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Prevalence of diabetes mellitus according to associated factors in rural traditional populations in Goiás, Brazil: a cross-sectional study

Prevalência de diabetes mellitus *autorreferido e fatores associados em população rural e tradicional de Goiás: estudo transversal*

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ABSTRACT: ***Objective:*** To identify the prevalence of and factors associated with diabetes mellitus in rural traditional communities. ***Methods:*** Cross-sectional study carried out in 115 rural communities distributed in 45 municipalities in the state of Goiás, including: 13 river communities, 51 quilombolas and 63 agrarian reform settlements. Probabilistic sampling was performed, and participants were selected at random. The outcome variable was self-reported diabetes mellitus, while exposure variables were sociodemographic, lifestyle, health conditions and access to health services. Multiple regression was used to determine the association between study variables. ***Results:*** Among the 2,537 participants, the overall prevalence of diabetes was 9.8%, with 13.5% in river dwellers, 10.0% in quilombolas and 9.3% in settlers. Factors associated with diabetes were negative self-perception of health, being a former smoker, high blood pressure, hypercholesterolemia, and living in a river community. ***Conclusion:*** The results reinforce the need to strengthen strategies for the prevention and control of diabetes and its complications in rural populations, especially among river dwellers.

Keywords: Diabetes mellitus. Rural population. Ethnic groups. Access to health services.

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RESUMO: ***Objetivo:*** Identificar a prevalência e os fatores associados ao diabetes *mellitus* em comunidades rurais. ***Métodos:*** Estudo transversal desenvolvido em 115 comunidades rurais distribuídas em 45 municípios do Estado de Goiás, sendo: 13 ribeirinhas, 51 quilombolas e 63 assentamentos de reforma agrária. Realizou-se amostragem probabilística, e os participantes foram selecionados de forma aleatória. A variável desfecho foi diabetes *mellitus* autorreferido, enquanto as de exposição foram sociodemográficas, estilo de vida, condições de saúde e acesso a serviços de saúde. Utilizou-se regressão múltipla para verificar a associação entre variáveis de estudo. ***Resultados:*** Entre os 2.537 participantes, a prevalência geral de diabetes foi de 9,8%, sendo 13,5% nos ribeirinhos, 10,0% nos quilombolas e 9,3% nos assentados. Os fatores associados ao diabetes foram a autopercepção negativa de saúde, ser ex-fumante, hipertensão arterial, hipercolesterolemia e residir em comunidade ribeirinha. ***Conclusão:*** Os resultados reforçam a necessidade de fortalecer estratégias para prevenção e controle da diabetes e suas complicações em populações rurais, especialmente entre os ribeirinhos.

Palavras-chave: Diabetes mellitus. População rural. Grupos étnicos. Acesso aos serviços de saúde.

INTRODUCTION

Diabetes mellitus (DM) is a chronic non-communicable disease (NCD) with a global impact, and its prevalence tends to increase especially in low-income countries[1]. The International Diabetes Federation (IDF) estimates that 463 million people worldwide have DM (9.3%), and that in the next 25 years, this number will reach 700 million, representing an approximate increase of 51%[1]. Brazil ranks fifth among the ten countries with the highest prevalence of DM in the world[1], which is linked to risk factors prevalent among Brazilians, such as overweight, obesity and sedentary lifestyle[2].

Most studies on DM in Brazil are concentrated in urban areas[3], and little is known about its occurrence in rural areas. The National Health Survey (PNS), one of the largest Brazilian epidemiological surveys, estimated a prevalence of 7.9% in urban areas and 6.3% in rural areas[4]. In other countries, the prevalence varies from 4.7 to 19.6%[5-7] in different rural populations. Brazilian studies with river dwellers in the North region[8] and rural population in the South[9] show a prevalence of 10 and 16.4%, respectively.

Rural traditional populations are historically marked by situations of inequality, inequities and exploitation of rural activity, which are reflected in significant social and health vulnerability[10]. Conceptually, they are understood as peoples and communities that have a socioeconomic and sociocultural lifestyle closely related to the land, including family farmers, peasants, settlers and/or campers, as well as river and quilombola people[10].

In this group, the geographic location, lack of basic sanitation, less education, less access to transport, and moreover economic and social determinants and the difficulty of accessibility to basic health units[11] are among the main barriers to recognition,

monitoring and the control of health problems[12]. It is noteworthy here that access to health services can be widely understood and is directly related to the ability of a group to seek and obtain care, taking into account the availability of health resources, the ability to produce services, and resistance of the service (obstacles to seeking and getting attention)[13].

In the case of NCDs, such as DM, the lifestyle of rural populations has led to an increase in the frequency of unhealthy behaviors, such as smoking, consumption of alcoholic beverages, physical inactivity and inadequate consumption of vegetables and fruits[14-17]. In addition, rural and traditional populations have a high prevalence of hypercholesterolemia and hypertension, which are risk factors related to DM[18,19]. These factors, associated with low education and lower socioeconomic status, contribute to the occurrence of NCDs, conditions that increase the demand for health services[12]. Specifically in the case of DM, studies show that people with this disease in rural areas are at greater risk for developing complications such as diabetic foot because of working conditions, mycoses and lower health education level for diabetes care[20,21].

