REVIEW

Diabetes Care in Brazil

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Abstract

BACKGROUND The diabetes epidemic affects most countries across the world and is increasing at alarming rates in Latin America. Nearly 12 million individuals have diabetes in Brazil, and the current prevalence ranges from 6.3% to 13.5%, depending on the region and the diagnostic criteria adopted in each study.

OBJECTIVE To provide an overview of diabetes care in Brazil, focusing on studies of diabetes epidemiology, prevalence of patients within the standard targets of care, and economic burden of diabetes and its complications.

METHODS SciELO and PubMed searches were performed for the terms "diabetes," "Brazil," "Brazilian," and "health system"; relevant literature from 1990 to 2015 was selected. Additional articles identified from reference list searches were also included. All articles selected were published in Portuguese and/or English.

FINDINGS Recent studies detected a prevalence of gestational diabetes mellitus of nearly 20%. Among patients with type 1 diabetes, almost 90% fail to reach target of glycemic control, with less than 30% receiving treatment for both hypertension and dyslipidemia. More than 75% of patients with type 2 diabetes are either overweight or obese. Most of these patients fail to reach glycemic targets (42.1%) and less than 30% reached the target for systolic and diastolic blood pressure, body mass index, or low-density lipoprotein cholesterol. Only 0.2% of patients reach all these anthropometric and metabolic targets.

CONCLUSIONS Brazil is the fourth country in the world in number of patients with diabetes. Regardless of the diabetes type, the majority of patients do not meet other metabolic control goals. The economic burden of diabetes and its complications in Brazil is extremely high, and more effective approaches for preventions and management are urgently needed.

KEY WORDS Brazil, diabetes, diabetes care, health care expenditures, Latin America, public health care, type 2 diabetes

INTRODUCTION

Brazil is a continent-sized country divided into 5 major geographic regions: north, northeast, midwest, southeast, and south. There are wide inter-regional demographic, socioeconomic, and cultural disparities. According to the last census, conducted by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*) in 2010,[1] there were about 190,755 million inhabitants in Brazil, concentrated in urban areas (84.4%) and in the southeast region (42.6%), comprising 10.9% of Brazil's total area. The average monthly incomes of the mid-west and southeast regions were similar and the highest in the country, followed by the monthly incomes of the south region. On the other hand, the average monthly incomes of the north and northeast regions were only 67.3% and 56.7%, respectively, of that found in the mid-west region.[1] These disparities are important when interpreting inter-regional differences in diabetes care in Brazil.

The Brazilian National Public Health Care System, also known as the Unified Health System (*Sistema Único de Saúde*; SUS), was created based on the Brazilian Constitution of 1988, which established that every Brazilian citizen has the right to access primary, secondary, and tertiary health care, which are provided free of cost by a national health system.[2] The SUS comprises public and private health care institutions and providers, financed primarily through taxes with contributions from federal, state, and municipal budgets. Health care management is decentralized, and municipalities are responsible for most primary care services as well as some hospitals and other facilities.[3] The SUS applies to the spectrum of economic classes and provides basic to the most complex services, free of cost. It has been improved through new programs and policies but is also challenged by many operational obstacles.[2] As a result, 24% of the total Brazilian population is still assisted by the private or supplementary health care system.[4]

In Brazil, the costs of certain drugs for diabetes and hypertension are fully subsidized by the public sector; the federal government co-subsidizes private sector expenses through the Brazilian Popular Pharmacy Programme (*Programa Farmácia Popular do Brasil*), developed by the health ministry. The SUS also provides self-monitoring blood glucose (SMBG) supplies, but not always in the amount needed or recommended for optimal patient monitoring, and seldom uniformly across cities. Moreover, because medications available through this program do not always meet the patient's needs,

the patient or family must pay some of the treatment costs.[5] Despite its many accomplishments, the SUS also faces serious financial challenges. Less than half of total health care spending in Brazil comes from public sources, a proportion that places Brazil far below the Organization for Economic Cooperation and Development average for government share of health expenditures.[3]

