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The impact of COVID-19 on people with diabetes in Brazil

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ABSTRACT

The present study aims at identifying main barriers faced by people living with diabetes in Brazil during the COVID-19 pandemic.

Methods: In a convenience sampling study, data were collected from 1701 individuals, aged 18 or above; 75.54% female participants; 60.73% T1D and 30.75% T2D, between April 22nd and May 4th, using an anonymous and untraceable survey containing 20 multiple choice questions (socio-demographic; health status and habits of life during COVID-19 pandemic). Relationship between variables was established using the multiple correspondence analysis technique.

Results: 95.1% of respondents reduced their frequency of going outside of their homes; among those who monitored blood glucose at home during the pandemic (91.5%), the majority (59.4%) experienced an increase, a decrease or a higher variability in glucose levels; 38.4% postponed their medical appointments and/or routine examinations; and 59.5% reduced their physical activity. T1D, the youngest group, was more susceptible to pre-

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senting COVID-19 symptoms despite not being testing; whilst the T2D group had higher frequency of comorbidities that are additional risk factors for COVID-19 severity.
Conclusions: This study provides a first hand revelation of the severity of COVID-19 on individuals with diabetes in Brazil. Their habits were altered, which impacted their glycemia, potentially increasing the risk of poor outcomes and mortality if infected by SARS-CoV-2, and of acute and chronic diabetes complications.

1. Introduction

The COVID-19 outbreak has led to an unprecedented global health crisis, testing health systems' preparedness and ability to cope with a pandemic response [1–4]. Brazil experienced a similar challenge. The first SARS-CoV-2 case was officially reported in December 2019 in Wuhan, China, and rapidly spread in the entire country and beyond within 30 days [5–7]. The first suspected case in Latin America was reported on January 27th in Brazil and the first case was confirmed in the same country on February 26th of 2020 [2,3,7]. A series of measures were put in place to prepare Brazil for the anticipated health crisis prior to the declaration of COVID-19 as a Public Health Emergency of International Concern, on January 30th [2], and then a pandemic, on March 11th [8]. Following these international alerts, less than a month after the first confirmed case, on March 20th, the Brazilian Ministry of Health recognized that community transmission was already happening in Brazil [2].

Infection by SARS-CoV-2 causes major disruptions and threats, in addition to the loss of human lives, with case fatality rate ranging from 0.2% in Germany, to 7.7% in Italy [9], the impact of COVID-19 is beyond imagination and is sparkling a global mourning, booming a feeling of unsafety and uncertainty. On July 5th, according to the World Health Organization (WHO), 11,301,850 cases and 531,806 deaths due to COVID-19 were confirmed in 216 countries areas or territories with cases [10]. On this same day, the number of cases and mortality in Brazil had reached 1,603,055 and 64,867 respectively, with a case fatality rate of 4.0% [11]. While this is the highest number of cases and one of the highest case fatality rate in Latin America [12], scientists argue that cases and mortality are extremely underscored due to the low number of tests performed among other reasons [1,4,12,13] by possible 14–20 times the official reported figures [14].

Authors of the first Chinese and Italian reports alerted for the worse prognosis of individuals with diabetes and other noncommunicable disease (NCDs), in comparison with populations of the same age group without chronic health conditions [5,15–18]. Further retrospective studies have revealed that, within this group of individuals, hyperglycemia was associated with higher severity and mortality rates [15,19,20,21], for reasons under investigation [22,23]. Additionally, usual comorbidities such as hypertension, cardiovascular disease, older age, and gender (male) also complement increased severity and mortality risks of individuals with diabetes hospitalized due to COVID-19 [24].

With a prevalence as high as 16.8 million people or 11.4% of the population between 20 and 79 years old, Brazil is among the top 5 countries regarding diabetes prevalence [25]. Moreover, its observes more than 135,000 deaths caused by this condition and its complications yearly [25]. Brazil struggles with the continuous treatment routine of impacted populations; only 28.8% are considered to be in target, having a glycated hemoglobin A1C below 7.0% (53 mmol/mol) [26]. Consequently, 71.2% of Brazilians with diabetes belong to a subgroup more exposed to hyperglycemia, which makes them vulnerable to even higher risk of poor outcomes when infected by the SARS-CoV-2 virus.