It is therefore essential that surveys on the health conditions of rural populations are conducted to give visibility to the health needs of this group and thereby propose health care strategies, considering their specificities and collaborating for the execution of the objectives of the National Policy of Comprehensive Health for People of the Countryside, Forests and Waters[10].

The aim of this study was to analyze the prevalence of self-reported DM and its associated factors in a rural traditional population in central Brazil.

METHODS

STUDY DESIGN AND PARTICIPANTS

We conducted an observational study with a cross-sectional design, nested within the matrix project titled "Sanitation and Environmental Health in Rural Traditional Communities in Goiás (Sanrural Project)", which covered 45 municipalities in the state of Goiás, central region of Brazil. A total of 115 rural communities were included, distributed as follows: nine river communities, 44 quilombo remnants certified by the Palmares Quilombolas Foundation and 62 agrarian reform settlements. The choice criterion was based on the selection of municipalities that had one or more accredited quilombola and river communities, followed by the presence of agrarian reform settlements under the management of the National Institute of Colonization and Agrarian Reform, Regional Superintendence 04 (INCRA SR-04).

The parameters considered for the sample size calculation of the larger study were:

1. Estimated total number of existing families in the 115 communities;
2. 90% confidence level;

3. Maximum error of 10% in the interval estimates of proportions of the characteristics investigated in the families of the communities;
4. Bonferroni correction for multinomial responses, with 14 categories[22].

The parameter estimates were approximated by the simple random sampling method. Considering these parameters, the number of 3,779 families to be interviewed in the 115 communities was estimated. In the present study, families whose members were residents of permanent homes in a lot/area of the community who, during the data collection period, were present or temporarily absent, were eligible. For the interview, a family member aged ≥18 years was considered responsible for the household in a consensual way with the other family members, about whom he provided information. Thus, to estimate the prevalence of DM and associated factors, the analyses were restricted to the individual characteristics of the resident responsible for the families. Therefore, the missing answers about the presence of diseases used to compose the outcome of this study were considered as exclusion criteria. Considering the data collected in the larger project, a new sample calculation for simple proportion was performed to determine if the sample of individuals from this cut had sufficient power to estimate the prevalence of self-reported DM. Thus, a minimum sample of 1,573 individuals was estimated as sufficient to detect the minimum prevalence of DM of 9.8% found in this study, with a 90% confidence level and a sampling power of 0.95. The power of the *a posteriori* test for the binomial distribution was also estimated to determine the adequacy of the sample for the estimates, considering the number of samples actually collected (n=2,537). For these estimates, the results showed that the sample collected, at the 95% confidence level, had a power of 99.6% for the analysis of the prevalence of DM.

DATA COLLECTION

Data collection took place between August 2018 and August 2019 during one of the stages of the project called Workshop 2, which consisted of on-site activity in 115 communities. Three teams were formed with three field researchers, who had higher education and previous training to apply the questionnaires and approach people.

For data collection in the communities, mobilization first took place, carried out between the researchers and a community mobilizer (person of reference or identified as a leader). Upon arriving at the community, the researchers made a reconnaissance of the area, the local mobilization and the definition of the itinerary of visits. After scheduling the visit, the resident was visited by the project researchers at their home, and they interviewed them using the HP iPAQ Pocket PC device to fill in the information obtained. All participants were informed about the research objectives.

Standardized questionnaires were used that addressed demographic and health conditions, demand for and use of health services, prepared for this study. The questions had already been used in epidemiological surveys, but some questions were included for the

purposes of the present study, after standardization in a pilot study. The health data questionnaire consisted of 36 questions.

VARIABLES

The outcome variable was self-reported DM estimated by the question: *"Has a doctor ever told you that you have diabetes?"*[23]. Prevalence was calculated using the number of adults interviewed who responded positively to this question as the numerator and the total number of people interviewed as the denominator.

Exposure variables were grouped as follows:

1. Sociodemographic: sex, age group, skin color and education;
2. Health conditions: self-assessment of health status, hypertension, hypercholesterolemia, use of alcohol and tobacco, physical activity and hospitalization in the last year. Regarding this item, self-rated health was measured through the question: *"What do you think your state of health is*?". The answers were dichotomized into very good/good/fair and bad/very bad[24]. Hospitalization in the last year was identified through the question: *"Have you been hospitalized in the last year*?". Hypertension and hypercholesterolemia were verified by the question: *"What diseases has the doctor said you have*?" Alcohol consumption, tobacco use and physical activity were determined using the following questions, respectively: *"How often do you drink alcohol?"*[25]; *"How often do you smoke?"*[25] and *"How often do you engage in physical activity?*". For the three questions, the response options were "daily", "weekly", "monthly", "on occasion" and "not at all". Thus, the daily and weekly frequencies were considered as regular practice of physical activity (yes)[26]; regular use of alcoholic beverages (yes) was with reference to daily and weekly consumption; and daily, weekly, monthly and occasional smoking was considered as tobacco use (yes). Having health insurance was evaluated by: *"Do you have health or medical insurance?*";
3. Indicators related to the availability of health services: *"Have you received a visit from a member of Family Health Strategy, as a community health agent, in the last year?"*; and
4. Search for services, with the questions: *"Have you sought medical attention in the last year?* and *"Have you sought a specialist in the last year?"*[25].