EPIDEMIOLOGY OF DIABETES IN BRAZIL

Prevalence of Diabetes. According to the current estimates by the International Diabetes Federation, 11.9 million individuals between 20 and 79 years of age currently have diabetes in Brazil, ranking the country as having the fourth largest number of diabetes cases worldwide.[6] A single nationwide study, carried out in the late 1980s, detected a diabetes prevalence of 7.6% in individuals aged 30 to 69 years,[7] similar to the prevalence of 7.1% in the same age-group in Rio de Janeiro in the mid-1990s.[8] However, more recent regional studies[9-11] demonstrated an increase in prevalence rates. The cities of Ribeirão Preto and São Carlos, both in the State of São Paulo (southeast region), and Porto Alegre, in the State of Rio Grande do Sul (south region), showed prevalence rates of 12.1%, 13.5%, and 12.4%, respectively.[9-11]

Moreover, the prevalence of chronic disease risk factors in Brazil is estimated annually by the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (*Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*; VIGITEL), which is conducted among the adult population in state capitals and the Federal District. In this survey, diabetes is defined as a self-report of a previous diabetes diagnosis by a physician. The prevalence of self-reported diabetes in adults (18 years and older) residing in the capitals of Brazil in 2011 was 6.3% (5.9-6.7). The prevalence increased dramatically with increasing age and, importantly, with overweight and obesity. Lower educational level and African ethnicity were associated with greater prevalence. Only minor differences were observed among regions, which disappeared almost entirely after taking into account differences in sociodemographic factors and nutritional status.[12]

However, it is important to note that (1) results from VIGITEL pertain to Brazilians living in capital cities, which according to the 2010 population census, account for only 24% of the total Brazilian population; and (2) because the vast majority (90%) of those who

reported having diabetes were diagnosed at or after 35 years of age, VIGITEL reflects predominantly the prevalence of type 2 diabetes (T2D).[12]

Incidence of Type 1 Diabetes. Although scarce information is available about the variability in the incidence of type 1 diabetes (T1D) in the Brazilian population in the last decades, previous studies[13-16] conducted in 4 different cities showed a large difference and a polar-equatorial gradient on their T1D incidences: for example, Campina Grande, in the northeast region, showed an incidence of 1.8 per 100,000 persons/year; Bauru, in the southeast region, 10.4 per 100,000 persons/year; and Londrina and Passo Fundo, both in the south region, 12.7 per 100,000 and 12 per 100,000 persons/year, respectively.

The only study that evaluated the secular trends in the incidence of T1D in Brazil was the one conducted in Bauru.[16] The incidence of T1D was estimated in the entire population up to 14 years of age living in the city over a 21-year follow-up period (from 1986 to 2006; n = 1,673,132).[16] A total of 176 cases were diagnosed and the average age at diagnosis was 8.66 ± 3.76 years for both genders. The overall adjusted incidence over this period was 13.7 per 100,000 persons/year.[16] The ratio between the highest (2002) and the lowest (1987) estimated incidence rates shows that a great variation in incidence (9.6-fold) occurred during the study.[16] This increasing incidence of T1D in Bauru was observed mainly among Caucasians from low and medium socioeconomic classes.[16] It remains unknown whether these results could be extrapolated to other cities from different regions of Brazil.

