Prevalence of People at Risk of Developing Diabetes Mellitus and the Involvement of Community Pharmacies in a National Screening Campaign: A Pioneer Action in Brazil

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Abstract

Background

Brazil is one of top 10 countries with the highest number of people with diabetes mellitus (DM), affecting 16.8 million peoples. It is estimated that 7.7 million people (20–79 years) in the country have not yet been diagnosed, representing an under-diagnosis rate of 46%. Herein we aimed to screen people for high blood glucose or risk for developing type 2 DM (T2DM) through community pharmacies in Brazil.

Methods

A cross-sectional study was carried out in November 2018, involving 977 pharmacists from 345 municipalities in Brazil. The study evaluated people between 20 and 79 years old without a previous diagnosis of DM. Glycemia was considered high when its value was ≥ 100 mg/dL fasting and ≥ 140 mg/dL in a casual feeding state. The FINDRISC (Finnish Diabetes Risk Score) was used to estimate the risk for developing T2DM. The prevalence of high blood glucose was estimated and the associated factors were obtained using Poisson's multivariate analysis with robust variance.

Results

During the national screening campaign, 17,580 people were tested with the majority of the consultations (78.2%) being carried out in private pharmacies. The population was composed mainly of women (59.5%) and people aged between 20 and 45 years (47.9%). The prevalence of patients with high blood glucose was 18.4% (95% CI 17.9–19.0). Considering the FINDRISC, 22.7% of people had a high or very high risk for DM. The risk factors associated with high blood glucose were: Body Mass Index > 25 kg/m^2, abdominal circumference > 94 cm for men and > 80 cm for women; education level below 15 years of study, no daily intake of vegetables and fruits; previous diagnosis of arterial hypertension; history of high blood glucose and family history of DM.

Conclusions

This is the largest screening study that evaluated the prevalence of high blood glucose and its associated factors in a population without a previous diagnosis, ever performed in community pharmacies in Brazil. These results may help to guide public health preventive actions and involve pharmacists in screening and education actions aimed at this undiagnosed population in a continent-size country such as Brazil.

Background

The epidemiological transition is a major challenge for health systems and societies in the Americas [1]. Population aging, urbanization, and changes in lifestyle have impacted the prevalence of chronic noncommunicable diseases (NCD), with emphasis on hypertension, diabetes mellitus, and dyslipidemia [1, 2].

Diabetes mellitus (DM) is a group of metabolic disorders characterized by the presence of persistent hyperglycemia, resulting mainly from a deficiency in insulin production or its action, or a combination of both mechanisms [3]. In 2015, it was estimated that more than 41 million adults in Latin American and Caribbean countries present with DM. In addition to the high disease burden, DM has a high economic impact deriving from direct and indirect costs, with an annual estimated total cost of US $ 102 to 123 billion, including parameters such as premature mortality and temporary or permanent disability [1, 2, 4]. In Latin America, about 25% of health expenditures refer to the treatment of DM and its complications [4]. Brazil is one of the top 10 countries with the highest number of people with DM in the world and currently is the 5th in the ranking [5]. International estimates indicate a growing trend in the prevalence of DM in the country, with an expected increase ranging from 6–7.8% in 2030 [6]. Despite the lack of nationwide studies on the prevalence of DM, results from the Vigitel 2017 household survey showed a prevalence of 7.7% in the 27 Brazilian capitals, with 7.1% for men and 8.1% for women [7]. The 2019 9th IDF Diabetes Atlas estimated that in Brazil, in the population between 20 and 79 years old, there are approximately 16.8 million people with diabetes in Brazil, and 7.7 million undiagnosed DM, representing an under-diagnosis proportion of 46.0% [5].

Several studies have pointed out impressive data on pre-diabetes in Brazil. The National Health Survey, conducted from 2014–2015, which used glycated hemoglobina (HbA1c) as a diagnostic tool in a sample over 8,500 people, identified a prevalence of 6.8–16.9% of pre-diabetes, depending on the criteria used [8]. The ELSA longitudinal study, involving Brazilian adults, reported pre-diabetes prevalence ranging from 20–59% of the sample recruited among university professional staff [9].

In addition to the diagnostic challenges, control rates of DM in Brazil remain unsatisfactory. The last largest nationwide study analyzing glucose control was conducted in 2006 and showed that 75% of 6.671 individuals with T2DM and 90% of those with type 1 DM (T1DM) assisted in private and public services by either specialists or no-specialists presented HbA1c higher than 7% [10]. Other studies have shown similar or even worse results among T1DM [11, 12].

In Brazil, the treatment of diabetes micro and macrovascular complications represents the main component of the disease expenses, with 48.2% of the cost attributed to medicines to treat these complications [13, 14]. Therefore, early diagnosis of T2DM is important to prevent chronic complications associated with the disease and to reduce the costs associated with health care delivery.

The Finnish Diabetes Risk Score (FINDRISC) is a simple, non-invasive and easy-to-use screening instrument used to predict the risk of an adult developing DM2 in 10 years [15]. This instrument has been adopted worldwide to lead T2DM prevention programs in primary care [16–19] and has been adapted to be applied in Brazil by the Brazilian Diabetes Society during national awareness campaigns [20].

Studies conducted in several countries have shown that pharmacies are successful partners in diabetes programs aiming to screening and diagnosis, in addition to risk factors for cardiovascular diseases [21–

25]. In Brazil, pharmacies are establishments that provide pharmaceutical services as well as individual and collective health guidance, including assessment of capillary blood glucose, blood pressure measurement, among other procedures Pharmacists are higher education health professionals with responsibilities for carrying out clinical activities, including screening, education, and monitoring of patients [26, 27].