DATA ANALYSIS

Data analysis was performed using Stata software, version 12.0 (StataCorp, College Station, TX, United States). Initially, a descriptive analysis of the sample was performed using absolute and relative frequencies of qualitative variables and mean and standard deviation (SD) of quantitative variables. The prevalence of self-reported DM was determined with a 95% confidence interval (95%CI) for binomial distributions, for the total sample and the subpopulation under study (quilombolas, river dwellers and settlers).

To verify the association between the dependent variable (self-reported DM) and the independent variables, bivariate and multiple analyses were performed using the Poisson regression model. In the bivariate analysis, each independent variable was associated with the dependent variable, obtaining the crude prevalence ratio (PR) and respective 95%CI. Variables with a value of $p<0.20$ were then included in a multiple Poisson regression model. The input method for the independent variables was stepwise, with forward as the selection method. In this modeling, the beginning occurs without variables in the regression equation, incorporating statistically significant variables into the model, one by one. The criterion for maintaining the variable in the final model was a value of $p\leq0.05$ in the regression. The magnitude of the association was estimated using the adjusted prevalence ratio (PRa) and 95%CI. Statistical significance was established by the Wald test, considering a significance level of 5% ($p<0.05$).

ETHICAL ASPECTS

This project was approved by the Research Ethics Committee of the Federal University of Goiás, under approval No. 2.886.174/2018, respecting the ethical principles of the National Health Council (CNS) resolution 466/2012, which regulates research involving human beings. Before the study participants filled out the questionnaire, an informed consent form was read and explained to obtain the interviewee's written or digital signature.

RESULTS

A total of 2,537 people were included, 55.5% men and 44.5% women. The mean age was 51.6 years (SD: 14.7); 41.0% reported having brown skin color, and 61.5% had completed elementary school or incomplete high school (Table 1).

The overall prevalence of DM was 9.8% (95%CI 8.7–11.0), with 13.5% in river dwellers, 10.0% in quilombolas and 9.3% in settlers (Figure 1).

In the bivariate analysis, the prevalence of DM was higher in women (10.3%), in people aged 60 or older (10.5%), with black skin color (10.3%) and with incomplete elementary education (12.8%). Schooling showed a statistically significant difference ($p=0.006$) (Table 1).

In the bivariate analysis of health conditions, there was an association of DM with: poor self-perception of health (PR: 2.84; 95%CI 2.16–3.72), hypertension (PR: 4.04; 95%CI 3.15–5.17), hypercholesterolemia (PR: 4.27; CI: 3.40–5.36), being a former smoker (PR: 1.86; 95%CI 1.44–2.41) and use of alcohol (PR: 0.55; 95%CI 0.41–0.74). Regarding access to health services, the following indicators were associated: having health insurance (PR: 1.39; 95%CI 1.03–1.88), seeing a general practitioner (PR: 1.66; 95%CI 1.19–2.31), seeing a specialist (PR: 1.52; 95%CI 1.19–1.93) and hospitalization in the last year (PR: 1.40; 95%CI 1.03–1.91) (Table 2).

In the multiple analysis, self-reported DM remained associated with self-perception of poor health (PR: 1.73; 95%CI 1.29–2.31), being an ex-smoker (PR: 1.56; 95%CI 1.22–2.01),

Table 1. Prevalence of diabetes mellitus according to sociodemographic characteristics in communities of river dwellers, settlers and quilombolas in Goiás, 2018.

	Sample	Prevalence of DM		p-value
		n (%)	PR (95%CI)	
Sex				
Female	1,408 (55.5)	145 (10.3)	1.10 (0.87–1.40)	0.406
Male	1,129 (44.5)	105 (9.3)	1.00	
Age range (years)				
18–39	576 (22.7)	48 (8.3)	1.00	<0.3661
40–59	1,135 (44.7)	115 (10.1)	1.21 (0.88–1.67)	
≥60	826 (32.6)	87 (10.5)	1.26 (0.90–1.77)	
Skin color				
White	472 (19.0)	47 (9.9)	1.00	0.5674
Black	892 (35.9)	10 (10.3)	1.03 (0.74–1.44)	
Brown	1,019 (41.0)	102 (5.8)	1.00 (0.72–1.39)	
Yellow	103 (4.2)	6 (5.8)	0.57 (0.25–1.31)	
Education				
Elementary school incomplete	580 (22.9)	74 (12.8)	2.41 (1.41–4.13)	**0.006**
Elementary school completed/ high school incomplete	1,556 (61.5)	152 (9.8)	1.84 (1.10–3.09)	
High school completed/ higher education incomplete	284 (11.2)	15 (5.3)	1.00	
higher education completed	109 (4.3)	8 (7.3)	1.38 (0.60–3.20)	

DM: diabetes mellitus; PR: prevalence ratio; Values in bold: p<0.05.

having a diagnosis of hypertension (PR: 2.35; 95%CI 1.78–3.09), hypercholesterolemia (PR: 2.64; 95%CI 2.06–3.38), being from a river community (PR: 1.55; 95%CI 1.01–2.35) and using alcohol as a protective factor (PR: 0.73; 95%CI 0.54–0.98) (Table 3).