Gestational Diabetes. Most of the data regarding gestational diabetes mellitus (GDM) in Brazil are derived from the Brazilian Gestational Diabetes Study (EBDG). The EBGD is a cohort of pregnant women enrolled consecutively in prenatal care clinics of the SUS from 1991 to 1995, a time and setting in which those with lesser than diabetes hyperglycemia rarely received drug treatment. A total of 5564 women aged 20 or more years were recruited, with no history of diabetes other than gestational, who attended general prenatal care clinics in 6 Brazilian state capitals (Porto Alegre, São Paulo, Rio de Janeiro, Salvador, Fortaleza, and Manaus). Of these, 4998 underwent a 2-hour 75-g oral glucose tolerance test between the 24th and 28th weeks of pregnancy.[17]

Among these women studied in EBGD, 2.4% (95% CI 2.0-2.9) were diagnosed with GDM by the American Diabetes Association (ADA) criteria,[18] and 7.2% (6.5-7.9) by World Health Organization (WHO) criteria.[19] After adjustment for the effects of age, obesity, and other risk factors, GDM by ADA criteria predicted an increased risk of macrosomia (relative risk [RR] 1.29, 0.73-2.18), preeclampsia (RR 2.28, 1.22-4.16), and perinatal death (RR 3.10, 1.42-6.47). Similarly, GDM by WHO criteria predicted increased risk for macrosomia (RR 1.45, 1.06-1.95), preeclampsia (RR 1.94, 1.22-3.03), and perinatal death (RR 1.59, 0.86-2.90). Among women positive by WHO criteria, 260 (73%) were negative by ADA criteria. Conversely, 22 (18%) women positive by ADA criteria were negative by WHO criteria.[20]

Using data from EBDG and the definition of GDM proposed by the International Association of Diabetes and Pregnancy Study Groups (IADPSG),[21] a recent study[22] found a GDM prevalence of 18.0% (16.9-19.0). Relative risks for large for gestational age and preeclampsia were generally small. The authors conclude that the IADPSG criteria identified more women as having GDM, but their impact on diagnostics and population health with respect to adverse outcomes were small.[22]

Prevalence of Patients within the Standard Targets of Care. *Findings in patients with T1D.* The Brazilian Type 1 Diabetes Study Group (BrazDiab1SG)[23] is an ongoing survey that analyzes the demographic, clinical, and socioeconomic data of patients with T1D receiving treatment in public clinics in Brazil. The prevalence of patients with T1D who meet cardiovascular disease (CVD) and glycemic risk factors goals and the frequency of screening for diabetes complications (according to the ADA guidelines)[24] were evaluated in a cross-sectional, multicenter study conducted between December 2008 and December 2010 in 28 public clinics from 20 cities of 4 Brazilian geographic regions (north/northeast, mid-west, southeast, and south).[23] Considering, first, that SUS is divided into primary, secondary, and tertiary health care levels according to the characteristics and infrastructure of the health care units,[5] and second, that patients with T1D usually are treated at secondary or tertiary centers in Brazil, then it is evident that primary care centers were not included in the study.[23]

Data were obtained from 1774 adult patients (56.8% females, 57.2% Caucasians) aged 30.3 ± 9.8 years with T1D duration of 14.3 ± 8.8 years. Patients with T1D for less than 5 years were not included in the analysis of diabetes complications (n = 200, 11.3%). The most commonly used therapeutic regimen was the combination of intermediate-acting or long-acting insulin plus short-acting insulin

(80.8% of patients). Three or more daily injections of short-acting insulin and 3 or more measurements of SBGM were reported by 60.2% and 83.5% of patients, respectively.[23] The goal for hemoglobin A1c (A1C) was achieved by 206 patients (11.6%).[23] A1C levels ≥ 7% and < 9% were found in 643 (40.2%) and A1C levels ≥ 9% in 682 (42.9%) patients.[23] A weak negative correlation between A1C levels and the daily frequency of SBGM was observed ($r = -0.08$; $P = .001$), which may reflect challenges with insulin dose adjustments, difficulties of basal/bolus balances, and poor diabetes health care and education.[23] Mean A1C levels were related to economic status, which was low or very low in 61.7% of the patients.[23] It is important to emphasize that the economic status in Brazil also takes into account educational level.[23]

