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Supplies for Type 1 Diabetes management during COVID-19 social distancing in Brazil

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Abstract

This study analyzed socioeconomic factors related with the acquisition of supplies for blood glucose management by people with Type 1 Diabetes Mellitus during social distancing due to the COVID-19 Pandemic in Brazil. This was a cross-sectional study with data collected during 21 days in July 2020, by an online form on socioeconomic data and acquisition of supplies for glycemic monitoring. This research applied Pearson's Chi-Squared test with adjusted residual analysis ($p<0.05$). 472 adults of both sexes participated. Relationships were found between the type of device used for blood glucose monitoring (glucometer or Flash system) and income ($p<0.000$), education ($p=0.007$), macro-regions ($p=0.049$), and type of city ($p=0.043$); between insulin acquisition and income ($p<0.000$), macro-region ($p=0.027$) and type of neighborhood ($p=0.003$); between acquisition of reagent strips and income ($p<0.000$); between acquisition of lancets and income ($p=0.001$), type of city ($p=0.035$) and neighborhood ($p=0.010$); between the use of Flash System and income ($p<0.000$) and type of neighborhood ($p=0.006$). The results expose the social inequalities in the acquisition of supplies for blood glucose management by people with Type 1 Diabetes during the Pandemic in Brazil.

Keywords: Type 1 Diabetes Mellitus. Pandemics. Blood glucose self-monitoring. Insulin. Social isolation.

INTRODUCTION

During the pandemic caused by SARS-CoV-2 (COVID-19), it was observed that higher levels of glycated hemoglobin (>10%) were related with a higher risk of death from COVID-19 in people with Type 1 Diabetes Mellitus (T1DM) and 2 (T2DM)[1]. T1DM is an autoimmune disease, originated from the progressive destruction of pancreatic β cells, causing deficiency and even total incapacity of insulin production by the pancreas[2]. Thus, the person with T1DM needs to have self-care procedures that are part of their treatment. Therefore, they need to develop habits to manage diabetes, which includes having a healthy diet, performing physical activity regularly, applying multiple doses of exogenous insulin per day, and self-monitoring their blood glucose frequently with the aim of maintaining good glycemic control. Such self-monitoring procedure requires the acquisition of specific supplies[2].

It is noteworthy that in Brazil, a law regulates the supply by the Unified Health System (UHS) of supplies necessary for the treatment of Diabetes[3] of people who are registered in the UHS care programs. Among the supplies

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that can be provided, insulin, syringes with needles, reagent strips and lancets are included, therefore being a right for people with diabetes. Supplies are at the discretion of the frequency of glycemic monitoring and insulin prescription conducted by the health team[4]. However, when there are delays in the supply by Primary Health Care (PHC), patients may need to buy them with their own resources, under penalty of having their treatment harmed.

In a study on the impact of the COVID-19 pandemic on the Brazilian population with diabetes, it was concluded that treatment adjustments were absent or insufficient at the beginning of the pandemic, which compromised treatment adherence through behaviors such as abstaining from collection of supplies for glycemic and insulin monitoring and/or prescribed medications, with the consequence of worsening glycemic control[5]. However, studies on the impact of social distancing measures on adherence to self-monitoring and insulin application by people with T1DM are still scarce.

It is possible that an unfavorable socioeconomic situation or even the difficulty of acquiring the necessary supplies in PHC during social distancing may impair self-care monitoring procedures that are so important for the treatment of people with T1DM. In this sense, it is extremely important to investigate access to supplies for managing blood glucose during social distancing, as well as understanding the conditions related to the acquisition of these supplies. The present study aimed to analyze the socioeconomic factors related with the acquisition of supplies for blood glucose management by people with T1DM in the period of social distancing due to COVID-19 in Brazil.

METHODS

This was a cross-sectional, descriptive, and analytical study, with a convenience sample, carried out after approval by the Ethics Committee (Opinion letter 4.047.909), according to resolutions nº 466/2012[6] and 510/2016[7].

As a result of the social distancing measures necessary due to the COVID-19 pandemic, the survey was carried out through an online form, created on the Google Forms® platform, which was disseminated through social networks (Facebook®, Instagram® and WhatsApp®) through an invitation containing the link to fill out the form. It was initially published on the social networks of an Extension Project in Diabetes linked to a public university, located in the capital of the state of Pará, in Brazil. By clicking on the link, the participants had access to the Informed Consent Form (ICF), making it possible to read, download and print the document. The form was available for completion for 21 days in July 2020, a period in which social distancing measures were in place in all Brazilian states.

The inclusion criteria were: having a diagnosis of T1DM, being 18 years of age or older, and accepting to participate in the research by selecting the option "I have read the ICF, and I accept to participate in the research" available on the platform before the questions. Then, at the beginning of the questionnaire, the participants had to choose their condition, with the options: being an adult and having a diagnosis of T1DM, not having diabetes, having other types of diabetes, being a child or adolescent with T1DM, and being a caregiver. If the selection did not correspond to the audience of adults with T1DM, the survey was automatically terminated. Therefore, those who marked an alternative different from the inclusion criteria were excluded, as well

as people who did not complete the research or did not agree with the informed consent, option "I do not accept to participate in the research". Participation was voluntary and anonymous.