In this context, the present study aimed to identify the prevalence of high blood glucose and its risk factors, through the screening of people without a previous diagnosis of DM, in community pharmacies in Brazil.

Methods

Study design and population

A cross-sectional study was carried out in November 2018, involving 977 pharmacists from 345 municipalities in Brazil, to assess the prevalence of high blood glucose in individuals without a previous diagnosis of DM in Brazil.

Brazil is the largest country in South America, with a territorial area of 8,510,820.623 Km2, divided into five geographic regions (North, South, Midwest, Southeast, and Northeast) and subdivided into 27 federative units, including the Federal District. The estimated national population, for the year 2018, was 210,867,954 inhabitants [28]. To calculate the ideal sample size, there were considered the Brazilian population aged between 20 and 79 years (141,802,185 people; IBGE 2017); an estimated prevalence of pre-diabetes or DM of 23% [29]; 95% confidence level; and 1% estimate accuracy. The estimated sample for the country (11,750) was further stratified taking into account the population aged 20 to 79 years in each state.

People aged between 20 and 79 years old who attended the selected pharmacies were invited by pharmacists to participate in the study. Participants could be in their feeding routine (unknown diet) or fasting (8 hours without any caloric intake). The exclusion criteria were: participants' records presenting blood glucose data collected with glucometers without ISO 15197: 2013 certification (ISO, 2013); previous diagnosis of DM; any data collected with non-standard anthropometric tape; age < 20 years or > 79 years); lack of data on weight (measured on a scale), height, BMI and abdominal circumference; capillary blood glucose (CBG) lower than 70 mg/dL without confirmation or CBG higher than 300 mg/dL without confirmation.

Selection Of Pharmacies And Training Of Pharmacists

Participated in the study volunteer pharmacists from private and public pharmacies, located in different municipalities located throughout the national territory. Pharmacies were selected in a non-probabilistic manner, by fulfilling the following criteria: (i) ability to collect and send data by electronic means; (ii) agreeing to use their inputs (glucometer, blood glucose test strips, scale, anthropometric tape, office supplies); (iii) be located in a municipality that has a primary public health service care unit and that was covered by the Mobile Emergency Care Service; (iv) be regularly enrolled in the Regional Pharmacy Council of their jurisdiction, with the presence of the pharmacist at all hours of operation; (v) have a patient care room allowing visual and sound privacy (pharmaceutical care room).

The recruitment of the target population of the study was carried out by broadcasting campaigns in various media (television, radio, Federal Pharmacy Board website [30], and a website developed exclusively for the campaign [31] and locally, by the participating pharmacies. Standardized disclosure materials were provided to participating pharmacies

Testing Protocol And Data Collection

During November 2018, people who attended any of the study's participating pharmacies were invited by the pharmacist to participate in the study, being informed of the objectives of the project and the inclusion criteria. Those who agreed to participate signed the Free and Informed Consent Form, answered a questionnaire with personal information, clinical data and the FINDRISC [15], translated and cross-culturally adapted to Brazilian Portuguese [32].

The FINDRISC analyses eight clinical characteristics: age, Body Mass Index (BMI), abdominal circumference (AC), daily physical activity, eating habits, blood pressure, use of antihypertensive medication, history of hyperglycemia, and family history of diabetes. The final score corresponds to the sum of the scores attributed to each question, ranging from 0 to 26, and the individual risk of developing T2DM is stratified into five categories, ranging from low to very high risk [17]. Subsequently, anthropometric measurements and CBG test were performed. Height was obtained with a tape measure fixed on the wall. Weight was obtained by weighing the participant on a digital or analog scale registered at the National Health Surveillance Agency (Anvisa), available at the pharmacy at the time of the evaluation. BMI was obtained by dividing the weight (in kilograms) by the square of height (in meters); AC was measured using a professional anthropometric tape, following the recommendations of the Brazilian Association for the Study of Obesity and Metabolic Syndrome [33]; CBG tests were performed using glucometers registered by Anvisa, with ISO 15197: 2013 (ISO, 2013) certification, such as Accu Check Performa® (Roche), Accu Check Performa Connect® (Roche), Accu Check Guide® (Roche), One Touch Select Plus Flex® (J&J), Contour Plus® (Bayer), G-Tech Free Lite (GTech), Freestyle Freedom Lite® (Abbott), and Freestyle Optium Neo® (Abbott). The results were interpreted, according to the recommendations of the Brazilian Diabetes Society, considering the patient's feeding status at the time when the CBG test was taken [20]. CBG levels less than 100 mg/dL were considered normal when fasting or less than 140 mg/dL, in a casual feeding state.

The interpretation of the CBG result and the subsequent orientation to the patient were performed by the pharmacist. Patients with results suggestive of pre-diabetes or DM were referred to the local public or private health system, with a proper filled in declaration form [27], containing the result of the parameters evaluated during the screening procedures (Fig. 1).

Data analysis

After filling in the survey instruments, the data were entered into an online platform (Surveymonkey) and later exported for analysis using the Stata Version 14.0 software.

A difference observed in the degrees of risk defined by FINDRISC and CBG levels were evaluated by chi-square test.

To identify the risk factors associated with high blood glucose, the Poisson multivariate model was used, with robust variance, and the estimates were obtained using the prevalence ratio (PR) with 95% CI. Initially, a univariate analysis was performed and the variables that showed a statistical association in this analysis ($p < 0.25$) were analyzed in a multivariate model. Variables with more than two categories were transformed into dummy variables. For the construction of the final model, a complete model was started, containing all the variables, and the successive disposal of the variables was carried out until only those with significance level remained in the model ($p < 0.05$).