DISCUSSION

This study showed that the prevalence of DM in the communities studied was 9.8%, higher than that identified by the global estimates of the International Diabetes Federation (IDF), which show a prevalence of 7.2% in the rural population[1]. Research carried out in

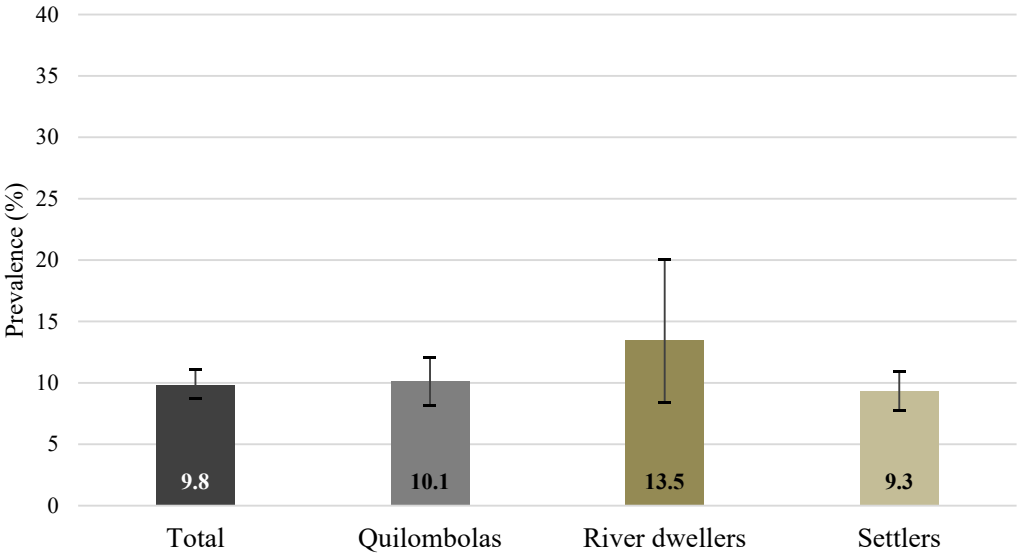

Figure 1. Global prevalence of self-reported diabetes mellitus according to type of rural community, Goiânia, Goiás, 2018.

Table 2. Prevalence of diabetes mellitus according to health conditions and availability and demand of health services for river, settler and quilombola communities in Goiás, 2018.

	Sample	Prevalence of DM		p-value
		n (%)	PR (95%CI)	
Health self-assessment				
Good/very good	1,255 (49.9	65 (5.2)	1.00	**<0.001**
Fair/poor/very poor	1,257 (50.1)	185 (14.7)	2.84 (2.16–3.72)	
Regular physical activity				
Yes	695 (27.4)	73 (10.5)	0.91 (0.71–1.18)	0.507
No	1,839 (72.6)	177 (9.6)	1.00	
Drinks alcohol regularly				
Yes	789 (31.1)	50 (6.3)	0.55 (0.41–0.74)	**<0.001**
No	1,745 (68.9)	200 (11.5)	1.00	
Tobacco use				
No	1,592 (62.8)	138 (6.7)	1.00	**<0.001**
Yes	454 (17.9)	33 (7.3)	0.83(0.58–1.21)	
Ex-smoker	488 (19.3)	79 (16.2)	1.86 (1.44–2.41)	

Continue...

Tabela 2. Continuação.

	Sample	Prevalence of DM		p-value
		n (%)	PR (95%CI)	
Hypertension				
Yes	813 (32.1)	164 (20.2)	4.04 (3.15–5.17)	**<0.001**
No	1,723 (67.9)	86 (5.0)	1.00	
Hypercholesterolemia				
Yes	487 (19.2)	126 (28.9)	4.27 (3.40–5.36)	**<0.001**
No	2,049 (80.8)	124 (6.0)	1.00	
Health insurance				
Yes	352 (13.9)	46 (13.1)	1.39 (1.03–1.88)	**0.030**
No	2,176 (86.1)	204 (9.4)	1.00	
Visited by ESF				
Yes	1,562 (61.6)	162 (10.4)	1.14 (0.89–1.46)	0.281
No	972 (38.4)	88 (9.0)	1.00	
Sought medical attention				
Yes	1,937 (76.4)	211 (10.9)	1.66 (1.19–2.31)	**0.002**
No	597 (23.6)	39 (6.5)	1.00	
Sought specialist				
Yes	781 (30.8)	101 (12.9)	1.52 (1.19–1.93)	**<0.001**
No	1,753 (69.2)	149 (8.5)	1.00	
Hospitalization in last year				
Yes	326 (12.9)	43 (13.2)	1.40 (1.03–1.91)	**0.029**
No	2,208 (87.1)	207 (9.4)	1.00	

DM: diabetes mellitus; PR: prevalence ratio; ESF: Family Health Strategy; values in bold: p<0.05.

other countries using a self-reported measure of DM and with people in the same age group as this study showed a prevalence of 16.9% in Iran[6] and 10.9% in China[27]. In Brazil, self-reported DM had a prevalence of 6.3% in rural areas[23]. Other national studies show a higher prevalence in relation to other river and rural communities, being 16.4% in the Livramento Community[8] and 10% in rural areas in the state of Amazonas[8], in addition to 16.9% in the South region[9].

Table 3. Multiple analysis of diabetes mellitus and exposure variables, Goiás, 2018.