This state of affairs calls for deep commitments from the public health in all its forms and a concrete alignment with the WHO. Unfortunately, in the midst of the fight against this novel virus, Brazil experienced a troublesome atmosphere of political disputes, blinding authorities to make swift decisions aligned with the global technical recommendations [1,4,12]. This also harmed adjustments to continue the proper follow-up and management of other diseases, including both communicable and NCDs. For these reasons, the present study aims to investigate challenges encountered by people living with diabetes in Brazil during the COVID-19 pandemic.

2. Method

Data from individuals with diabetes were collected through an anonymous and untraceable survey containing 20 multiple choice questions in Portuguese. The authors shared this survey on websites and social media including Facebook and WhatsApp, through their affiliated institutions, co-ligated or partner entities, and diabetes social media groups. Hence, the convenience sampling nature of this study. In addition to being a person living with diabetes, individuals needed to be legally adults (above 18 years old) and accept the terms to share anonymous and untraceable answers. Survey responses were collected from April 22nd through May 4th.

The first question provided a complete overview of the questionnaire and required confirmation of the health condition (diabetes) by the respondent. This was followed by sociodemographic questions related to age, gender, state of residence, capital/inland/coast, education level, number of people living in the household, and nature of the health system which could be public, private or both. Subsequent questions served to identify the health status of the participants, asking about diabetes type, and presence and type of comorbidity. All remaining questions covered aspects attributed to the COVID-19 pandemic: frequency of going outside, strategies to protect from infection when outside, noted changes in the glycemic levels, access to medical care, changes in eating

habits and physical activity, changes in smoking and drinking habits, and suspected or confirmed COVID-19 infection by the respondent or cohabitant family member. At the end of the survey, the respondent could leave a comment. Several questions and their answers were regarding subjective perceptions, such as "my blood glucose increased", "I am eating more" or "I am exercising much less" than before the pandemic. Therefore, answers should not be interpreted as objective measurements, but as subjective comparisons with the pre-pandemic states.

A multivariate analysis of dimensions of COVID-19 and types of diabetes (type 1 diabetes - T1D; type 2 diabetes - T2D; others: LADA, MODY, gestational; and unknown) was performed with multiple correspondence analysis (MCA) in R (version 3.6.1) and RStudio (version 1.1.453) [27].

3. Results

The survey was answered by 1701 individuals, 75.54% were female respondents, 70.78% between 18 and 50 years old, 64.96% of respondents were from Southeast of Brazil, and the main diabetes types were type 1 (60.73%) and type 2 (30.75%) (full socio-demographic profile in table 1). Among the main reported consequences of the COVID-19 pandemic were: 95.1% reduced frequency of going outside home (26.9% never went outside since the beginning of the pandemic); among the ones who monitored their blood glucose at home (91.5%), the majority (59.4%) experienced a deterioration, which included: 31.2% reported greater variability than before the pandemic, 20% higher glycemia and 8.2% lower glycemic levels. Moreover, 38.4% postponed medical appointments and/or routine exams, and 40.2% did not schedule a medical appointment since the onset of the pandemic. Among recommended habits, slated for diabetes treatment, physical activity was the most impacted, with a reduction reported by 59.5% of the respondents (14.7% with a slight reduction and 44.8% with a great reduction). See Table 2 for habits and behaviors.

Regarding comorbidities, for the current study and analysis, we opted to group them into the following: 1) "Mental Health" which includes the following conditions: depression, anxiety, bulimia, anorexia and diabulimia; and 2) "Cardiovascular Diseases" comprising: stroke, infarction, hypertension and dyslipidemia. Two other groups were already established in the survey as single answers, which had a parenthesis to facilitate comprehension, the "Diabetes Related Complications" with: retinopathy, neuropathy and diabetic renal disease; and the "Respiratory Diseases": asthma and COPD (Table 1).