Results

The final sample screened was 20,171 participants, of which 17,580 (87.2%) were eligible for the study (Fig. 2).

Characteristics Of The Assessed Population

Of the 17,580 participants included, most were women (59.5%) and the predominant age group was less than 45 years old (47.9%). The mean and median age were 46 ± 15.7 years, with the first and third quartiles being 33 and 59, respectively. The predominant skin color was white (47.3%), followed by brown (38.0%). In terms of education, 77.7% of the participants had more than eight years of study, 18.0% reported 8 to 10 years of study, 29.1% indicated 11 to 14 years, and 30.6% informed 15 or more years of study. As for the practice of physical exercises, 68.3% reported not practicing any activity and, concerning eating habits, 43% did not eat vegetables or fruits daily. It was observed that 30.8% of the sampled population self-reported hypertension or used antihypertensive medication. As for blood glucose rates, 15.8% reported having high glucose levels events in the past and 58% informed a family history of T1DM or T2DM(Table 1).

Table 1
Baseline characteristics of the population included in the screening of high blood glucose in Brazil, 2018

Variables	**n**	**%**
Gender		
Male	7,112	40.5
Female	10,468	59.5
Age (years)		
20–45	8,412	47.9
45–54	3,374	19.2
55–64	3,188	18.1
65–79	2,606	14.8
Abdominal circumference (cm)		
Male < 94	2,916	41.0
94–102	2,099	29.5
> 102	2,097	29.5
Female < 80	2,222	21.2
80–88	2,184	20.9
> 88	6,062	57.9
Color		
White	8,318	47.3
Brown	6,679	38.0
Black	2,253	12.8
Yellow	192	1.1
Indigenous	52	0.3
Uninformed	86	0.5
Educational level (years)		
Illiterate	814	4.6
1 –3	173	1.0
4 –7	2,936	16.7

Variables	n	%
8 –10	3,166	18.0
11 –14	5,108	29.1
≥ 15	5,383	30.6
Practice of physical activity		
Yes	5,575	31.7
No	12,005	68.3
Consumption of vegetables and/or fruits		
Every day	10,024	57.0
Do not eat every day	7,556	43.0
Diagnosis or use of medicines for hypertension		
Yes	5,413	30.8
No	12,167	69.2
High blood glucose in the past		
Yes	2,780	15.8
No	14,800	84.2
Family member with type 1 or 2 diabetes mellitus		
No	7,377	42.0
Yes (grandparents, uncles, cousins)	3,741	21.3
Yes: parents. siblings or children	6,462	36.7

Risk Of Developing Dm2 In The Next 10 years

According to the FINDRISC, 22.1% (n = 3,873) were at low risk for developing T2DM (1 in 100 develops the disease); 35.1% (n = 6,169) slightly moderate risk (1 in 25 develops the disease); 20.1% (n = 3,523) moderate risk (1 in 6 develops the disease); 19.6% (n = 3,436) high risk (1 in 3 develops the disease) and 3.1% (n = 555) very high risk (1 in 2 develops the disease) (Table 2).

Table 2
Risk for developing T2DM (FINDRISC), according to capillary blood glucose levels, regardless of dietary status, Brazil, 2018.

FINDRISC	Blood glucose (mg/dL)*		Total
	Normal n (%)	High n (%)	n (%)
Low risk	3,565 (24.9)	308 (9.5)	3,873 (22.1)
Slightly moderate risk	5,275 (36.8)	894 (27.6)	6,169 (35.1)
Moderate risk	2,828 (19.8)	695 (21.4)	3,523 (20.1)
High risk	2,350 (16.4)	1,086 (33.5)	3,436 (19.6)
Higher risk	297 (2.1)	258 (8.0)	555 (3.1)

* Glycemia considered normal: fasting < 100 mg/dL or casual < 140 mg/dL. Results excluding 24 patients with blood glucose results < 70 mg/dL.

Patients with low or mildly moderate risk were represented by a large portion of the population with normal CBG, 24.9% and 36.8%, respectively. Participants who presented high or very high FINDRISC were mainly those who had high CBG levels, with percentages much higher than those found in individuals with normal CBG, corresponding to 33.5% and 8.0% respectively.

Prevalence Of High Capillary Blood Glucose Levels

The prevalence of high CBG levels (fasting CBG ≥ 100 mg/dL or in random condition ≥ 140 mg/dL) among the individuals enrolled in this present screening was 18.4% (95% CI 17.9–19.0). When the prevalence by geographic region was assessed, the Midwest presented the highest prevalence (24.6%; 95% CI: 22.4 – 27.0), followed by the North (22.5%; 95% CI 20.4 – 24.8) and Northeast (19.8%; 95% CI: 18.8 – 20.8) regions (Fig. 3).

Risk Factors For High Capillary Blood Glucose

Preliminary selection of variables ($p < 0.25$), through univariate analysis, are described in Table 3. According to multivariate analysis (Table 4), the BMI of 25–30 kg/m^2 (PR 1.1; 95% CI 1, 1 – 1.2) and BMI > 30 kg/m^2 (PR 1.3; 1.2 – 1.4), when compared with BMI < 25 kg/m^2; AC for men of 94–102 cm or for women of 80–88 cm (PR 1.2 CI 95% 1.1 – 1.3) as well as AC for men > 102 cm or for women > 88 cm (PR 1.3; 95% CI 1.2 – 1.5) compared to AC < 94 cm for men or < 80 cm for women, increase the risk of high CBG. People with less education had a higher prevalence of high CBG, compared to people with 15 or more years of education (illiterate PR 1.5; 95% CI 1.3 – 1.7). People who did not eat fruits or vegetables every day (PR 1.1; 95% CI 1.1 – 1.2), reported being hypertensive or use of medication for high blood pressure (PR 1.1; 95% CI 1.1 – 1.2), and those informing a high glycemia rate in the past (PR 1.9; 95% CI 1.8 – 2.0) and having first-degree relatives with either T1DM or T2DM (PR 1.3; 95% CI 1.2 – 1.4) were associated with a higher prevalence of high CBG. The PR values obtained in the multivariate model were adjusted for the participants' age and sex.