	Prevalence of DM		p-value
	PRc (95%CI)	PRa (95%CI)	
Self-assessment of health			
Good/very good	1.00	1.00	**<0.001**
Fair/poor/very poor	2.84 (2.16–3.72)	1.73 (1.29–2.31)	
Use of alcohol			
Yes	0.55 (0.41–0.74)	0.73 (0.54–0.98)	**<0.039**
No	1.00	1.00	
Uses tobacco			
No	1.00	1.00	**<0.001**
Yes	0.83 (0.58–1.21)	1.06 (0.74–1.52)	
Ex-smoker	1.86 (1.44–2.41)	1.56 (1.22–2.01)	
Hypertension			
Yes	4.04 (3.15–5.17)	2.35 (1.78–3.09)	**<0.001**
No	1.00	1.00	
Hypercholesterolemia			
Yes	4.27 (3.40–5.36)	2.64 (2.06–3.38)	**<0.001**
No	1.00	1.00	
Type of community			
River dwellers	1.34 (0.85–2.10)	1.55 (1.01–2.35)	**0.040**
Settlers	0.92 (0.72–1.18)	0.88 (0.69–1.12)	
Quilombolas	1.00	1.00	

DM: diabetes mellitus; PRc: crude prevalence ratio; PRa: adjusted prevalence ratio; adjusted for sex, age, self-assessment of health, use of alcohol, use of tobacco, hypertension, hypercholesterolemia, type of community, health insurance, saw specialist, hospitalization in last year, saw general practitioner; value in bold: p<0.05.

The prevalence found in this study may be due to the general underdiagnosis of DM in Brazil[28]. It is estimated that 7.7 million people who have DM are not diagnosed[28,29] — a reality that has a higher proportion in rural populations, due to organizational and structural factors of primary care[23,29,30]. Despite the advances of the Family Health Strategy (ESF) in the country, the inequalities in the rural population's access to health services and the low tracking of this population by primary care professionals can be understood by the lower adherence to

the ESF by the municipalities, especially in the North, Central-West and Southeast regions, which implies the lack of a professional community health agent (CHA) and others, who play a fundamental role in the active search and monitoring of communities and families[28,29,31]. Also, when there is the presence of the multidisciplinary team by the ESF, there is an overload of the service for the different communities because of the difficult geographical access, due to the territorial peculiarities where these communities are located, especially the quilombolas[12,32]. This results in less monitoring of health by primary care, which makes it complex for users to enter the Health Care Network (RAS)[29,32]. All these factors can contribute to late diagnosis in the presence of an emergency complication of DM[27,28].

The present study also shows that the prevalence of DM was higher in riverine people, compared to quilombolas and rural settlers. To our knowledge, no studies were found with these groups that could be compared with our findings. Only in river communities, was there a study in the state of Amazonas that observed a prevalence of 16.4 and 10.0% in two investigated communities[8]. The ease of access by this group to urban areas through river vessels can contribute to changing lifestyles, such as increased consumption of processed foods, resulting in a higher prevalence of DM[33]. Also, the Mais Médicos (More Doctors) project, established in 2017, the expansion of the Basic River Health Units (UBSF) and the establishment of the Riverbank Family Health Teams (eSFR) and the River Family Health Teams (eSFF) contribute to greater screening and diagnosis of DM in this population[34-36].

Regarding health conditions, hypertension and hypercholesterolemia were associated with DM, a result consistent with previous studies in rural and urban areas[1,27,37]. In the Brazilian rural population, both conditions are frequent, with prevalence between 20 and 35%[18,19,37]. Specifically in rural traditional populations, some studies explain these associations by genetic components and sociodemographic factors, such as low education and difficulties in accessing health services[19,37]. Also noteworthy is the increase in the frequency of unhealthy behaviors, with the ease of consumption of inappropriate foods due to the urban-rural connection, and better income conditions, linked to such social welfare projects as Bolsa Família, Bolsa Floresta and Seguro Defeso[10,18,19].

Negative self-perception of health is also an indicator that is often associated with DM, which may be linked to the demand for care perceived by the need for continuous metabolic and glycemic control, the complexity of care and the possibility of complications[14]. In rural populations, this negative perception may be greater, mainly due to the risk of developing foot neuropathies, bone deformities, fungal infections and ulcers, due to housing and occupation conditions related to agribusiness and agriculture[9,16].

Being a former smoker was associated with DM, similarly to previous studies[38,39]. The rural area has a significant prevalence of smokers and ex-smokers, ranging from 10 to 16.6%, higher than in urban areas, which favors the association with DM[15,38,39].

Alcohol use was a protective factor for DM in this study. PNS data with urban populations show that alcohol abuse is associated with DM[23]. However, a meta-analysis of 38 observational studies showed that reduction in the risk of type 2 DM was present at all levels of alcohol intake up to 63 g per day, with greater risks above this threshold, especially in women and

in Western populations[40]. Specifically in rural populations in China, only the consumption of high daily doses of alcohol was related to an increase in the risk of type 2 DM[17]. In this study, information on the daily dose of alcohol and type of beverage consumed was not collected, which constitutes a limitation for comparison with the cited works. Despite this, it is important to point out alcohol as a risk factor for DM and other chronic diseases, accidents and violence, as well as the difficulties in seeking health services by rural populations in view of the possible consequences of its use.