The questionnaire was developed by researchers based on the pillars of T1DM treatment according to the Guidelines of the Brazilian Society of Diabetes[2], in addition to sociodemographic information. The questions were divided into the following axes:

a. Socioeconomic and demographic data: sex; age; schooling; family income in minimum wage (MW = R$ 1,045); macro-region of Brazil (North, Northeast, Midwest, Southeast and South); type of city (capital, metropolitan or rural area); type of neighborhood (slums, periphery, middle class, upper class and rural area, the option "none of the above" was removed from the results, as it meant not knowing how to inform).

b. Blood glucose monitoring: which device you used to monitor blood glucose (glucometer, Flash Glucose Monitoring System [FGM], both or do not monitor).

c. Acquisition of supplies: how you acquired the supplies (insulin, reagent strips, lancets and FGM device) for the treatment of T1DM in the last 30 days (through UHS; purchase with own resources; donation; did not need to acquire; could not acquire; other; or does not use this supply).

The software Statistical Package for the Social Sciences (SPSS) version 21 was used, the descriptive results were expressed as mean, standard deviation, absolute frequency and proportion. For analytical statistics, Pearson's Chi-Square test was applied with adjusted residuals analysis (statistical significance level of $p<0.05$).

RESULTS

A total of 472 adults participated in the study, the mean age was 30.24 years (± 9.75), most were female (86.0%), lived in the Southeast macro-region (47.0%) and 52.97 % had completed higher education or was in progress.

Regarding monthly family income, 32.42% received from 3 to 5 MW, 28.39% earned from 1 to 2 MW and only 4.03% lived on less than 1 MW. A minority (3.6%) had an income above 20 MW. Regarding the device used for blood glucose monitoring, 72.9% used only the glucometer, 22.5% used FGM and glucometer, 3.8% used only FGM and only 0.8% reported not performing blood glucose monitoring.

Regarding the purchase of insulin and supplies to monitor capillary blood glucose, 59.1% reported having obtained insulin through the UHS, 32.4% bought it with their own resources and only 2.5% did not need to purchase insulin during this period. Among the participants who used a glucometer, 61.9% obtained the reagent strips and 46.9% had access to the lancets through the UHS, 26.8% and 31.8% needed to buy strips and lancets, respectively. The others obtained through other means, such as donations or exchanges, or did not need to acquire during this period.

Regarding family income and the type of device used for blood glucose monitoring, a relationship was observed between having an income lower than 1 MW and not monitoring blood glucose; receive from 1 to 5 MW and use the glucometer and have an income above 5 to 20 MW and use the FGM together with the glucometer. However, there was an inverse relationship between receiving from 1 to 5 MW and using the FGM together with the glucometer and having an income above 5 to

20 MW and using the glucometer (p<0.000) (Table 1).

Regarding the level of education, there was a relationship between having elementary school and using the FGM, having high school and using the glucometer, having technical education and not monitoring blood glucose, and having a graduate degree and using the FGM together with the glucometer to glycemic monitoring. There was an inverse relationship between having high school and using the FGM together with the glucometer and having a graduate degree and using only the glucometer (p=0.007) (Table 1).

There was an inverse relationship between living in the North region and using FGM together with a glucometer (p=0.049). Regarding the type of city in which the participant lived, living in capital cities was inversely related with using the glucometer and directly related with using the FGM, while living in an interior city was related with using a glucometer and inversely related with using the FGM (p=0.043) (Table 1).

Table 1 – Relationship between socioeconomic and demographic data with a glucose monitoring device in adults with type 1 Diabetes Mellitus during social isolation in Brazil, 2020.

	Glucometer (n/%)	FGM* (n/%)	FGM and glucometer (n/%)	No blood glucose monitoring (n/%)	p-value**
Family income* **					
<1	16 (3.4)	0	2 (0.4)	1 (0.2) (+)	
1 - 2	118 (25.0) (+)	1 (0.2) (-)	14 (3.0) (-)	1 (0.2)	
3 - ≤5	125 (26.5) (+)	5 (1.1)	22 (4.7) (-)	1 (0.2)	**<0.000 †**
>5 - ≤10	57 (12.1) (-)	7 (1.5)	38 (8.1) (+)	1 (0.2)	
>10 - ≤20	19 (4.0) (-)	4 (0.8)	23 (4.9) (+)	0	
>20	9 (1.9)	1 (0.2)	7 (1.5)	0	
Education					
Elementary School	3 (0.6)	1 (0.2) (+)	0	0	
High School	21 (4.5) (+)	0	0 (-)	0	
Technical education	54 (11.7)	0	9 (1.9)	2 (0.4) (+)	**0.007 †**
University education	100 (21.6)	7 (1.5)	27 (5.8)	1 (0.2)	
Postgraduate studies	162 (35.1) (-)	10 (2.2)	64 (13.9) (+)	1 (0.2)	
Macro-region					
North	27 (5.7)	3 (0.6)	2 (0.4) (-)	1 (0.2)	
Northeast	75 (15.9)	0	21 (4.4)	1 (0.2)	**0.049 †**
Midwest	24 (5.1)	0	13 (2.8)	0	
Southeast	164 (34.7)	10 (2.1)	47 (10.0)	1 (0.2)	
South	54 (11.4)	5 (1.1)	23 (4.9)	1 (0.2)	
Neighborhood Type					
Slums	10 (2.1)	0	0	0	
Periphery	65 (13.8)	1 (0.2)	12 (2.5)	1 (0.2)	
Middle class	188 (39.8)	11 (2.3)	58 (12.3)	3 (0.6)	**0.083**
Upper class	41 (8.)	4 (0.8)	28 (5.9)	0	
Rural area	17 (3.6)	1 (0.2)	2 (0.4)	0	

*Flash Glucose Monitoring System (FGM); **Chi-square test; ***Minimum Wage= R$1,045.00; † Significant statistics; Residual analysis: (+) Significant relationship (-) Significant negative relationship. Note: data referring to participants who marked "None of the options" were removed.

