.28 – 1.78	< 0.001
Smoking			
Non-smoker	1.00		
Ex-smoker	1.51	1.27 – 1.79	< 0.001
Smoker	1.75	1.45 – 2.12	< 0.001
Hypertension			
No	1.00		
Yes	1.20	1.02 – 1.42	0.028

Continue...

Table 5. Continuation.

Variable	OR	95%CI	p
High cholesterol			
No	1.00		
Yes	1.83	1.56 – 2.15	< 0.001
Health status assessment			
Good/very good	1.00		
Normal	2.68	2.25 – 3.19	< 0.001
Poor/very poor	4.70	3.75 – 5.88	< 0.001

OR: Odds Ratio; 95%CI: 95% confidence interval.

DISCUSSION

To our knowledge, this is the first nationwide study to assess factors associated with self-reported CKD. Most of the studies that address this theme are international, and those found in the Brazilian literature were carried out in small groups or in RRT units.

The present study sought to assess the association between sociodemographic factors and anthropometry, lifestyle, chronic diseases and self-rated health. An association was observed between increasing age and CKD, which is consistent with findings from other studies[7,20,21]. With increasing age, renal atrophy occurs and there is a 10% reduction in the renal cortex per decade, starting at the age of 30[21]. Aging is related to changes in the renal system and increased prevalence of nephrosclerosis with glomerular sclerosis, tubular atrophy, interstitial fibrosis and atherosclerotic changes[20].

This study showed that having a health plan was associated with CKD and having completed higher education was a protective factor. The literature points to higher education as a proxy for socioeconomic conditions associated with income and health[19]. Individuals with favorable socioeconomic conditions, such as higher education, are less exposed to risk factors[22]. Having a health plan is also associated with socioeconomic status, allowing greater access to preventive exams and early medical diagnoses, which may explain the findings of the study[11,23].

The prevalence of CKD found was lower among adults who identified as brown, which was also considered to be a protective factor. Several authors discuss the correlation between race and risk factors for NCDs, relating a higher prevalence of chronic diseases in blacks when compared to whites[13,24]. The analysis of factors associated with hypertension in the PNS also showed that brown-skinned people reported a lower frequency of hypertension[25]. The authors of this study argue that the black population has less access to health services and less possibility of early diagnosis of diseases. The literature also points to the challenge of establishing an association between CKD and race/color in societies in which racial minorities suffer socioeconomic effects, knowing that these factors impact the incidence

and prevalence of CKD[26]. Another important discussion is the use of formulas to estimate glomerular filtration rate (GFR), which considers the fit between blacks and whites, underestimating the prevalence of CKD among blacks. As a result, blacks end up having less diagnoses of CKD, worse evolution, and worse outcomes[16]. Brazil is a country with great ethnic diversity, which makes it difficult to analyze this association, indicating that similar equations for whites and blacks that are better suited to the Brazilian reality are needed, because the country has a different origin and miscegenation from the North American populations. The use of equations without adjustment will allow for new national analyses of the association of race/color with CKD. Some Brazilian studies, such as Elsa/Brasil, used similar equations for calculating GFR between whites and blacks and, after these adjustments, found no differences by race[24]. Therefore, the data found here should be reviewed with biochemical data. Thus, the literature points to the need for further studies to better understand this variable[23].

This study confirms the association between smokers and the higher prevalence of CKD found in the literature. The literature also shows an association between smoking and diabetes and hypertension[12,27]. A study carried out to assess the association between lifestyle and glomerular filtration and proteinuria showed that smoking was associated with increased albuminuria, which, in turn, was related to progressive kidney damage and hypertension[28].

Blood pressure is considered to be a modifiable risk factor for several NCDs. PNS data in 2013 revealed that 31.3 million adults had self-reported AH, equivalent to 21.4% of respondents[25]. Similar results were found in Vigitel 2013 indicating a prevalence of 24.1% of self-reported AH among adults living in the capital cities and in the Federal District, associated with age, low level of education, black race/color, ex-smokers, obesity, diabetes and hypercholesterolemia[29]. AH is present in 75% of patients with CKD[12]. The relationship between HA and the decline in glomerular filtration has been widely studied. Studies on the importance of hypertension in CKD report diverse and complex damages, which include renal vasoconstriction, mainly of the pre-glomerular vasculature, microvascular damage, loss of peritubular capillaries, local ischemia, inability to excrete salt, and hypertensive kidney disease, among others[26,30].