As for indicators related to availability and demand for health services, although they did not remain associated with DM in the multiple analysis, they should be considered. In the present study, between 60 and 70% of the population with DM received a visit from a CHA or sought medical attention with a general practitioner in the last year, which shows that people with NCDs tend to seek health services more assiduously[10,12,34,38]. In Brazil, the National Policy of Comprehensive Health for People of the Countryside, Forests and Waters foresees in its first axis the guarantee of the population's access to quality services, with equity and in an adequate time to meet their needs[10]. Access to services by rural traditional communities occurs mainly through the ESF, which ensures the territorialization and coverage of a given area by a multidisciplinary team[30,31], enabling the construction of relationships of bond and trust, as well as continuity, resolution and longitudinality of care[29]. However, access to health services by the rural population faces several difficulties, such as geographical barriers that make it difficult for professionals to travel to communities and for users themselves to get to health services when necessary in a timely manner[4,11].

The use of health insurance and the search for a specialist among individuals with DM were also found in the PNS of 2019[4], because of the need to have an assistance complement to public health services, which still have structural and organizational weaknesses in the care of patients[4,11,31].

Some limitations can be highlighted in this investigation. First, there were the limitations of cross-sectional studies, which restrict inferences about the directionality of some associations in the multiple analysis model. Second, the use of a self-reported measure can lead to underestimations, given that it depends on access to diagnostic services. Finally, the evaluation of some exposure variables, such as physical activity and alcohol, may have suffered information bias due to the way in which it was performed.

Despite these limitations, this study makes several contributions. The results are unprecedented in the state of Goiás and allow us to establish a set of factors associated with DM, contributing to better planning and execution of intersectoral strategies and to the synthesis of evidence for the process of formulating and implementing policies and programs for rural populations, enabling better quality of life for rural traditional populations in the state, as provided for in the Evidence-Informed Policy[41]. Specifically, in Goiás, such actions may involve the sectors of the Department of Education, Sport and Leisure, of Transport, and also of the State Department of Agriculture, Livestock and Supply (SEAPA), responsible for rural traditional areas in the state[42].

Finally, this study allowed us to identify the prevalence of and factors associated with DM in rural communities, pointing out possible choices, due to unhealthy lifestyle habits in the

communities, which result in hypertension, hypercholesterolemia and smoking history, factors associated with DM. Accordingly, the risk of complications from DM can become even greater, which requires more intersectoral and singular strategies, which are appropriate in relation to income distribution and the use and appreciation of resources already available in communities. For future research, an objective assessment of DM is recommended, as well as the assessment of other variables related to access and use of health services and healthy habits, and also existing barriers in the view of users and professionals.

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REFERENCES

1. International Diabetes Federation. IDF diabetes atlas. 9th ed. Bruxelas: International Diabetes Federation; [Internet]. 2019 [cited on Mar 2021]. Available at: https://diabetesatlas.org/atlas/ninth-edition/
2. Sousa APM, Pereira IC, Araujo LL, Rocha MR, Bandeira HMM, Lima LHO. Prevalência e fatores associados ao excesso de peso em adultos nas capitais e no Distrito Federal, Brasil, 2019. Epidemiol Serv Saúde 2021; 30(3): e2020838. https://doi.org/10.1590/S1679-49742021000300014
3. Coimbra Jr CEA. Rural health in Brazil: a still relevant old subject. Rev Saúde Pública 2018; 52(suppl. 1): 2s. https://doi.org/10.11606/S1518-8787.2018052000supl1ap
4. Brasil. Ministério da Saúde. Fundação Oswaldo Cruz. Painel de indicadores de saúde. Pesquisa nacional de saúde. Brasília: FioCruz; [Internet]. [accessed on Aug. 15, 2021. Available at: https://www.pns.icict.fiocruz.br/painel-de-indicadores-mobile-desktop/.
5. Rajput R, Rajput M, Singh J, Bairwa M. Prevalence of diabetes mellitus among the adult population in rural blocks of Haryana, India: a community-based study. Metab Syndr Relat Disord 2012; 10(6): 443-6. https://doi.org/10.1089/met.2012.0067
6. Ghafuri S, Ghaderi E, Fahami Y, Rajabnia M, Naleini SN. Epidemiologic study of type 2 diabetes mellitus and metabolic syndrome in rural population of Kurdistan province, Iran, in 2011-2017. Diabetes Metab Syndr 2019; 13(3): 1689-97. https://doi.org/10.1016/j.dsx.2019.03.037
7. Liu Y, Zhang X, He L, Wang S. Prevalence and the relevant factors of type 2 diabetes mellitus among adults in Guizhou Province in 2010-2012. Wei Sheng Yan Ji 2019; 48(5): 723-27. PMID: 31601311
8. Mariosa DF, Camilo MVRF. Território, trabalho e saúde: repercussões socioambientais do estilo de vida em duas comunidades da reserva de desenvolvimento sustentável do Tupé, Manaus, Amazonas. Rev Gest Sist Saúde 2018; 7(2): 189-205. https://doi.org/10.5585/rgss.v7i2.12804
9. Silva JMTS, Haddad MCFL, Rossaneis MA, Vannuchi MTO, Marcon SS. Fatores associados à ulceração nos pés de pessoas com diabetes mellitus residentes em área rural. Rev Gaúcha Enferm 2017; 38(3): e68767. https://doi.org/10.1590/1983-1447.2017.03.68767
10. Brasil. Ministério da Saúde. Política nacional de saúde integral das populações do campo e da floresta. Brasília: Ministério da Saúde, Secretaria de Gestão Estratégica e Participativa, Departamento de Apoio à Gestão Participativa; [Internet] 2013 [cited on Mar 2021]. Available at: https://bvsms.saude.gov.br/bvs/folder/pni_populacoes_campo_floresta.pdf
11. Franco CM, Lima JG, Giovanella L. Primary healthcare in rural areas: access, organization, and health workforce in an integrative literature review. Cad Saude Publica 2021; 37(7): e00310520. https://doi.org/10.1590/0102-311X00310520