Table 2 – Relationship between socioeconomic and demographic data with insulin acquisition by adults with type 1 Diabetes Mellitus during social isolation in Brazil, 2020.

	Acquisition of insulin (n/%)					
	From UHS	Own resources	Donation	No need to acquire	Could not acquire	p-value*
Family income (MW)**						
< 1	12 (2.5)	5 (1.1)	2 (0.4)(+)	0	0	
1 to 2	90 (19.1)(+)	29 (6.1)(-)	3 (0.6)	7 (1.5)(+)	1 (0.2)	
3 to ≤ 5	94 (19.9)	47 (10)	4 (0.8)	2 (0.4)	0	
> 5 to ≤ 10	66 (14)	32 (6.8)	2 (0.4)	2 (0.4)	0	**<0.000†**
> 10 to ≤ 20	15 (3.2)(-)	27 (5.7) (+)	2 (0.4)	0	0	
> 20	2 (0.4)(-)	13 (2.8) (+)	0	1 (0.2)	0	
Macro-region						
North	22 (4.7)	7 (1.5)	0	2 (0.4)	1 (0.2)(+)	
Northeast	59 (12.5)	31 (6.6)	2 (0.4)	3 (0.6)	0	
Midwest	24 (5.1)	9 (1.7)	3 (0.6)(+)	0	0	**0.027 †**
Southeast	119 (25.2)(-)	83 (17.6)(+)	8 (1.7)	4 (0.8)	0	
South	55 (11.7)	24 (5.1)	0	3 (0.6)	0	
City type						
Capital	109 (23.1)	61 (12.9)	8 (1.7)	7 (1.5)	0	
Metropolitan region	68 (14.)	31 (6.6)	2 (0.4)	1 (0.2)	0	**0.261**
State interior	102 (21.6)	61 (12.9)	3 (0.6)	4 (0.8)	1 (0.2)	
Neighborhood type						
Slums	5 (1.1)	4 (0.8)	1 (0.2)	0	0	
Periphery	48 (10.2)	23 (4.9)	2 (0.4)	3 (0.6)	0	
Middle class	159 (33.7)	81 (17.2)	7 (1.5)	6 (1.3)	0	**0.003 †**
Upper class	35 (7.4)(-)	36 (7.6)(+)	0	1 (0.2)	0	
Rural area	11 (2.3)	6 (1.3)	0	2 (0.4)(+)	0	

*Chi-square test; **Minimum wage = R$1,045.00; † Significant statistics; Residual analysis: (+) Significant relationship (-) Significant negative relationship. Note: data referring to participants who marked "None of the options" were removed.

Table 3 – Acquisition of reagent strips by patients with type 1 Diabetes Mellitus in relation to socioeconomic and demographic aspects during the coronavirus pandemic in Brazil, 2020.

	Reagent strips acquisition (n/%)						
	From UHS	Own resources	Donation	No need to acquire	Could not acquire	No use	p-value*
Family income (MW)**							
< 1	7 (1.5) (-)	5 (1.1)	3 (0.6) (+)	0	2 (0.4) (+)	1 (0.2)	
1 to 2	90 (19.3)	28 (6)	5 (1.1)	6 (1.3)	1 (0.2)	0	
3 to ≤ 5	108 (23.1) (+)	32 (6.9) (-)	5 (1.1)	1 (0.2)	2 (0.4)	2 (0.4)	**<0.000†**
> 5 to ≤ 10	63 (13.5)	28 (6)	3 (0.6)	3 (0.6)	2 (0.4)	0	
> 10 to ≤ 20	18 (3.9) (-)	21 (4.5) (+)	3 (0.6)	2 (0.4)	0	1 (0.2)	
> 20	3 (0.6) (-)	11 (2.4) (+)	0	0	0	1 (0.2) (+)	
Macro-region							
North	16 (3.4)	11 (2.4)	1 (0.2)	1 (0.2)	1 (0.2)	2 (0.4)	
Northeast	47 (10.1)	36 (7.7)	6 (1.3)	3 (0.6)	2 (0.4)	1 (0.2)	
Midwest	22 (4.7)	10 (2.1)	1 (0.2)	1 (0.2)	0	0	**0.16**
Southeast	147 (31.5)	50 (10.7)	10 (2.1)	4 (0.9)	4 (0.9)	1 (0.2)	
South	57 (12.2)	18 (3.9)	1 (0.2)	3 (0.6)	0	1 (0.2)	
City type							
Capital	111 (23.8)	49 (10.5)	14 (3)	5 (1.1)	1 (0.2)	2 (0.4)	
Metropolitan region	74 (15.8)	24 (5.1)	1 (0.2)	2 (0.4)	2 (0.4)	1 (0.2)	**0.242**
State interior	104 (22.3)	52 (11.1)	4 (0.9)	5 (1.1)	4 (0.9)	2 (0.4)	
Neighborhood type							
Slums	8 (1.7)	2 (0.4)	0	0	0	0	
Periphery	57 (12.2)	15 (3.2)	3 (0.6)	1 (0.2)	1 (0.2)	0	
Middle class	163 (34.9)	66 (14.1)	11 (2.4)	6 (1.3)	5 (1.1)	3 (0.6)	
Upper class	35 (7.5)	30 (6.4)	2 (0.4)	3 (0.6)	0	1 (0.2)	**0.242**
Rural area	7 (1.5)	9 (1.9)	0	1 (0.2)	0	1 (0.2)	

* Chi-square test; **Minimum Wage = R$1,045.00; † Significant statistics; Residual analysis: (+) Significant relationship (-) Significant negative relationship. Note: data referring to participants who marked "None of the options" were removed.