The analysis revealed the association between age and the occurrence of symptoms of COVID-19, type of diabetes and some of the comorbidities evaluated (Fig. 1). People with T1D were among the youngest and appeared in proximity to mental health diseases category, but also close to the no-

Table 1 – Socio-demographics and health status of the study population (n = 1701).

Gender	**n**	**%**	Education	**n**	**%**
Male	414	24,34%	Elementary, incomplete	52	3,06%
Female	1285	75,54%	Elementary, complete	46	2,70%
Non-Binary	2	0,12%	High school, incomplete	55	3,23%
			High school, complete	355	20,87%
Age (years)	**n**	**%**	College degree incomplete	312	18,34%
18–30	395	23,22%	College degree complete	434	25,51%
30–40	453	26,63%	Post-graduation	447	26,28%
40–50	351	20,63%			
50–60	271	15,93%	**Health Service Coverage**	**n**	**%**
60–70	164	9,64%	Public (SUS)	479	28,16%
70–80	59	3,47%	Private (Out of pocket/Health Insurance)	657	38,62%
More than 80	8	0,47%	Both	565	33,22%
Brazil Region	**n**	**%**	**Comorbidities**	**n**	**%**
North	34	2,00%	Nothing/Unknown	688	40,45%
Northeast	223	13,11%	CVD*	674	39,62%
Midwest	107	6,29%	Mental Disease**	473	27,81%
Southeast	1105	64,96%	Obesity	273	16,05%
South	232	13,64%	Diabetes related complications	267	15,70%
			Asthma/COPD	82	4,82%
Town Type	**n**	**%**			
Capital	962	56,55%	**Diabetes Type**	**n**	**%**
Inland	680	39,98%	Type 1	1033	60,73%
Coast	59	3,47%	Type 2	523	30,75%
			LADA	67	3,94%
			MODY	14	0,82%
			Gestational	4	0,24%
			Unknown	60	3,53%

* Hypertension, previous stroke, myocardial infarction or dyslipidemia.
** Depression, anxiety, diabulimia, anorexia or bulimia.

Table 2 – COVID-19 impact on selected habits and behaviors (*n* = 1701).

Blood Glucose (BG) Impact	n	%	Physical Activity	n	%
People monitoring BG	1557	91,53%	High increase	39	2,29%
Deteriorated BG	925	59,41%	Low increase	79	4,64%
Higher BG	312	20,04%	No change	571	33,57%
Lower BG	128	8,22%	Low reduction	250	14,70%
Greater variation	485	31,15%	High reduction	762	44,80%
No changes	632	40,59%			
No BG measuring	144	8,47%	**TV Time**	**n**	**%**
Number of Meals	**n**	**%**	High increase	499	29,34%
High increase	88	5,17%	Low increase	332	19,52%
Low increase	292	17,17%	No change	656	38,57%
No change	1009	59,32%	Low reduction	141	8,29%
Low reduction	256	15,05%	High reduction	73	4,29%
High reduction	56	3,29%			
			Internet Time	**n**	**%**
Food Intake	**n**	**%**	High increase	616	36,21%
High increase	110	6,47%	Low increase	294	17,28%
Low increase	397	23,34%	No change	632	37,15%
No change	815	47,91%	Low reduction	124	7,29%
Low reduction	319	18,75%	High reduction	35	2,06%
High reduction	60	3,53%			