12. Hirschmann R, Bortolotto CC, Martins-Silva TM, Machado AKF, Xavier MO, Fernandes MP, et al. Simultaneidade de fatores de risco para doenças crônicas não transmissíveis em população rural de um município no sul do Brasil. Rev Bras Epidemiol 2020; 23: e200066. https://doi.org/10.1590/1980-549720200066
13. Giovanella L, Fleury S. Universalidade da atenção à saúde: acesso como categoria de análise. In: Eibenschutz C. Política de saúde: o público e o privado. Rio de Janeiro: FIOCRUZ; 1996. p. 177-98.
14. Cattafesta M, Petarli GB, Zandonade E, Bezerra OMPA, Abreu SMR, Salaroli LB. Energy contribution of NOVA food groups and the nutritional profile of the Brazilian rural workers' diets. PLoS One 2020; 15(10): e0240756. https://doi.org/10.1371/journal.pone.0240756
15. Xavier MO, Del-Ponte B, Santos IS. Epidemiology of smoking in the rural area of a medium-sized city in Southern Brazil. Rev Saude Publica 2018; 52(Suppl 1):10s. https://doi.org/10.11606/S1518-8787.2018052000269
16. Maiya AG, Gundmi S, Matpady P, Jadhav R, Lingadakai R, Hande M, et al. Prevalence of foot complications in people with type 2 diabetes mellitus: a community-based survey in rural Udupi. Int J Low Extrem Wounds 2018; 17(3): 169-75. https://doi.org/10.1177/1534734618791853
17. Wu X, Liu X, Liao W, Kang N, Dong X, Abdulai T, et al. Prevalence and characteristics of alcohol consumption and risk of type 2 diabetes mellitus in rural China. BMC Public Health 2021; 21(1): 1644. https://doi.org/10.1186/s12889-021-11681-0
18. Salaroli LB, Cattafesta M, Petarli GB, Ribeiro SAV, Soares ACO, Zandonade E, et al. Prevalence and factors associated with arterial hypertension in a Brazilian rural working population. Clinics (Sao Paulo) 2020; 75: e1603. https://doi.org/10.6061/clinics/2020/e1603
19. Mariosa DF, Ferraz RRN, Santos-Silva EN. Influence of environmental conditions on the prevalence of systemic hypertension in two riverine communities in the Amazon, Brazil. Cien Saúde Colet 2018; 23(5): 1425-36. https://doi.org/10.1590/1413-81232018235.20362016
20. Hu Z, Zhu X, Kaminga AC, Xu H. Associated risk factors and their interactions with type 2 diabetes among the elderly with prediabetes in rural areas of Yiyang City: a nested case-control study. Medicine (Baltimore) 2019; 98(44): e17736. https://doi.org/10.1097/MD.0000000000017736
21. Thapa S, Pyakurel P, Baral DD, Jha N. Health-related quality of life among people living with type 2 diabetes: a community based cross-sectional study in rural Nepal. BMC Public Health 2019; 19(1): 1171. https://doi.org/10.1186/s12889-019-7506-6
22. Köhl M, Magnussen SS, Marchetti M. Sampling methods, remote sensing and GIS multiresource forest inventory. Heidelberg: Springer; 2006.
23. Malta DC, Bernal RTI, Iser BPM, Szwarcwald CL, Duncan BB, Schmidt MI. Fatores associados ao diabetes autorreferido segundo a Pesquisa Nacional de Saúde, 2013. Rev Saúde Pública 2017; 51(suppl 1): 12s. https://doi.org/10.1590/S1518-8787.2017051000011
24. Pagotto V, Bachion MM, Silveira EA. Autoavaliação da saúde por idosos brasileiros: revisão sistemática da literatura. Rev Panam Salud Publica. 2013; 33(4): 302-10.
25. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Análise em Saúde e Vigilância de Doenças Não Transmissíveis. Vigitel Brasil 2019: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2019. Brasília: Ministério da Saúde; [Internet]. 2020 [cited on Jan 2022]. Available at: https://bvsms.saude.gov.br/bvs/publicacoes/vigitel_brasil_2019_vigilancia_fatores_risco.pdf
26. Freire RS, Lélis FLO, Fonseca Filho JA, Nepomuceno MO, Silveira MF. Prática regular de atividade física: estudo de base populacional no Norte de Minas Gerais. Rev Bras Med Esporte 2014; 20(5) 345-9. http://doi.org/10.1590/1517-8692201420050206.
27. Zhang H, Qi D, Gu H, Wang T, Wu Y, Li J, et al. Trends in the prevalence, awareness, treatment and control of diabetes in rural areas of northern China from 1992 to 2011. J Diabetes Investig 2020; 11(1): 241-9. http://doi.org/10.1111/jdi.13095
28. Correr CJ, Coura-Vital W, Frade JCQP, Nascimento RCRM, Nascimento LG, Pinheiro EB, et al. Prevalence of people at risk of developing type 2 diabetes mellitus and the involvement of community pharmacies in a national screening campaign: a pioneer action in Brazil. Diabetol Metab Syndr 2020; 12: 89. https://doi.org/10.1186/s13098-020-00593-5
29. Arruda NM, Maia AG, Alves LC. Desigualdade no acesso à saúde entre as áreas urbanas e rurais do Brasil: uma decomposição de fatores entre 1998 a 2008. Cad Saúde Pública 2018; 34(6): e00213816. https://doi.org/10.1590/0102-311X00213816
30. Giovanella L, Bousquat A, Schenkman S, Almeida PF, Sardinha LMV, Vieira MLFP. Cobertura da estratégia saúde da família no Brasil: o que nos mostram as Pesquisas Nacionais de Saúde 2013 e 2019. Ciênc Saúde Colet 2021; 26 (Supl. 1): 2543-56. https://doi.org/10.1590/1413-81232021266.1.43952020