Table 4 – Acquisition of lancets by patients with type 1 Diabetes Mellitus in relation to socioeconomic and demographic aspects during the coronavirus pandemic in Brazil, 2020.

	Lancets acquisition					
	From UHS	Own resources	Donation	No need to acquire	Could not acquire	p-value*
Family income (MW)**						
< 1	7 (1.5)	5 (1.1)	2 (0.4)	1 (0.2)	1 (0.2) (+)	**0.001 †**
1 to 2	78 (16.8) (+)	28 (6) (-)	9 (1.9)	11 (2.4)	0	
3 to ≤ 5	73 (15.7)	46 (9.9)	8 (1.7)	15 (3.2)	1 (0.2)	
> 5 to ≤ 10	44 (9.5)	35 (7.5)	3 (0.6)	17 (3.7) (+)	0	
> 10 to ≤ 20	14 (3) (-)	23 (4.9) (+)	3 (0.6)	4 (0.9)	0	
> 20	2 (0.4) (-)	11 (2.4) (+)	1 (0.2)	1 (0.2)	0	
Macro-region						
North	17 (3.7)	11 (2.4)	0	2 (0.4)	0	**0.116**
Northeast	40 (8.6)	37 (8)	6 (1.3)	10 (2.2)	2 (0.4)	
Midwest	14 (3)	15 (3.2)	1 (0.2)	2 (0.4)	4 (0.9)	
Southeast	106 (22.8)	60 (12.9)	17 (3.7)	25 (5.4)	9 (1.9)	
South	41 (8.8)	25 (5.4)	2 (0.4)	10 (2.2)	0	
City type						
Capital	89 (19.1)	52 (11.2)	15 (3.2)	25 (5.4)	1 (0.2) (-)	**0.035 †**
Metropolitan region	57 (12.3)	29 (6.2)	4 (0.9)	7 (1.5)	4 (0.9)	
State interior	72 (15.5) (-)	67 (14.4) (+)	7 (1.5)	17 (3.7)	10 (2.2) (+)	
Neighborhood type						
Slums	7 (1.5)	2 (0.4)	1 (0.2)	0	0	**0.01 †**
Periphery	46 (9.9) (+)	15 (3.2) (-)	5 (1.1)	8 (1.7)	4 (0.9)	
Middle class	121 (26)	81 (17.4)	13 (2.8)	29 (6.2)	6 (1.3)	
Upper class	25 (5.4) (-)	35 (7.5) (+)	2 (0.4)	8 (1.7)	2 (0.2)	
Rural area	4 (0.9) (-)	8 (1.7)	0	3 (0.6)	3 (0.6) (+)	

*Chi-square test; **Minimum Wage = R$1,045.00; † Significant statistics; Residual analysis: (+) Significant relationship (-) Significant negative relationship. Note: data referring to participants who marked "None of the options" were removed.

Table 5 – Acquisition of Flash Glucose Monitoring System by patients with type 1 Diabetes Mellitus in relation to socioeconomic and demographic aspects during the coronavirus pandemic in Brazil, 2020.

	Acquisition of Flash Glucose Monitoring System							
	Do not use	From UHS	Own resources	Donation	No need to acquire	Could not acquire	No use	p-value*
Family income (MW)**								
< 1	1 (0.2)	0	1 (0.3)	1 (0.3)	0	0	13 (3.5)(+)	
1 to 2	1 (0.2)	7 (1.9)	13 (3.5)(-)	3 (0.8)	0	1 (0.3)	77 (20.6)(+)	
3 to ≤ 5	2 (0.4)	9 (2.4)	17 (4.6)(-)	2 (0.5)	1 (0.3)	3 (0.8)	75 (20.1)(+)	
>5 to ≤ 10	1 (0.2)	10 (2.7)	37 (9.9)	5 (1.3)	2 (0.5)	0	28 (7.5)	**<0.000†**
>10 to ≤ 20	1 (0.2)	0	23 (6.2)(+)	2 (0.5)	1 (0.3)	0	17 (4.6)(-)	
> 20	1 (0.2)	0	6 (1.6)	1 (0.3)	0	0	6 (1.6)	
Macro-region								
North	2 (2.4)	1 (0.3)	5 (1.3)	0	0	0	15 (4)	
Northeast	1 (0.2)	5 (1.3)	12 (3.2)	3 (0.8)	0	0	54 (14.5)	
Midwest	0	0	13 (3.5)	3 (0.8)	0	0	11 (2.9)	**0.164**
Southeast	2 (0.4)	17 (4.6)	41 (11)	5 (1.3)	3 (0.8)	3 (0.8)	99 (26.5)	
South	2 (0.4)	3 (0.8)	26 (7)	3 (0.8)	1 (0.3)	1 (0.3)	37 (9.9)	
City type								
Capital	3 (0.6)	11 (2.9)	46 (12.3)	8 (2.1)	2 (0.5)	1 (0.3)	84 (22.5)	
Metropolitan region	2 (0.4)	6 (1.6)	19 (5.1)	4 (1.1)	2 (0.5)	2 (0.5)	54 (14.5)	**0.206**
State interior	2 (0.4)	9 (2.4)	32 (8.6)	2 (0.5)	0	1 (0.3)	78 (20.9)	
Neighborhood type								
Slums	0	0	0	0	0	0	8 (2.1)(+)	
Periphery	0	5 (1.3)	5 (1.3) (-)	4 (1.1)	0	0	38 (10,2)	
Middle class	4 (0.9)	15 (4)	61 (16.4)	3 (0.8)	2 (0.5)	2 (0.5)	121 (32.4)	
Upper class	2 (0.4)	5 (1.3)	22 (5.9)(+)	3 (0.8)	2 (0.5)	2 (0.5)	26 (7)(-)	**0.006†**
Rural area	1 (0.2)	1 (0.3)	4 (1.1)	1 (0.3)	0	0	7 (1.9)	