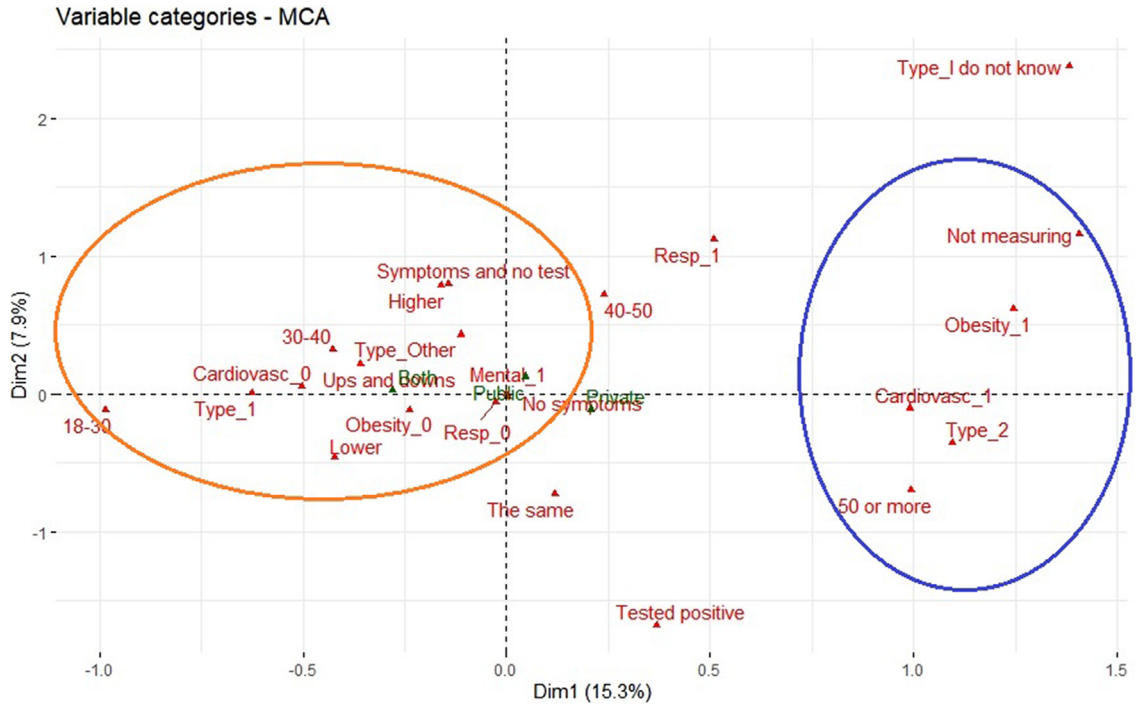

Fig. 1 – MCA for prevalence of cardiovascular diseases, obesity, mental disorders, respiratory diseases, type of diabetes, age (the horizontal axis is a progression of ages of the respondents), symptoms of COVID-19, health system, symptoms (supplementary), and glycemic measurements (supplementary).

cardiovascular conditions, no-obesity and no-respiratory disease categories. They were alarmingly close to the category that, despite having symptoms of COVID-19, had no testing for SARS-CoV-2. Not measuring the blood glucose is close to T2D and unknown diabetes type. T2D, not surprisingly, was more associated than other types with older age, cardiovascular diseases and obesity. It is also worth noting that T2D and older group were the closest to test positive for SARS-CoV-2. In opposition, individuals who had symptoms of COVID-19 and were not tested (125 people or 7.35%) presented higher proximity to increased blood glucose (Fig. 1).

Measuring blood glucose was related with food consumption and working out, as depicted on Fig. 2. Individuals that experienced decrease in blood glucose levels, increased