Table 3

Univariate analysis of population characteristics associated with high blood glucose levels, Brazil, 2018

Variables	Blood glucose (mg/dL)*		PR (CI95%)	p-value
	Normal (n/%)	High (n/%)		
Gender				
Male	8,720 (60.9)	1,734 (53.5)		
Female	5,595 (39.1)	1,507 (46.5)	1.3 (1.2–1.4)	0.01
Age (years)				
20–45	7,486 (52.3)	913 (29.2)		
45–54	2,655 (18.5)	716 (22.1)	1.9 (1.8–2.1)	0.01
55–64	2,357 (16.5)	827 (25.5)	2.4 (2.2–2.6)	0.01
65–79	1,817 (12.7)	785 (24.2)	2.8 (2.6–3.0)	0.01
Body Mass Index				
<25	5,220 (35.5)	782 (24.1)		
25–30	5,595 (39.1)	1,326 (40.9)	1.5 (1.4–1.6)	0.01
>30	3,500 (24.5)	1,133 (35.0)	1.9 (1.7–2.0)	0.01
Abdominal circumference (cm)				
♂ < 94 or ♀ < 80	4,491 (31.4)	635 (19.6)		
♂ 94–102 or ♀ 80–88	3,518 (24.6)	760 (23.4)	1.4 (1.3–1.6)	0.01
♂ > 102 or ♀> 88	6,306 (44.0)	1,846 (57.0)	1.8 (1.7–2.0)	0.01
Color				
White	6,821 (47.6)	1,489 (45.9)		
Brown	5,471 (38.2)	1,200 (37.0)	1.0 (0.9–1.1)	0.91
Black	156 (1.1)	36 (1.1)	1.0 (0.8–1.4)	0.77
Yellow	1,754 (12.3)	491 (15.2)	1.2 (1.1–1.3)	0.01
Indigenous	44 (0.3)	8 (0.3)	0.8 (0.4–1.6)	0.64
Uninformed	69 (0.5)	17 (0.5)	1.1 (0.7–1.7)	0.65
Educational level (years)				

* Glycemia considered normal. fasting < 100 mg/dL or casual < 140 mg/dL. Results excluding 24 patients with blood glucose results < 70 mg/dL. ♂ - Male ; ♀ - Female

Variables	Blood glucose (mg/dL)*		PR (CI95%)	p-value
	Normal (n/%)	High (n/%)		
≥ 15	4,644 (32.4)	734 (22.7)		
11 –14	4,347 (30.4)	752 (23.2)	1.1 (1.0–1.2)	0.10
8 –10	2,498 (17.4)	665 (20.5)	1.5 (1.4–1.7)	0.01
4 –7	2,143 (15.0)	791 (24.4)	2.3 (2.1–2.6)	0.01
1 –3	123 (0.9)	49 (1.5)	2.5(1.8–3.5)	0.01
Illiterate	560 (3.9)	250 (7.7)	2.8 (2.4–3.3)	0.01
Practice of physical activity				
Yes	4,608 (32.2)	964 (29.7)		
No	9,707 (67.8)	2,277 (70.3)	1.1 (1.0–1.2)	0.01
Consumption of vegetables and/or fruits				
Every day	8,216 (57.4)	1,796 (55.4)		
Do not eat every day	6,099 (42.6)	1,445 (44.6)	1.1 (1.0–1.1)	0.04
Diagnosis or use of medicines for hypertension				
No	10,362 (72.4)	1,787 (55.1)		
Yes	3,953 (27.6)	1,454 (44.9)	1.8 (1.7–1.9)	0.01
High blood glucose in the past				
No	12,533 (87.5)	2,243 (69.2)		
Yes	1,782 (12.5)	998 (30.8)	2.4 (2.2–2.5)	0.01
Family member with type 1 or 2 diabetes mellitus				
No	6,159 (43.0)	1,204 (37.1)		
Yes (grandparents, uncles, cousins)	3,228 (22.5)	505 (15.6)	0.8 (0.7–0.9)	0.01
Yes: (parents, siblings or children)	4,928 (34.4)	1,532 (47.3)	1.4 (1.3–1.5)	0.01

* Glycemia considered normal. fasting < 100 mg/dL or casual < 140 mg/dL. Results excluding 24 patients with blood glucose results < 70 mg/dL. □ - Male ; □ - Female

Table 4
Multivariate analysis of characteristics associated with high blood glucose, Brazil, 2018