*Chi-square test; **Minimum Wage = R$1,045.00; † Significant statistics; Residual analysis: (+) Significant relationship (-) Significant negative relationship. Note: data referring to participants who marked "None of the options" were removed.

DISCUSSION

The present study analyzed the socioeconomic factors related with the acquisition of supplies necessary for blood glucose monitoring by people with T1DM during the period of social distancing due to COVID-19 in Brazil. Most of the participants reported using the UHS to acquire the necessary supplies for the treatment. Barone *et al.*[5], when studying the impact of the pandemic on people with T1DM and T2DM in Brazil, found that 28.16% of the participants used the UHS exclusively and 33.22% used both the private system and the UHS, subjects with T1DM being those who most used the combination of public and private health systems. In the study by Gomes *et al.*[8], carried out with 1760 people with T1DM in Brazil, 69.7% of them used the UHS exclusively for the treatment of diabetes. Reis *et al.*[9] studied self-care and treatment repercussions in the daily lives of individuals with diabetes.

They reported that despite the free provision of supplies by the government, in practice there is no effective guarantee that all DM patients have access to the supply of these materials, since the quantity is insufficient to meet the demands of patients in relation to the blood glucose management. Lima *et al.*[10] also found in their results that the interviewees had difficulties in their treatment due to the lack of supplies and medicines, thus having to buy the supplies at their own cost. Therefore, it is suggested that people with T1DM seek the UHS mainly for the acquisition of necessary supplies in the treatment.

This study showed that lower income levels were related with not having blood glucose monitoring or using only a glucometer. Even though capillary blood glucose monitoring is a more affordable method, compared to new technologies, the maintenance cost for using a glucometer is still high and, in the absence of efficient supply strategies, it is impossible to reach recommended levels for self-monitoring of blood glucose by low-income people[11].

Currently, it is known that having higher levels of income and education are related with better glycemic control[12]. A study carried out in Ethiopia showed that only 38.3% of people with diabetes had their own glucometer and having a glucometer was related with higher income and education[13]. It was also observed that higher levels of income and education were related with using a glucometer combined with the FGM. According to the Brazilian Society of Diabetes[2], even when using the FGM, it is recommended that the individual has the glucometer and uses it when he suspects that the information shown is not in accordance with reality, or to calibrate the system when necessary.

Therefore, one hypothesis is that the participants of this study did not use the glucometer or did not carry out glycemic monitoring due to lack of knowledge about the right to receive supplies from the UHS or, even, it is possible that there was no regular supply of these supplies by the government during the period of the study. Santos *et al.*[14] highlight the importance of information and knowledge for people with diabetes about their rights, so they can plead in court for the supply of such materials for the management of the disease.

It was observed that having lower income was related with receiving insulin and reagent strips by donation, and participants with better financial status had greater access to supplies, through the UHS or with their own resources. No studies were found on the acquisition of supplies for blood glucose monitoring in Brazil during the pandemic, however, every patient with diabetes is entitled to periodically receive such materials through the UHS[3,4]. However, even before the pandemic, there were already inconsistencies in this supply[14–16], which tends to harm the treatment of these individuals and leads many to file lawsuits to ensure adequate receipt.

In a study that analyzed the procedural elements and the individual lawsuits filed by users with DM for the supply of medicines, supplies or materials, it was observed that 71.9% of the lawsuits were requested by medical prescription from private clinics, obtaining[17] lawsuits for materials and supplies related to glycemic self-monitoring, such as reagent strips, lancets and glucometer[14]. Therefore, it is possible that, in the present study, participants with an income of 3 to 5 MW had greater knowledge about their rights and, therefore, ended up getting more supplies through the state, compared to participants with income less than 1 MW, which was related with receiving by donation.

It is known that higher socioeconomic levels are related with higher expenses with diabetes, including materials needed for blood glucose monitoring[17], and that lower levels are related to worse glycemic control[12]. The

average expenditure of Brazilians with medicines in general increases as their income increases, suggesting the availability of more own resources and treatment possibilities[18]. Similar results were found in the Health Satellite Account (2010 – 2017)[19], which indicated that in 2017 Brazilian families spent 12 times more than the government on medicines that are freely distributed. These expenses corresponded to 30% of the health expenses of Brazilian families. Among the poorest, total expenditures were lower, however, the commitment of income was greater, indicating the difficulties of these families in maintaining their subsistence[20]. Moreover, the lower-income population in Brazil is the one that most uses the public supply of medicines[21].