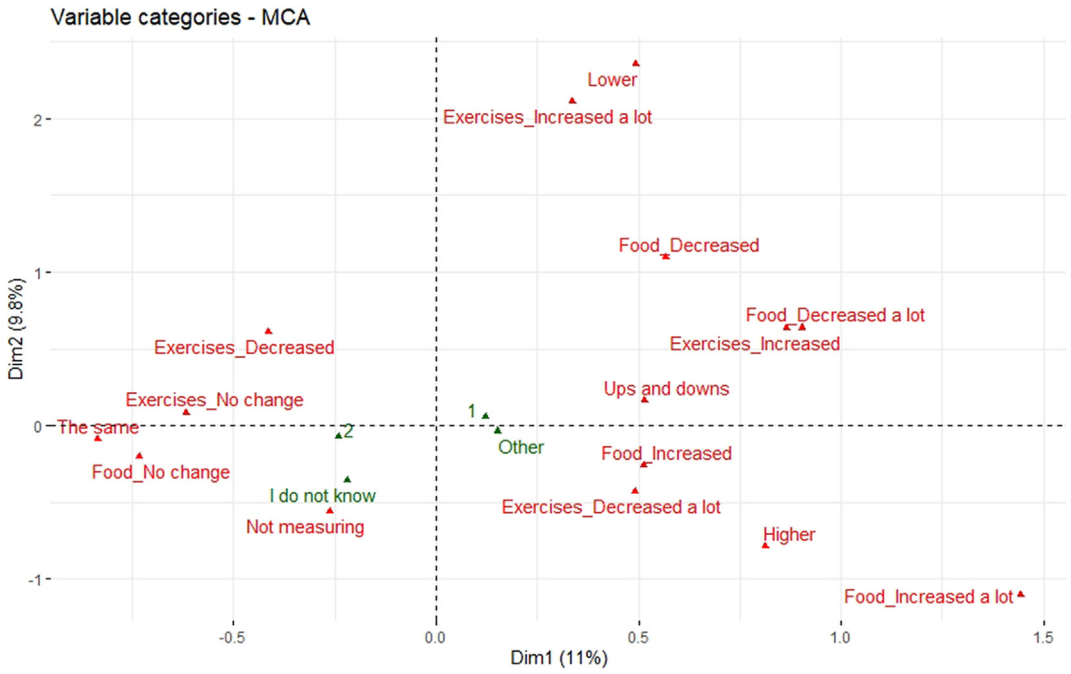

Fig. 2 – MCA for glycemya, food consumption, physical activities, and type of diabetes (supplementary).

physical activity and decreased food consumption. Meanwhile, higher food consumption and reduced physical activity were associated with higher blood glucose levels. While it seems that the pandemic had a higher impact on habits and glycemic levels of T1D individuals (right side of Fig. 2), with significant perceived changes, T2D respondents seem to have maintained most of their habits during this period.