Variables	**PR (CI95%) crude**	**PR (CI95%) ajusted***
Body Mass Index		
<25	–	–
25–30	1.5 (1.4–1.6)	1.1 (1.1–1.2)
>30	1.9 (1.7–2.0)	1.3 (1.2–1.4)
Abdominal circumference (cm)		
♂ < 94 or ♀ < 80	–	-
♂ 94–102 or ♀ 80–88	1.4 (1.3–1.6)	1.2 (1.1–1.3)
♂ > 102 or ♀> 88	1.8 (1.7–2.0)	1.3 (1.2–1.5)
Educational level (years)		
≥ 15	–	-
8 –10	1.5 (1.4–1.7)	1.3 (1.1–1.4)
4 –7	2.3 (2.1–2.6)	1.4 (1.3–1.5)
1 –3	2.5 (1.8–3.5)	1.5 (1.2–1.9)
Illiterate	2.8 (2.4–3.3)	1.5 (1.3–1.7)
Consumption of vegetables and/or fruits		
Every day	-	-
Do not eat every day	1.1 (1.0–1.1)	1.1 (1.1–1.2)
Diagnosis or use of medicines for hypertension		
No	–	-
Yes	1.8 (1.7–1.9)	1.1 (1.1–1.2)
High blood glucose in the past		
No		
Yes	2.4 (2.2–2.5)	1.9 (1.8–2.0)
Family member with type 1 or 2 diabetes mellitus		
No	–	–
Yes (parents, siblings or children)	1.4 (1.3–1.5)	1.3 (1.2–1.4)

♂ - Male ; ♀ - Female. *Final model adjusted for age and sex.

Discussion

This is the largest study evaluating the prevalence of high blood glucose levels and regarding risk for developing diabetes ever conducted in pharmacies in all regions of Brazil. Performing NCD screening is important because it can identify asymptomatic people at high risk or with initial signs and symptoms of a disease, allowing for timely diagnosis and treatment and this is very important for a disease such as diabetes. The prevalence of people with high CBG levels, demonstrated in the present study, indicated that the country has approximately 38 million people that should be monitored by the health system either private or public.

According to the WHO, a substantial fraction of the disease burden and mortality due to NCD are related to a small set of risk factors, among which stand out smoking, inadequate food consumption, physical inactivity, and excessive consumption of alcoholic beverages [34]. Early detection of people at risk of developing T2DM is very important, since changes in lifestyle, including physical activity and proper diet, can reduce the incidence of the disease by approximately 58% [16, 20, 35]

It was found that the prevalence of high CBG levels was higher in the Midwest, North, and Northeast regions. These findings can be explained by the heterogeneous profile of the Brazilian population, related to lifestyle and prevalence of obesity which has been increasing. Indeed, acccording to data from Vigitel 2018 [36], the prevalence of obesity (BMI > 30 kg/m^2) in adults is 19.8%, with the highest frequencies observed in capitals of the Midwest, North, and Northeast regions, with emphasis on the capital cities like Cuiabá (23.0% CI 95% 20.5–25.4), Manaus (23.0% CI 95% 19.7–26.3), and Recife (21.9% CI 95% 19.3–24.4). The same pattern was observed regarding the consumption of fruits and vegetables, with the lowest percentages observed in the North and Northeast regions [36]. The Vigitel survey also pointed out that consumption of fruits and vegetables is more frequent among women and, despite the increase in the consumption of these foods observed in the last ten years, only 23.1% of Brazilians consume the five daily portions at least five times a week as recommended by the WHO [36]. In Brazil, overweight (BMI > 25 kg/m2) and obesity rates are spreading in all age groups, both sexes, and all income levels, with the obesity rates being more frequent in the population with lower family income [37].

Similar to the results reported by Passos et al. (2005), it was verified a positive relationship between physical inactivity and high CBG [38]. Sedentary lifestyle has been associated with insulin resistance in individuals without a diagnosis of diabetes, regardless of obesity [39, 40]. Reporting of previous arterial hypertension was also associated with high CBG. It is known that hypertension has a prevalence up to three times higher in people with DM when compared to those who do not have the disease, being the major determinant of atherosclerotic cardiovascular diseases (ASCVD) in this population [41, 42].

The percentage of people at high and very high risk of developing T2DM in Brazil was similar to the screening performed in pharmacies in Spain (23.5% had a high risk of diabetes -FINDRISC > 14 points) [43] and smaller than the risk reported by the screening performed in Thailand, in seven pharmacies, which showed a prevalence of 48% of high risk for DM [44]. The prevalence of high CBG in Brazil was higher than the prevalence found in other countries such as Spain, Switzerland, and Thailand [43–45], indicating the need for multidisciplinary monitoring of these people.

T2DM is characterized by a long asymptomatic period before the diagnosis is made [16]. The early diagnosis of T2DM contributes to the reduction of ASCVD, prevention of microvascular complications (retinopathy, neuropathy, kidney disease), and premature mortality [16, 40, 46, 47]. People with T2DM have a two to four times greater risk of developing coronary heart disease, when compared to the general population, and approximately 8% of people with pre-diabetes develop retinopathy (Alberti et al. 2007). Moreover, more recent data have shown high percentages of peripheral neuropathy among people with obesity and pre-DM 29% versus 11% with normal glucose, and ranges from 11 to 34% among individuals with pre-DM [48]. Thus, early interventions to prevent or delay progression to T2DM represent an important benefit not only for, increasing life expectancy and quality of life, but also reducing costs related to the management of the disease and its complications [17].

Success in the treatment of diabetes depends on the concomitant implementation of three types of interventions: educational, self-monitoring, and pharmacological strategies. Whenever possible, it is recommended that care for people with diabetes should include a health care professional (HCP) interdisciplinary team composed of professionals with the proper qualification and practical experience in health education activities [49]. Pharmacists working in community pharmacies can contribute not only with HCP screening and education, but also with the monitoring of patients with DM, in collaboration with other HCP thus helping to improve the treatment and disease control.