During the COVID-19 pandemic, studies have identified problems in accessing reagent strips and insulin[22,23]. Odeh *et al.*[22], with 229 families of children and adolescents with T1DM in Jordan, found that the lockdown had an impact on the delivery and availability of medicines. Most of the families studied depended on health insurance to receive insulin and almost two-thirds of them had to purchase it with their own financial resources, which led to a rationing of doses by 14% of the sample. Nevertheless, 43.5% of the families reported having rationed reagent strips, and of these, 75.5% had hypoglycemia and hyperglycemia after rationing.

When there is no supply of supplies by the UHS on a regular basis, treatment expenses increase for families, as diabetes care demands a large part of their income[24] and, to save money, individuals with low purchasing power usually use supplies inappropriately, such as performing glycemic self-monitoring at a lower frequency than recommended, reusing disposable products such as lancets, and reducing insulin doses, which can impact glycemic control and the development of micro and macrovascular complications[17].

It was observed that residing in the Southeast region was inversely related with acquiring insulin through the UHS and living in the North region was related with not being able to acquire insulin. These results demonstrate the existing socioeconomic inequalities between Brazilian regions, knowing that the highest per capita household incomes are found in São Paulo (R$ 1,946.00) and Rio de Janeiro (R$ 1,882.00) - located in the Southeast region, making it easier to purchase supplies with their own resources when compared to the Northeast and North regions, which have the lowest per capita household incomes in the country[25].

In this study, living in neighborhoods in rural areas and state interior cities was related with greater difficulty in accessing supplies and not acquiring them through the UHS. The relationship between living in a rural area and not having received supplies from the UHS indicates a spatial inequality that may reflect on the health of these individuals. The distance, time and cost of travel are factors that can make access to healthcare difficult[26]. Because the survey results also indicate that those who lived in rural areas did not need to purchase these supplies in the 30 days prior to the survey, and they do not show a relationship between living in rural areas and other complementary methods of acquisition (purchases and donations, for example), the hypothesis is suggested that there would be a possibility for these participants to stock up on some supplies due to more difficult access.

The environment and its disparities have been studied to explain the influences on the behavior and health of individuals, since the impact of these socioeconomic and spatial differences on the health of the population is recognized[27]. These environmental inequalities, in this study, demonstrated in the difficulties of acquiring supplies by people in rural areas, or in certain regions of the country, are

potentiated by socioeconomic characteristics, such as income, already discussed above. The importance of correlating the social, environmental and economic aspects of health is highlighted, in order to develop policies that seek to intervene in these inequalities.

No other studies were found that evaluated relationships related to the acquisition of lancets and the type of city, however, Verma *et al.*[23] pointed out that the restriction of transport due to the lockdown was one of the main factors for the unavailability of insulin in rural areas and semi-urban areas of India during the COVID-19 pandemic, which exposes the difficulty of accessing these areas.

Furthermore, living in upper-class neighborhoods was related with buying insulin with one's own resources. In this sense, it is suggested that individuals who live in upper-class neighborhoods purchase supplies on their own and choose not to depend on the UHS. The use of FGM was also related with having better socioeconomic conditions. Caruso *et al.*[28] found that adults with T1DM who used the FGM had a reduction in hypoglycemia episodes and less glycemic variability when comparing the data for the first two weeks of February 2020 and the lockdown period in Italy. The benefits of using this system by people with T1DM who use multiple doses of insulin per day have already been described in the literature[29], however, one should pay attention to the access to this supply, since the acquisition and maintenance costs can be a barrier to the use of this system.

Understanding the importance of maintaining social distancing measures to limit the negative effects of the pandemic, it is known that economic problems will remain for a period post-pandemic. To minimize impacts, policies are needed that increase public spending and invest in health care, especially among the most vulnerable[30].

It is important to highlight that the present study has as limitations: the online format, which excluded individuals who do not have regular access to electronic media or the internet, as well as the difficulty in reaching a representative sample of all Brazilian macro-regions. However, this is a pioneering study that characterizes the acquisition of supplies by people with T1DM in Brazil during the COVID-19 pandemic, a challenging public health period[30], and can help in the planning of public policies that enhance adherence to treatment during and after the COVID-19 pandemic.

CONCLUSION

The results of the present study expose the economic and social inequalities in the acquisition of supplies for blood glucose monitoring by adults with T1DM during the COVID-19 pandemic in Brazil, since relationships were observed between the device used for blood glucose monitoring (glucometer or system Flash) and income, education, macro-regions, and type of city. Furthermore, there was a relationship between insulin acquisition and income, macro-region, and type of neighborhood; between acquisition of reagent strips and income; acquisition of lancets and income, type of city and neighborhood; and relationships between the use of the Flash System and income and type of neighborhood.

It was noted that worse socioeconomic conditions are related with greater difficulty in acquiring supplies and the better-off participants chose to buy supplies with their own financial

resources. Restricted access to PHC in more remote regions, financial limitation for the purchase of supplies and difficulty in obtaining them through the UHS are factors related with worse adherence to treatment, since many people had their family income harmed during the pandemic.

It is necessary to emphasize that the study is extremely important to identify how the access to supplies by the population with T1DM has been, and in this way, contribute to the establishment of strategies that facilitate access to services and supplies offered by the public system. It is noteworthy that no other studies were found in Brazil that make similar descriptions, therefore, it is suggested that further research delve into the reasons related to difficulties in acquiring supplies and investigate the supply by the public health network. Moreover, it is emphasized that public policies are necessary to support people with T1DM, especially at times when financial vulnerability may occur, such as during and after the COVID-19 pandemic period, since T1DM is a chronic condition in which the person needs supplies continuously throughout life.