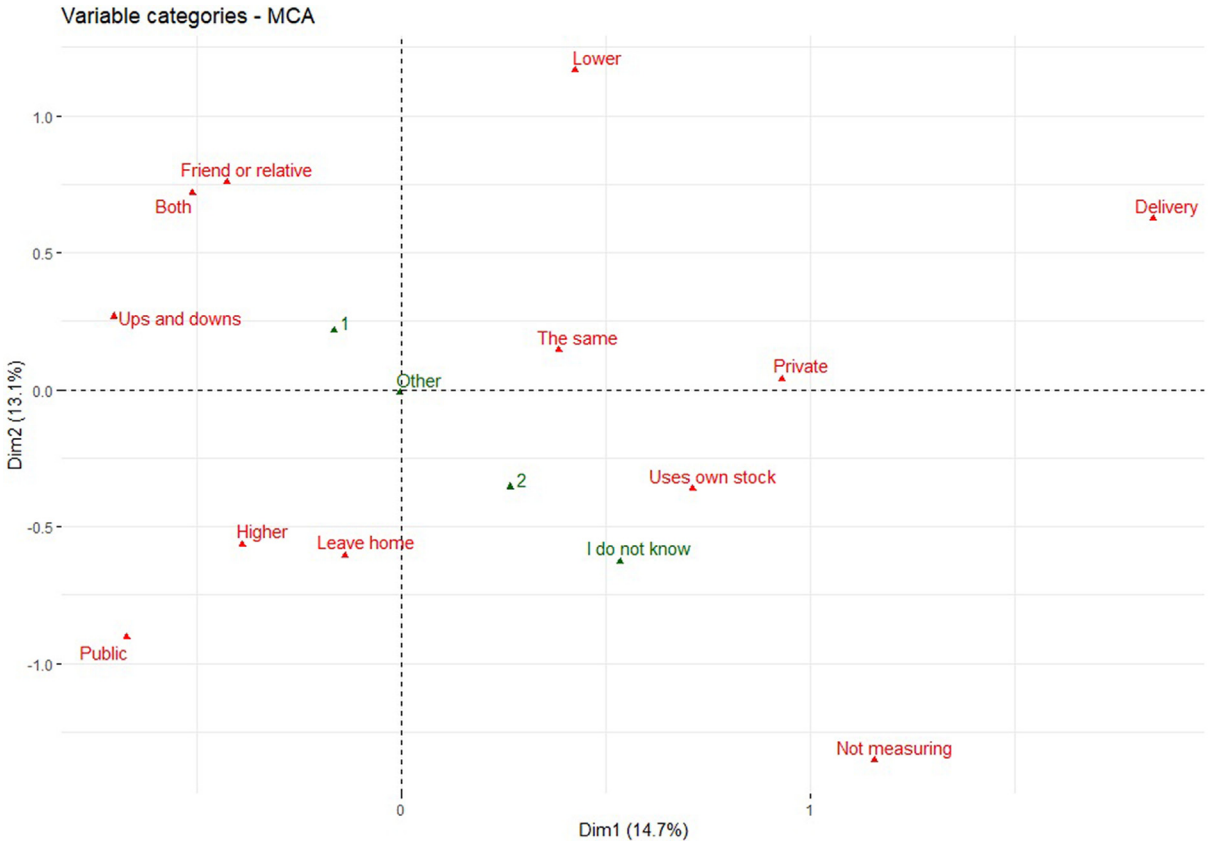

Fig. 3 – MCA for glycemic measures, method for buying/receiving medicine, health system, and type of diabetes (supplementary).

Individuals who exclusively use the Brazilian public health system (Unified Health System - SUS), which serves more than 70% of the Brazilian population [28] (in our case, 28.16% of the respondents), were who kept venturing out during the pandemic and experienced an increase of blood glucose levels, as shown in Fig. 3. T1D individuals were the closest to the use of both health systems (SUS and private) and also experienced higher glycemic variability (ups and downs). They had the ability to have friends or relatives to buy or collect their medicines and medical supplies. Users of the private health system were closer to experience no glycemic changes during the pandemic (the same), and used their own stocks of medicine and medical supplies or ordered for home delivery from private pharmacies (Fig. 3).

4. Discussion

The results above unveil short, mid and long-term risks for individuals with diabetes in Brazil. While the federal government and some states made initial commitments and plans [2], knowing the risks for poor prognosis among individuals living with diabetes and/or other NCDs if infected by SARS-CoV-2, our data revealed that implemented measures did not cover most of this population. The strategy to distribute medicines and medical supplies for 90 days, as recommended by different organizations in order to avoid monthly trips [29,30], were effective for only 21% of the 64.5% who received their medication and supplies from SUS (or 13.5% of the total respondents). This provision of medicines and supplies for 3 months, avoiding the monthly rounds to public primary healthcare facilities or pharmacies, seemed to be one of the only specific policies to protect individuals with diabetes and others NCDs in Brazil [31,32]. Although limited, if working well, this would at least protect them from encountering infected people seeking care. Meanwhile, at municipality level, certain locations successfully implemented alternative strategies, as hailed by one participant from an inland town: "my town adopted a delivery of medicine method for people with chronic diseases".

According to our data, especially individuals who exclusively depended on SUS were at higher risk, venturing out of home more often and experiencing an increase in blood glucose levels (Fig. 3). Differences would not be expected, since Brazil prides itself for its Universal Health Coverage, and most people, including the ones with private insurance, rely on SUS to receive part or all their medicines and supplies. We hypothesise that this finding highlights the socioeconomic inequalities in the country, which exposes the less privileged more often to unsafe environments by forcing them to continue going out to work during the pandemic and/or to access affordable food.

Even though 44.3% of the individuals reported having a family member or friend going monthly to public pharmacies on their behalf to collect medicines and supplies, 49.9% went themselves, perhaps due to lack of direct support. It is important to highlight that family member's or friend's support may reduce but not eliminate the risk of infection, especially if residing in the same location, acting as a potential vehicle of indirect transmission. Another uncomfortable answer came from 5.8% of the individuals who reported halting collection of their medicines and medical supplies and relying on personal stocks, which might not last the entire pandemic period. This situation may place those who avoided leaving their homes during the pandemic in a risky untreated situation, a globally shared concern [15,17,33,34,35].