Although clinical practice guidelines recommend aggressive dyslipidemia and hypertension management in patients with T1D, less than 30% of these patients were receiving treatment for both clinical conditions.[23] Systolic blood pressure was at target in 40.3% and diastolic blood pressure in 26.6% of hypertensive patients.[23] Low-density lipoprotein cholesterol was on target in 45.2% of the patients.[23] Smoking was reported by 7.3% of patients. Overweight (body mass index [BMI] ≥ 25 and < 30 kg/m^2) was present in 25.6% and obesity (BMI ≥ 30 kg/m^2) in 6.9%.[23] Among those with more than 5 years of T1D, screening for retinopathy was performed in the preceding year in 70.1%.[23] Nephropathy and diabetic foot complications were screened in 63.1% and 65.1%, respectively.[23]

Because the majority of patients did not meet metabolic control goals and a substantial proportion were not screened for diabetic complications, the risk of chronic complications is increased further, burdening the public health care system. These findings are alarming in several ways, and the data suggest that it is necessary and urgent to develop another health care model for T1D in Brazil.[23]

It is worth noting that the wide availability of new technologies and treatment options for T1D is still limited in Brazil. The use of insulin pumps is incipient, especially when integrated with continuous glucose monitoring. However, there are already some centers with experience in this therapy and with good results.[25] Moreover, despite its economic difficulties and limited resources, Brazil has a special health policy for organ transplants. The government covers all costs of the transplant, including immunosuppressants, and the vast majority of procedures are performed in philanthropic or public hospitals.

However, in 2014, only 126 pancreas transplants were performed in the country.[26] This number, which has been declining since 2011, fell to 11.3% in 2014.[26] This can be explained by inadequate funding, the complexity of the surgery, and the small number of suitable donors.[26] Islet cell transplantation also is still very incipient. There is only one active islet transplant program in the country, and the first procedure was performed in 2002.[27]

Stem cell therapy for T1D is a reality in Brazil, but at present this can only be done in a research setting. Since 2003, a Brazilian research group has been conducting a clinical trial (registered at http://clinicaltrials.gov under number NCT00315133) of nonmyeloablative hematopoietic stem cell transplantation in patients with newly diagnosed T1D.[28]

Findings in patients with T2D. The prevalence of patients with T2D within the targets of care in daily clinical practice was assessed in a cross-sectional multicenter study conducted between May 2000 and May 2001 in 13 public endocrine clinics from 8 Brazilian cities.[29] Using the guidelines of the Brazilian Diabetes Society (BDS),[30] CVD risk factors, glycemic control, and the availability of screening for diabetes complications were evaluated in 2233 outpatients (60% females) with T2D aged 59.2 ± 11.3 years and with a known duration of T2D of 9.2 ± 7.2 years. All patients received health care from SUS and had a low income and education level.[29]

The therapeutic prescription by the time of the last clinic visit was not documented in 14.1% of the clinical charts. Diet alone (11.6%), one oral antidiabetic drug (33.2%), combination therapy, and insulin as monotherapy (55.2%) were the therapeutic regimens prescribed for 85.9% of the patients.[29]

Only 46% reached the A1C goal, defined as 1 percentage point above the upper limits of normality for the method used, because there was no standardization of A1C determination defined in Brazil during the time of the study.[29] Moreover, an association was found between treatment groups and the percentage of patients meeting glycemic targets.[29] Patients treated with diet (67%), one oral antidiabetic drug (56.4%), or combination of oral antidiabetic drugs (43.4%) reached the targets better than those treated with insulin as monotherapy (35.3%) or a combination of insulin and oral antidiabetic drugs (39%).[29] It was surprising that a significantly higher fraction of patients treated with diet or oral antidiabetic drugs reached the BDS criteria for metabolic control than those treated with insulin.[29] A large proportion of the patients were either overweight (42.1%) or obese (33.3%).[29] Less than 30% reached

the target for systolic (28.5%, <130 mm Hg) and diastolic (19.3%, <80 mm Hg) blood pressure, body mass index (24.6%, <25 kg/m^2), or low-density lipoprotein cholesterol (20.6%, <2.6 mmol/L).[29] Only 0.2% of patients reached all anthropometric and metabolic targets.[29] It was concluded that the most relevant goals established by local guidelines for glycemic control, blood pressure, and lipid levels are rarely achieved in clinical practice and that availability for diabetic complication screening is still poor.