31. Brasil. Ministério da Saúde. Gabinete do Ministro. Portaria nº 2.488, de 21 de outubro de 2011. Aprova a Política Nacional de Atenção Básica, estabelecendo a revisão de diretrizes e normas para a organização da Atenção Básica, para a Estratégia Saúde da Família (ESF) e o Programa de Agentes Comunitários de Saúde (PACS). Diário Oficial da União, 21 de outubro de 2011. [Internet]. 2011 [accessed on May 20, 2022]. Available at: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2011/prt2488_21_10_2011.html
32. Souza CL, Barroso SM, Guimarães MDC. Oportunidade perdida para diagnóstico oportunista de diabetes mellitus em comunidades quilombolas do sudoeste da Bahia, Brasil. Ciênc Saúde Coletiva 2014; 19(6): 1653-62. https://doi.org/10.1590/1413-81232014196.08662013
33. Soares AN, Silva TC, Franco AAAM, Maia TF. Cuidado em saúde às populações rurais: perspectivas e práticas de agentes comunitários de saúde. Physis: Revista de Saúde Coletiva 2020; 30(3): e300332. http://doi.org/10.1590/S0103-73312020300332
34. Gomes KO, Reis EA, Guimarães MDC, Cherchiglia ML. Utilização de serviços de saúde por população quilombola do Sudoeste da Bahia, Brasil. Cad Saúde Pública 2013; 29(9): 1829-42. https://doi.org/10.1590/0102-311X00151412
35. Gama ASM, Fernandes TG, Parente RCP, Secoli SR. Inquérito de saúde em comunidades ribeirinhas do Amazonas, Brasil. Cad Saúde Pública 2018; 34(2): e00002817. https://doi.org/10.1590/0102-311X00002817
36. Guimarães AF, Barbosa VLM, Silva MP, Portugal JKA, Reis MHS, Gama ASM. Access to health services for river residents in a municipality in Amazonas State, Brazil. Rev Pan Amaz Saude 2020; 11: e202000178. http://doi.org/10.5123/s2176-6223202000178
37. Xiao L, Le C, Wang GY, Fan LM, Cui WL, Liu YN, et al. Socioeconomic and lifestyle determinants of the prevalence of hypertension among elderly individuals in rural southwest China: a structural equation modelling approach. BMC Cardiovasc Disord 2021; 21(1): 64. https://doi.org/10.1186/s12872-021-01885-y
38. Campagna D, Alamo A, Pino AD, Russo C, Calogero AE, Purrello F, et al. Smoking and diabetes: dangerous liaisons and confusing relationships. Diabetol Metab Syndr 2019; 11: 85. https://doi.org/10.1186/s13098-019-0482-2
39. Coughlin LN, Bonar EE, Bohnert KM, Jannausch M, Walton MA, Blow FC, et al. Changes in urban and rural cigarette smoking and cannabis use from 2007 to 2017 in adults in the United States. Drug Alcohol Depend 2019; 205: 107699. https://doi.org/10.1016/j.drugalcdep.2019.107699
40. Knott C, Bell S, Britton A. Alcohol consumption and the risk of type 2 diabetes: a systematic review and dose-response meta-analysis of more than 1.9 million individuals from 38 observational studies. Diabetes Care 2015; 38(9):x1804-12. https://doi.org/10.2337/dc15-0710
41. Brasil. Ministério da Saúde. Secretaria de Ciência, Tecnologia, Inovação e Insumos Estratégicos em Saúde. Departamento de Ciência e Tecnologia. Diretriz metodológica: síntese de evidências para políticas Brasília: Ministério da Saúde; [Internet]. 2020 [cited on Apr 2022]. Available at: https://bvsms.saude.gov.br/bvs/publicacoes/diretriz_sintese_evidencias_politicas.pdf
42. Governo do Estado de Goiás. Secretaria de Estado de Agricultura, Pecuária e Abastecimento. Portal expresso [Internet] [cited on Apr 2022]. Available at: https://www.agricultura.go.gov.br/

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