While it is hard to predict social, economic and health impacts of a pandemic, specialists alert to the consequences of implementing only light measures [4,12,13,36,37,38], but, at the same time, also the harmful consequences of lockdowns, mobility restrictions and social distancing on the prevention and control of diabetes and other NCDs [17,34,39]. Barone et al. [39] reported an association between stricter measures against the pandemic and perceived challenges and fear in the diabetes community in South and Central America, which, when disconnected from information and educational strategies, would increase the pressure on the health systems [37,39].

Although decentralized (defined by states and municipalities) and delayed [1,4,12,13,40], the measures to contain the SARS-CoV-2 spread in Brazil, and reflected on mobility reduction, was experienced by 95.1% of this study's respondents in different degrees (with 26.9% never going outside their homes). Differently from Kluge et al.'s prediction [17], in our case it was not associated with increased consumption of alcohol, tobacco and unhealthy foods. Notwithstanding, physical activity was affected, being reduced for 59.5% of the respondents. Other researchers have also reported physical activity reductions during the pandemic, and alerted for the potential negative consequences on metabolic, cardiovascular and musculoskeletal health [41,42]. They alert that these effects are observed even after short periods of inactivity, are hard to recover and, not only increase premature mortality, but also favor the development of diabetes chronic complications [41,42]. A strategy to minimize those consequences would be developing good channels and partnerships for informing these populations through the internet, TV broadcasting and messaging through mobile phone applications in a structured manner, focusing on preventive measures and maintenance or improvement of habits and behaviors, such as regular physical activity [17,34,41,42,43]. This recommendation is compatible with the present findings where 87.4% of the individuals maintained or increased their time watching TV and 90.7% maintained or increased their time on the internet.

Regarding treatment, the COVID-19 pandemic, as predicted and observed by different authors, is impacting availability and access to healthcare professionals (HCPs) for the routine care of people with diabetes, since many of them relocated to emergency rooms, testing sites, ICUs and other services to attend infected individuals [15,17,33,34,39]. We found that 38.4% postponed their medical appointments and/or examinations. We attributed these results to shortage of HCPs, as expressed by 3 individuals in the comments space of the survey, reporting appointment cancelation or absence of physician; or personal decision because of the fear of getting infected at a hospital or clinic, as identified in other studies [39,35]. The potential consequence of this phenomenon of fear during the pandemic was reported in a pediatric emergency department, in Italy, with reduction and delay in children's arrival, which included cases of severe diabetes ketoacidosis and hypoglycemia [35].

Although online consultation and other telemedicine strategies were not investigated profoundly in the present study, one of the respondents commented that he/she was having online medical appointments. Brazilian laws and regulations became more flexible allowing this type of approach during the COVID-19 pandemic [44]. In alignment with other authors and international organizations, we highly recommend it [15,33,36,45,46,47,48], reinforcing Primary Healthcare's role during the pandemic through ensuring close and timely monitoring of people with diabetes and other NCDs [37,44,49].

The results show that all types of diabetes were close to additional risk factors for poor prognosis of individuals infected by SARS-CoV-2. While T2D and unknown diabetes type (Fig. 1) appear near other NCDs (especially cardiovascular and obesity) [18,24,47,50,51], T1D and other types (LADA, MODY and gestational grouped) presented close proximity to glycemic variability (Fig. 2) [5,15,52]. Therefore, we suggest that none of the types should feel safe. Although, not surprising, T2D was associated with the category "50 years and older" (Fig. 1), reason to be vigilant, since the COVID-19 mortality and severity increase with age [5,24,53]. An unfortunate result was the proximity of individuals reporting increased blood glucose levels and the presence of COVID-19 symptoms without testing (Fig. 1). The global shortage of tests for SARS-CoV-2 poses a grand challenge [2–4], however, cognizant that high blood glucose increases the risk for infection severity and death [15,19,20,21,22,23], early testing efforts must be prioritized in this group. In addition, supporting the intensification of diabetes self-care practices to quickly bring individuals' glycemia back on track must be prioritized [45,51,54]. Fig. 2 depicts the importance of balancing food and exercise, since individuals who increased or decreased any of them experienced changes in their blood glucose levels, whereas those able to maintain exercise and food consumption avoided glycemic changes.