A systematic review and meta-analysis assessing the impact of pharmaceutical care for people with diabetes in outpatient services, revealed a 1.1% reduction in HbA1c compared to standard care (95% CI 0.88–1.27)[50]. In Brazil, a 12-months study enrolling patients with DM, followed in a pharmacy, showed a reduction of 2.2% in HbA1c compared to 0.3% in the control group [51]. These studies suggest that the health care intervention by the pharmacist in patients with DM can improve the HbA1c results acting as an “additional” effect to the standard care provided to the patient. Other parameters such as blood pressure, LDL cholesterol, triglycerides, BMI, and coronary risk were also sensitive to pharmaceutical intervention in this group of patients, as reported by Pousinho et al. [52].

Barcelo et al.[4] found that, most of the direct costs of treating DM in Latin America are related to the treatment of complications. The cost of a patient without chronic complications with HbA1c > 10% is 2.4 times higher than that of a patient better controlled with HbA1c < 8%. If the patient develops chronic complications, the resultant cost is 34 times higher [53]. Therefore, population-based DM screening actions can generate cost-effective results [54]. The campaign to track suspected cases of DM in Brazil, in 2018, reached a population larger than the number initially estimated, reinforcing the role of pharmacies in health promotion and disease prevention activities. As in other countries [44, 45], pharmacies in Brazil are health establishments that provide pharmaceutical services, individual and collective health guidance, handling and/or dispensing medications, and evaluation of CBG, blood pressure and weight measurements, among other procedures [26, 27]. Thus, pharmacies are favorable environments for carrying out clinical activities, including screening, education, and monitoring of people with NCD, particularly diabetes [55].

Strengths And Limitations

This is the first study to screen for T2DM in pharmacies in Brazil using CBG test. The sample screened in this study was higher than expected; thus, the approach presented herein reinforces the strategic importance of the health services provided by community pharmacies for screening actions across the country. Another strength of the study was the opportunity to expand the application of the FINDRISC tool, which has been already translated and validated for the Brazilian Portuguese and is strongly recommended by the Brazilian Diabetes Society in its yearly detection campaigns. The completion of the questionnaire by health professionals, as performed herein, is expected to have increased the reliability of the data [16].

This study has some limitations. Because it is a cross-sectional study, a causal relationship cannot be established. Another possible limitation was the population screened since it was a convenience sample and most participants had 11 or more years of formal education plus the fact that the majority of the pharmacies were private. Therefore, it is possible that the more vulnerable and least assisted people and also frequently less educated were under evaluated. Thus, although the prevalence reported herein is alarming, it may be underestimated.

Conclusions

This is the largest prevalence study and risk analysis regarding the development of T2DM ever conducted in Brazil performed by pharmacists. The profile of the people who were found to have high CBG indicates that strategies involving health education measures, encouragement to healthy eating, physical activity and weight loss could help to reduce the prevalence of T2DM in the country, especially in the most underserved regions of the country, North, Northeast and Midwest where the increase in obesity is an important concern. To this end, pharmacists working in community pharmacies may contribute to screening and perform health education, in the early referral of suspected cases to the health service for diagnostic confirmation, as well as in the monitoring of the patient with DM, in collaboration with the other health professionals and produce better results in the disease control.

Public health actions directed to the population with high CBG can enable the early diagnosis of T2DM, and contributes to the reduction of ASCVD, prevention of microvascular complications and avoid premature mortality. Worth to quote the partnership between the Brazilian Diabetes Society and the Federal Council of Pharmacists which represents an important step towards the liaison of pharmacists and other HCP involved in screening and care of people with diabetes in Brazil.

Abbreviations

ASCVD

Atherosclerotic Cardiovascular Diseases; BMI:Body Mass Index; CBG:Capilar Blood Glucose; CI:Confidence Interval; DM:Diabetes Mellitus; FINDRISC:Finnish Diabetes Risk Score; HCP:Health Care Professional; NCD:Non-Communicable Disease; PR:Prevalence ratio; T1DM:Type 1 Diabetes Mellitus; T2DM:Type 2 Diabetes Mellitus

Declarations

Availability of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The research was approved by the Research Ethics Committees of the Federal University of Parana and the Federal University of Ouro Preto under number 95218118.4.0000.0102 / 2018. All interviews were conducted by the pharmacists preceded by clarifying the objectives for the participant and signing the informed consent form.

Consent for publication

A written consent to publish the information and data of the participants was obtained.

Competing interests

There are no competing interests to declare.

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There was no funding for this study.

Authors’ contributions

Conception and study design: C.J.C., W.C.V., K.F.S.M., J.C.Q.P.F., J.V.A., M.S.A.L., E.B.P., J.S.R., J.P., H.C.P., W.S.J.J. Analysis and interpretation of data: C.J.C., W.C.V., J.C.Q.P.F., L.G.N., R.C.R.M.N., M.S.A.L., E.B.P., W.M.F. Drafting of the manuscript; CJS; WCV; RCRMN; JCQPF; LGN; WMF; HCP; WSJJ. All authors read and approved the final manuscript.