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REFERENCES

1. Holman N, Knighton P, Kar P, et al. (1). Lancet Diabetes Endocrinol. 2020;8(10):823-833. doi:10.1016/S2213-8587(20)30271-0.
2. Sociedade Brasileira de Diabetes (SBD). Diretrizes Sociedade Brasileira de Diabetes 2019-2020. Vol. 5. 2020. 1–491 p. Disponível em: http://www.saude.ba.gov.br/wp-content/uploads/2020/02/Diretrizes-Sociedade-Brasileira-de-Diabetes-2019-2020.pdf
3. Brasil. Lei Nº 11.347 de 27 de setembro de 2006. Dispõe sobre a distribuição gratuita de medicamentos e materiais necessários à sua aplicação e à monitoração da glicemia capilar aos portadores de diabetes inscritos em programas de educação para diabéticos. Diário Oficial da União 2006; 28 set. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/l11347.htm
4. Ministério da Saúde. Portaria Nº 2.583 de 10 de outubro de 2007. Define elenco de medicamentos e insumos disponibilizados pelo Sistema Único de Saúde, nos termos da Lei Nº 11.347, de 2006, aos usuários portadores de diabetes mellitus. [acessado 2020 nov 05]. Disponível em: http://bvsms.saude.gov.br/bvs/saudelegis/gm/2007/prt2583_10_10_2007.html
5. Barone MTU, Harnik SB, Luca PV de, Lima BL de S, Wieselberg RJP, Ngongo B, Pedrosa HC, Pimazoni-Netto A, Franco DR, Souza MFM, Malta DC, Giampaoli V. The impact of COVID-19 on people with diabetes in Brazil. Diabetes Res Clin Pract. 2020; 166: 1-9. doi: 10.1016/j.diabres.2020.108304.
6. Brasil. Resolução Nº 466, de 12 de dezembro de 2012. Dispõe sobre as diretrizes e normas para pesquisas com seres humanos. [acessado 2020 nov 05]. Disponível em: http://conselho.saude.gov.br/resolucoes/2012/Reso466.pdf
7. Brasil. Resolução Nº 510, de 7 de abril de 2016. Dispõe sobre as normas aplicáveis a pesquisas em Ciências Humanas e Sociais cujos procedimentos metodológicos envolvam a utilização de dados diretamente obtidos com os participantes ou de informações identificáveis ou que possam acarretar riscos maiores do que os existentes na vida cotidiana. [acessado 2020 nov 05]. Disponível em: https://www.in.gov.br/materia/-/asset_publisher/Kujrw0TZC2Mb/content/id/22917581