The pathogenesis of hypercholesterolemia in the evolution of CKD is complex. Studies have focused on the various mechanisms related to hypertriglyceridemia, the increase in serum of very low-density cholesterol (VLDL-C) and the reduction in cholesterol of high-density lipoproteins (HDL-C). However, the literature points to the need for further studies to better understand this association[28]. Hypercholesterolemia is also considered a risk factor for cardiovascular diseases[28], which, in turn, as previously mentioned, increases the susceptibility to the occurrence of CKD[12].

Self-perceived health is associated with the type of disease and comorbidities, among others. It is associated with CKD, because it inflicts dietary restrictions, fluid intake and use of medications on the individual, as well as greater use of health services and limitations in activities of daily living, leading to a worse health assessment[1,24]. Here, the strength of this association stands out, both in the assessment of normal and bad and

very bad health, demonstrating that self-perception is a predictor of worse disease progress and mortality.

In the current study, diabetes and obesity did not remain in the final model, although there is evidence of their association with CKD.

Diabetes is among the main causes of CKD, along with hypertension and obesity, and is the most common comorbidity in patients on RRT[2,4,7,12,13]. Authors argue that many people with diabetes and CKD have significantly altered blood pressure, with more severe pathological findings of hypertensive nephrosclerosis[24]. Furthermore, greater attention is being given to strict control of pressure levels to delay the progression of CKD[1]. There is also a probable deficiency in the diagnosis of *diabetes mellitus* (DM), since laboratory evaluation is required.

Regarding obesity, despite the increase in its prevalence and its recognition as a risk factor for cardiovascular diseases and as a modifiable risk factor for CKD, the association of overweight/obesity and CKD is still not well known. The literature points out that obesity can lead to insulin resistance, glucose intolerance, hyperlipidemia, atherosclerosis and hypertension and that insulin resistance reduces the activity of lipoprotein lipase, which may be implicated in the pathophysiology of dyslipidemia in CKD[30]. It is difficult to analyze this variable in isolation.

High alcohol intake was also not maintained in the current model. Studies on the effect of alcohol consumption on the evolution of CKD have shown different results. However, other studies indicate that high alcohol consumption is associated with the development of albuminuria, with worsening renal function[30].

The present study presented several limitations. Initially, because it dealt with self-reported morbidity, its prevalence may be underestimated. Another limitation is attributed to the study's cross-sectional design, since it was not possible to establish a chronology of events, so the associations found here may not correspond to the causal association and may hide older associations. Also, data referring to race/color may have had an underdiagnosis bias among black people, resulting from the equation used in GFR, which inappropriately increases GFR among blacks and delays the diagnosis of CKD in this population. It is worth noting that the diagnosis of CKD can lead to changes in an individual's behavior, such as restricting tobacco and salt consumption. As such, when answering the questionnaire, the person could have already changed their habits from being ill. This is also expressed in the assessment of their current health status. Thus, several factors identified in this study may have their relationship altered as a risk and protection factor, after the formal diagnosis of the disease or at the beginning of RRT.

CONCLUSION

The prevalence of self-reported CKD found in the 2013 PNS was 1.42%. The associated variables were increased age and aging, low levels of education, having health insurance, brown skin color, smoking, hypertension, hypercholesterolemia, and a normal or poor health status assessment.

CKD is an asymptomatic disease until it progresses to an advanced stage, and it is frequently detected late, which compromises its control and treatment. Knowledge of the prevalence of CKD in Brazil and the risk and protection factors are essential for the establishment of measures for the prevention and treatment of the disease, as well as to subsidize public health policies.

Even in primary care, the recognition and monitoring of individuals who present the identified risk factors can contribute to the implementation of health promotion and disease prevention actions. It is necessary to reflect on expanding the scope of actions in primary care, as well as greater resolution of such actions to control the risk factors of CKD.

In Brazil, there is little research on the prevalence of CKD and the associated factors. The PNS made it possible to collect information in order to support public policies and the surveillance of kidney disease.

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