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Figures

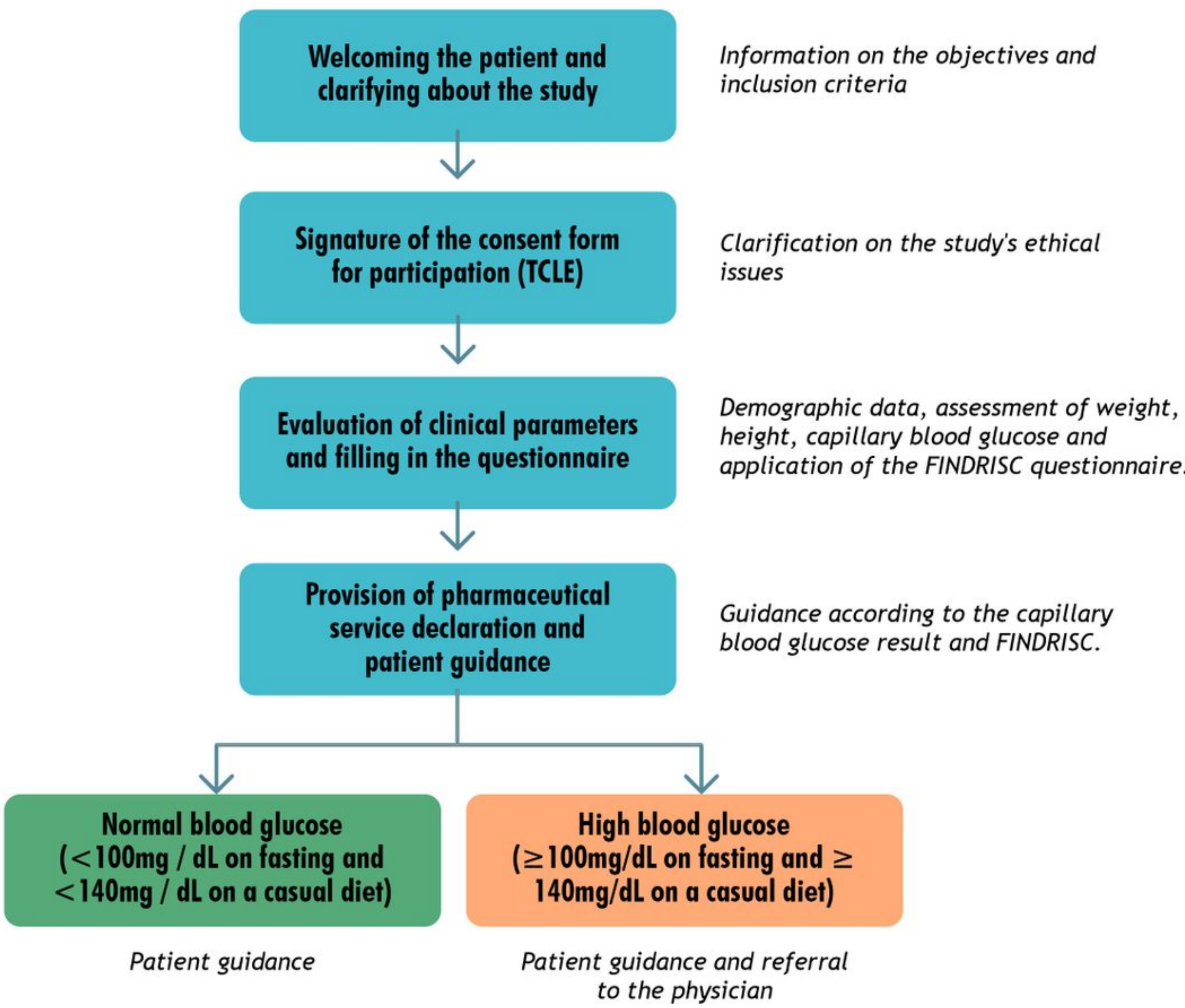

Figure 1

Flowchart of pharmaceutical services during the National Screening of high blood glucose in Brazil, 2018.