8. Gomes MB, Santos DC, Pizarro MH, Melo LGN, Barros BSV, Montenegro R, Fernandes V, Negrato CA. Relationship between health care insurance status, social determinants and prevalence of diabetes-related microvascular complications in patients with type 1 diabetes: a nationwide survey in Brazil. Acta Diabetol. 2019;0(0):0. doi: 10.1007/s00592-019-01308-7
9. Reis P Dos, Arruda GO de, Nass EMA, Ratuchnei ES, Haddad MDCFL, Marcon SS. Autocuidado e percepção do tratamento para o diabetes por pessoas em uso de insulina. Rev Enferm da UFSM. 2020;10(e60):1–20. doi: 10.5902/2179769239880.
10. Lima M da CS, Santos PHF, Cruz KCT da, Santos LC dos, Machado VB, Andrade J. Acesso à insulinoterapia de usuários com diagnóstico de Diabetes Mellitus acompanhados em ambulatório especializado. Enferm Foco. 2020;11(2):120–6. doi: 10.21675/2357-707X.2020.v11.n2.2793.
11. Klatman EL, Jenkins AJ, Ahmedani MY, Ogle GD. Blood glucose meters and test strips: global market and challenges to access in low-resource settings. Lancet Diabetes Endocrinol. 2019;7(2):150–60. Disponível em: https://www.thelancet.com/journals/landia/article/PIIS2213-8587(18)30074-3/fulltext
12. Scott A, Chambers D, Goyder E, O'Cathain A. Socioeconomic inequalities in mortality, morbidity and diabetes management for adults with type 1 diabetes: A systematic review. PLoS One. 2017;12(5):1–19. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5425027/pdf/pone.0177210.pdf
13. Tefera YA, Bishu KG, Gebregziabher M, Dawson AZ, Egede LE. Source of Education, Source of Care, Access to Glucometers, and Independent Correlates of Diabetes Knowledge in Ethiopian Adults with Diabetes. J Natl Med Assoc. 2018;111(2):218–30. Disponível em: https://www.sciencedirect.com/science/article/abs/pii/S0027968417303267?via%3Dihub
14. Santos ECB dos, Teixeira CR de S, Zanetti ML, Istilli PT, Pereira LHTR, Torquato MT da CG. Judicialização da saúde: Acesso ao tratamento de usuários com diabetes mellitus. Texto e Context Enferm. 2018;27(1):1–7. Disponível em: https://www.sciencedirect.com/science/article/abs/pii/S0027968417303267?via%3Dihub
15. Andrade CJ do N, Alves C de AD. Análise comparativa do controle glicêmico de crianças com diabetes melitos tipo 1 com base na distribuição de insumos: capital x interior da Bahia. Rev Ciênc Méd Biol. 2014;13(3):274–9. Disponível em: https://periodicos.ufba.br/index.php/cmbio/article/view/12930
16. Sauza VP de, Santos ECB dos, Angelim RC de M, Teixeira CR de S, Martins RD. Conhecimento e Práticas de Usuários com Diabetes Mellitus Sobre a Automonitorização da Glicemia Capilar no Domicílio. J res fundam care online. 2018;10(3):737–45. Disponível em: http://www.seer.unirio.br/index.php/cuidadofundamental/article/viewFile/6183/pdf_1
17. Cobas RA, Ferraz B, Mattos S De, Righeti L, Tannus M, Negrato A, Araújo LA de, Dib SA, Gomes MB. The cost of type 1 diabetes: a nationwide multicentre study in Brazil. Bull World Heal Organ. 2013;91(February):434–40. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3777141/pdf/BLT.12.110387.pdf
18. Barros AJ, Bertoldi AD. Out-of-pocket health expenditure in a population covered by the Family Health Program in Brazil. Int J Epidemiol. 2008; 37:758–65. Disponível em: https://academic.oup.com/ije/article/37/4/758/734746
19. Instituto Brasileiro de Geografia e Estatística. Conta-Satélite de Saúde: Brasil 2010-2017. 2019. 1–12 p. Disponível em: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=2101690
20. Boing AC, Bertoldi AD, Peres KG. Desigualdades socioeconômicas nos gastos e comprometimento da renda com medicamentos no Sul do Brasil. Rev Saude Publica. 2011;45(5):897–905. Disponível em: https://pesquisa.bvsalud.org/portal/resource/pt/lil-601135
21. Garcia LP, Sant'Anna AC, de Magalhães LCG, de Freitas LRS, Aurea AP. Gastos das famílias brasileiras com medicamentos segundo a renda familiar: Análise da Pesquisa de Orçamentos Familiares de 2002-2003 e de 2008-2009. Cad Saude Publica. 2013;29(8):1605–16. Disponível em: https://www.scielo.br/j/csp/a/HLVK3jgXsFtP5Z54rCdFzGG/?format=pdf&lang=pt
22. Odeh R, Gharaibeh L, Daher A, Kussad S, Alassaf A. Caring for a child with type 1 diabetes during COVID-19 lockdown in a developing country: Challenges and parents' perspectives on the use of telemedicine. Diabetes Res Clin Pract. 2020;168(January). Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7446666/pdf/main.pdf
23. Verma A, Rajput R, Verma S, Balania VKB, Jangra B. Impact of lockdown in COVID 19 on glycemic control in patients with type 1 Diabetes Mellitus. Diabetes Metab Syndr Clin Res Rev. 2020;14(5):1213–6. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7357511/pdf/main.pdf
24. Ogle GD, Kim H, Middlehurst AC, Silink M, Jenkins AJ. Financial costs for families of children with Type 1 diabetes in lower-income countries. Diabet Med. 2016;33(6):820–6. Disponível em: https://pubmed.ncbi.nlm.nih.gov/26482333/
25. Instituto Brasileiro de Geografia e Estatística (IBGE). IBGE divulga o rendimento domiciliar per capita 2019 [Internet]. 2019. [acessado em 2020 nov 05]. Disponível em: https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/26956-ibge-divulga-o-rendimento-domiciliar-per-capita-2019
26. Oliveira RAD de, Duarte CMR, Pavão ALB, Viacava F. Barreiras de acesso aos serviços em cinco Regiões de Saúde do Brasil: percepção de gestores e profissionais do Sistema Único de Saúde. Cad Saude Publica. 2019;35(11). Disponível em: https://www.scielo.br/j/csp/a/ysfcvHtsLzQ7vbnQs5FJbsv/?format=pdf&lang=pt
27. Roux AVD. Neighborhoods and Health: What Do We Know? What Should We Do? AJPH. 2016;106(3):430–1. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4815954/pdf/AJPH.2016.303064.pdf
28. Caruso I, Molfetta S Di, Guarini F, Giordano F, Cignarelli A, Natalicchio A, Perrini S, Leonardini A, Giorgino F, Laviola L. Reduction of hypoglycemia, lifestyle modifications and psychological distress during lockdown following SARS-CoV-2 outbreak in type 1 diabetic patients using flash continuous glucose monitoring: a retrospective cohort study. Diabetes Metab Res Rev. 2020; e3404. Disponível em: https://onlinelibrary.wiley.com/doi/epdf/10.1002/dmrr.3404
29. Ang E, Lee ZX, Moore S, Nana M. Flash glucose monitoring (FGM): A clinical review on glycaemic outcomes and impact on quality of life. J Diabetes Complications 2020; 34(6): 107559. Disponível em: https://www.sciencedirect.com/science/article/abs/pii/S1056872719313418?via%3Dihub

30. Barreto ML, Barros AJD de, Carvalho MS, Codeço CT, Hallal PRC, Medronho R de A, Struchiner CJ, Victora CG, Werneck GL. O que é urgente e necessário para subsidiar as políticas de enfrentamento da pandemia de COVID-19 no Brasil? Rev Bras Epidemiol. 2020; 23:1–4. Disponível em: https://www.scielo.br/j/rbepid/a/6rBw5h7FvZThJDcwS9WJkfw/?lang=pt&format=pdf

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