While the present study focused only on diabetes, WHO's data show that other NCDs serviced in similar health systems and pandemic environment are facing comparable challenges [55]. In terms of unattended needs of individuals with diabetes during this COVID-19 crisis, Brazil is not the only country with unaddressed demands. In a collection of testimonials from people with diabetes in different countries, the International Diabetes Federation exposed some similar issues whilst others different from the Brazilian context [56]. While the absence of specific measures to protect those with diabetes was reported in Greece and Spain, access to medicines was a challenge in Zimbabwe, Iran and India [56]. However, countries like Argentina, Italy, Portugal, and South Korea seemed to have adopted measures that made people with diabetes feel safer [48,56]. It is urgent for Brazil to follow international best practices and recommendations, since, as stated by the WHO Regional Office for Europe, "the prevention and control of NCDs have a crucial role in the COVID-19 response and an adaptive response is required to account for the needs of people with NCDs" [17].

The limitations of the present study include the fact that, although efforts were made to disseminate the survey as much as possible, its sample neither reflects the proportion of Brazilian population nor its fraction with diabetes. Thus, it is a convenience sample, without post-stratification weights. Questions about behaviors, habits and glycemic changes were subjective comparisons with the pre-pandemic state, therefore, we did not have access to objective data to validate the subjective responses. As an online survey, it is biased by individuals who have internet access. While 17% of the Brazilian population have a college degree [57] and 27.9% have private health insurance [28], among the respondents of the present survey, 51.8% had at least one college degree and only 28.2% exclusively access care services through SUS.

Other demographic limitations are related to the age groups distribution, younger than the general population with the great majority of the respondents from Sao Paulo state, which would be about 20% of the country, not 42.6% as in our group of respondents. We understand that one of the main factors leading to this bias is the network in which the authors are engaged, the geographic location of diabetes associations and the profile of their active members; tendency to have more individuals with T1D than T2D, mostly young and highly educated. An additional limitation is the number of choices for each question and the aggregation made for analysis purposes. This includes the fact that if separated, diseases aggregated in the Cardiovascular Disease group, for example, could behave differently in terms of proximity to other factors. Moreover, increase or decrease of the blood glucose, interpreted as distancing from the target, would in fact have led the glycemia to target, while the ones who successfully maintained the blood glucose in pre-pandemic levels, may have kept it out of target.

5. Conclusion

As revealed for the first time in the current study, individuals with diabetes were not spared by the COVID-19 pandemic in Brazil. Measures and adjustments lacked or were insufficient, paving the way to unhealthy and unsafe behaviors such as postponing medical appointments, reducing physical activity and refraining from collecting medicines and supplies, which led to a high percentage of glycemic worsen reports. Additionally, announced measures for prevention and mitigation of COVID-19 consequences on this population, such as supply of medicines for 3 months, worked just for a minority.

In conclusion, we see a pressing need from the Brazilian federal, states and municipal authorities to broaden the implemented measures in order to reach more people, and partner with civil society, private sector and media channels to quickly improve the response and, this way, prevent a surge of individuals with diabetes infected by SARS-CoV-2 and of acute and chronic diabetes complications. Measures to keep individuals healthy, ensuring their glycemia is on target and allowing them to stay at home as much as possible must be prioritized. We recommend that the public and the private health systems maintain, adapt and strengthen programs for the continuity of care of individuals with diabetes and other NCDs, and develop information and educational campaigns on how to access these programs. In addition to focusing on reducing the risk of infection and continuity of their healthcare, these measures should facilitate access to healthcare professionals' counseling for therapeutic adjustment.

Finally, as key measures we foresee are a) active monitoring, informing, educating and responding to communities' needs at primary healthcare level; b) high quality telehealth for consultations, monitoring and examining; c) distribution of medications and supplies for three or more months, ideally with home delivery; and d) home sampling for scheduled lab exams, using mobile point-of-care strategies or appointment in specific facilities with well established disinfection protocols. Consequently, we believe that the pandemic's challenges can be lessened if appropriate measures protecting individuals with diabetes and other chronic conditions are adopted, and investments are not solely directed to purchasing mechanical ventilators and equipping tertiary care.

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