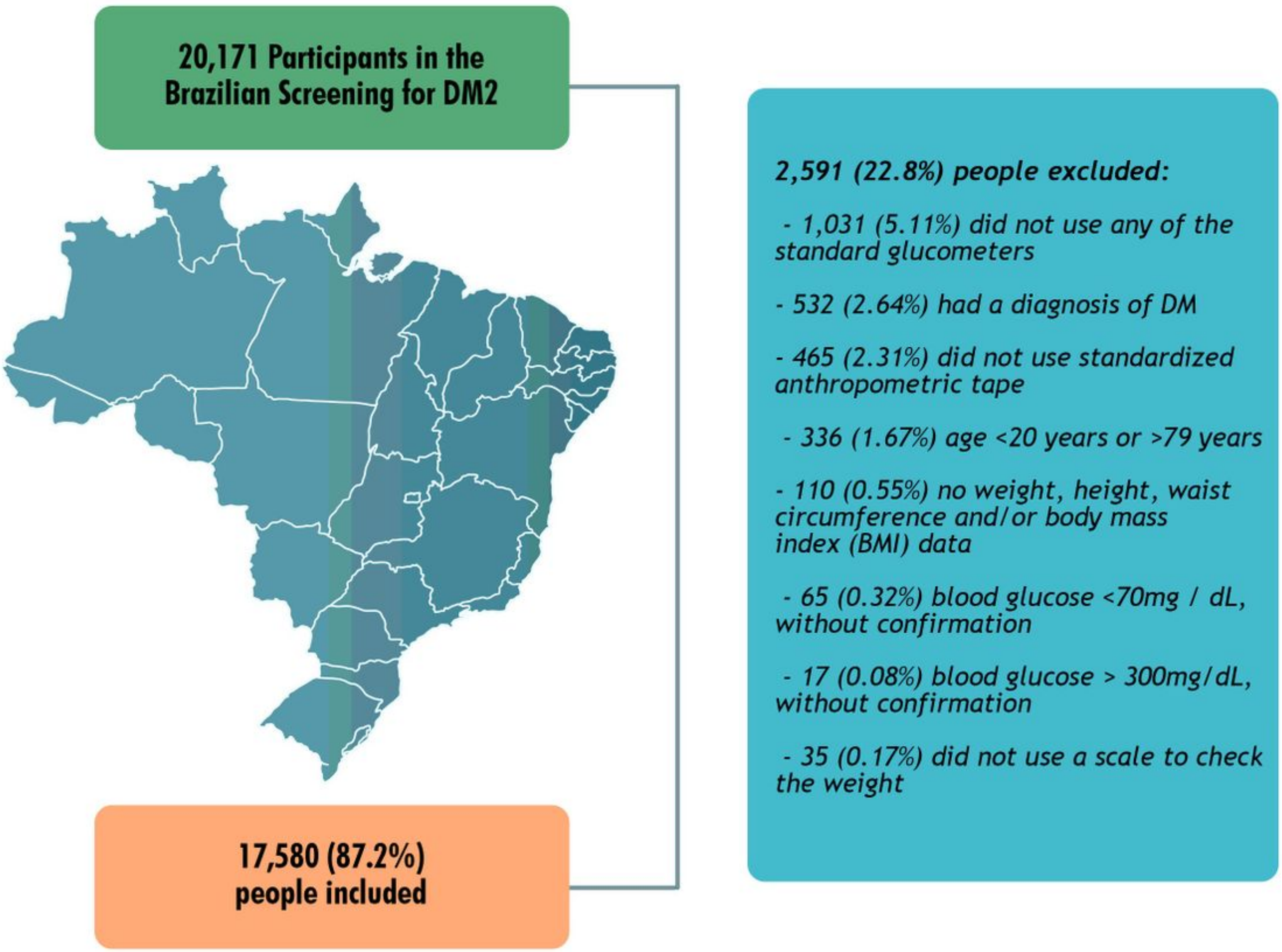

Figure 2

Population included in the screening of high blood glucose in Brazil, 2018.

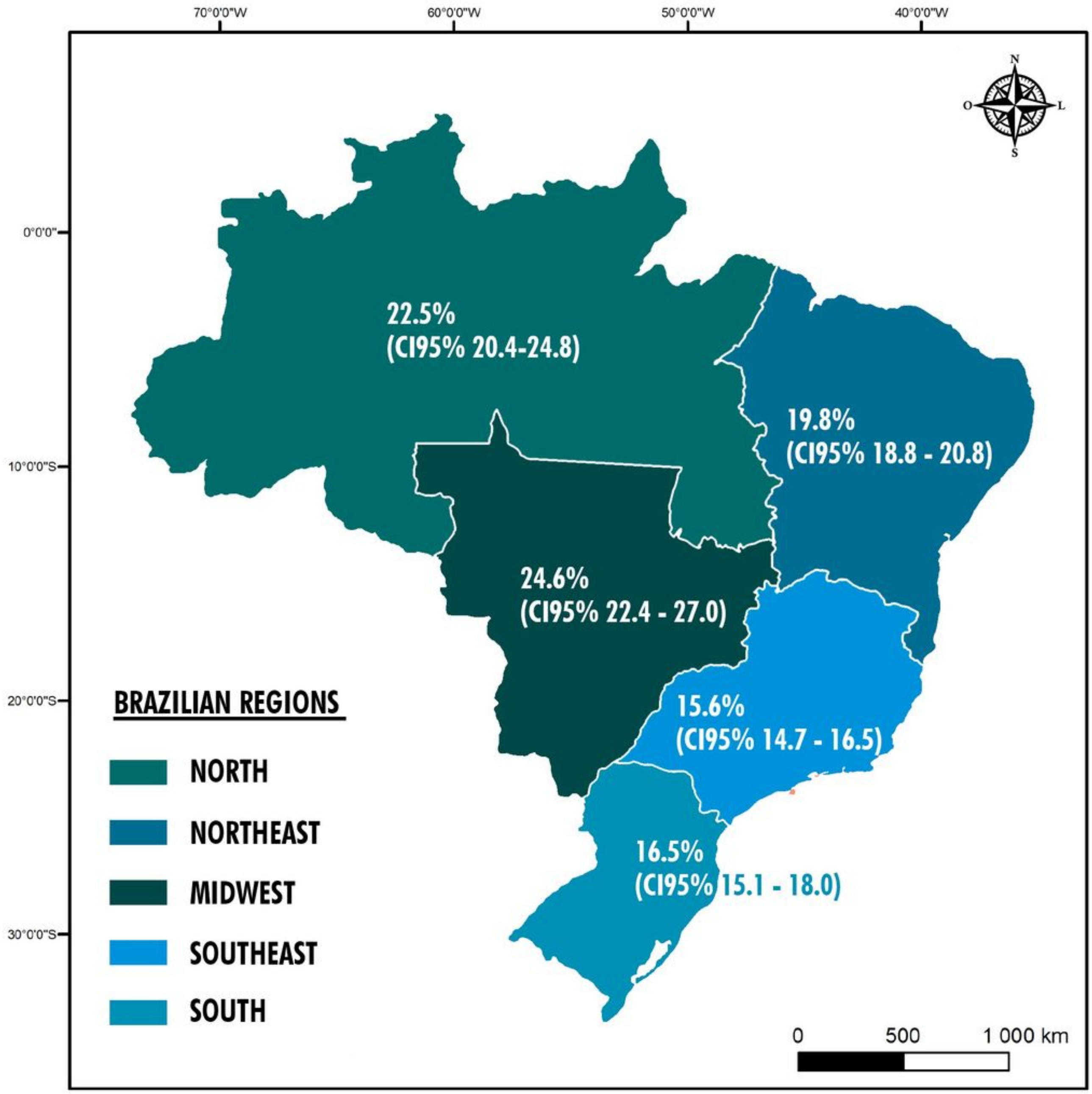

Figure 3

Prevalence of high capillary blood glucose, according to Brazilian region, 2018