THE ECONOMIC IMPACT OF DIABETES AND ITS COMPLICATIONS IN BRAZIL

Costs Attributable to T1D. T1D is associated with a major economic and social impact on the SUS. A retrospective, cross-sectional, nationwide multicenter study[5] conducted between 2008 and 2010 in 28 public clinics (secondary and tertiary care units) from 20 Brazilian cities (n = 3180) reported an average cost of $1319.15 per patient for the SUS, and most expenditures ($1216.33 per patient/year, 92.2% of total direct medical costs) were related to treatments. Insulin supplies and SMBG, required items for T1D management, accounted for 52.82% ($696.78 per patient/year) of total costs.[5] The expenditure on insulin pump and related supplies represented 5.5% of the total direct cost.[5] Only 38 patients (1.2%) used this treatment modality, at an average cost per patient of $6069.26.[5]

Medical procedures and hemodialysis accounted for 5.73% ($75.64 per patient/year) of direct medical costs.[5] Consultations accounted for only 1.94% of direct medical costs ($25.62 per patient/year), pointing to the need for more comprehensive logistical and financial planning in the integral health care model.[5] This would involve a significant investment with respect to multidisciplinary teams, diabetes education, and the rational and effective use of the available procedures and technologies.[5]

In the southeast region, the average per capita costs of T1D were 28% higher than in the north/ northeast regions and 17% higher than in the south region, respectively, although not different from the mid-west region.[4] In the southeast region (P < .001), the presence of microvascular diabetes-related complications (P < .001) and higher economic status (P < .001) were independently associated with higher medical costs.[4] Interestingly, patients from the north/northeast region had less complications, reflecting a survival bias.[4]

Additionally, it is important to point out that the real costs of hospitalization directly related to T1D

exceed the amount paid by SUS, which probably reimburses little more than the costs of medications and laboratory tests and excludes daily hospital stay and staff labor costs.[5] This, plus the fact that reimbursement by the SUS for medical and nonmedical visits and procedures is low, could have led to an underestimation of the direct medical costs associated with T1D from the perspective of the public health care system.[5]

Between 2008 and 2010, retirement as a result of disabilities occurred in 4.2% of Brazilian patients with T1D at an early age and was strongly associated with diabetes-related chronic complications, with adjusted odds ratios of 4.87 (2.66-8.78) for the presence of microvascular complications and 3.7 (2.04-6.7) for macrovascular complications.[31] This phenomenon resulted in 17.5 ± 9.1 years of workforce losses,[31] representing a major concern for the country and society.

Costs Attributable to T2D. T2D also leads to elevated costs both to the SUS and society. The costs of outpatient diabetes care in the SUS were evaluated in the Brazilian Study on Diabetes Costs (ESCUDI),[32] a retrospective study based on data collected from primary, secondary, and tertiary care units, conducted in 2007 in 8 Brazilian cities from northwest, south, and southeast regions (n = 1000). According to ESCUDI, the total costs of diabetes care amounted to $2,108,287 for 1000 patients/year (or $2108 per patient) with the following breakdown: $1144 per patient at the primary care level; $2445 at the secondary level; and $2810 at the tertiary level.[32]

Total direct outpatient costs of T2D care were $1335 per patient/year (63.3% of total diabetes costs), out of which $1014 per patient/year was expended on direct medical costs (medications, diagnostic tests, procedures, medical supplies, visits with health professionals, and hospital costs for emergency room visits) and $332 per patient/year expended on nonmedical costs.[32] Total annual cost of medications for 1000 patients was $747,356.[32] Although it is the responsibility of the SUS to provide drug treatment for any chronic disease, only $563,506 was paid by the SUS (75.4%) and $183,849 was paid by patients in private pharmacies (24.6%).[32] The cost of SMBG, exams/procedures, and health professionals' consultations were $299 per patient/year ($102,748; n = 343), $1216 per patient/year, and $794 per patient/ year, respectively.[32] Annual expenses for artificial sweeteners and dietary supplements amounted to $258,617 ($286 per patient).[32]

Total indirect costs (absenteeism and resulting loss of productivity for the patients and their

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Table 1. Key Features of Diabetes in Brazil

- Brazil is the fourth country in the world in number of patients with diabetes, comprising 11.9 million adults.
- Metformin, second-generation sulfonylureas, traditional insulins, and related supplies are fully subsidized by the public sector. However, these resources are not always in the amount needed or recommended for optimal glucose control. The availability of insulin analogues, new oral drugs, and new technologies for diabetes is still limited.
- Only 11.6% of patients with T1D and 46% of those with T2D reach the A1C goal. Regardless of the diabetes type, the majority of patients do not meet other metabolic control goals and a substantial proportion are not screened for diabetic complications.
- The economic burden of diabetes and its complications is extremely high and there are important inter-regional disparities in per capita investment in diabetes care. The investments seem to be greater in southeast and mid-west regions, followed by south region and then by north and northeast regions. These disparities are in accordance with those found for the average monthly incomes of these regions.

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caregivers, sick leave, and early retirement) were $773,212 ($773 per patient/year), which corresponds to 36.7% of total T2D costs.[32] Both direct and indirect costs increased as T2D progressed and also with the presence of chronic complications (25% cost increment in those with both microvascular and macrovascular complications compared with those with only one of them).[32]

It is important to emphasize that the results obtained in ESCUDI may not accurately reflect average costs of T2D care in all of Brazil. Moreover, the noninclusion of hospital costs in the analysis certainly resulted in an underestimate of the total cost of diabetes care. Regarding this issue, a previous study[33] investigated the costs of public hospital admissions in Brazil during 2 years (1999–2001) using diabetes (unspecified type) as the main diagnosis and the method of attributable risk associated to all admissions. During this period, there were 327,800 hospitalizations for diabetes in the country, representing a cost of $969.09 per 10,000 inhabitants, which is impressive.[33]

In a more recent study[34] conducted in a university's outpatient health care center (tertiary level of SUS) in the city of São Paulo, the most populous city in Brazil, the costs of hospitalizations and procedures were $137 per patient/year and amounted to 14% of the direct costs with T2D, reinforcing the need to enforce policies for the prevention of diabetes and its complications and to better allocate health care resources.

Costs Attributable to GDM. To date, no studies evaluating the costs of pregestational diabetes and/or GDM in Brazil are available. However, the costs are likely to vary according to the definition of GDM adopted (ADA, WHO, or IADPSG criteria) and likely to be relatively higher than those observed for the other types of diabetes. Specifically, GDM requires more medical and nutritional consultations, strips for SMBG, and exams and is more likely to require a prescription for insulin. The newborn's and mother's inpatient costs associated with the birth also contribute to the increase in expenses.

CONCLUSIONS

The high prevalence rate of diabetes in Brazil is alarming and profoundly affects society and economy. Key features of diabetes in Brazil are summarized in Table 1. Regardless of diabetes type, the large majority of patients are not achieving the treatment goals. Moreover, the availability of screening tests for diabetes complications is still poor, inevitably resulting in workforce losses and extra burden for the public health care system. Although this situation applies to all of Brazil, there are important inter-regional disparities in diabetes care. More effective policies for the prevention of diabetes and its complications, as well as better allocation of health care resources, are urgently needed to substantially improve care and clinical outcomes.

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