

## Use and access to medications for type 2 diabetes mellitus in elderly: a population-based household survey

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**Abstract** *The objective of this study was to analyze the use and access to medications for type 2 diabetes among older people registered in the family health strategy in Ribeirão Preto, São Paulo. A population-based household survey was undertaken with 338 older adults selected using two-stage cluster sampling. Pharmacotherapy of diabetes and access to medications was investigated using a structured questionnaire administered by means of face-to-face interviews. The number of medicines used to treat diabetes ranged between 1 and 4. Respondents predominantly used only oral antidiabetic agents. The use of metformin and sulfonylureas on their own was reported by 37.9% and 9.8% of respondents, respectively. Frequency of insulin use was greatest in the 80 years and overage group (38.9%). The large majority of respondents (96.4%) had full access to medicines. Means of payment was “free of charge” in 78.1% of the respondents and public pharmacies were the main source of medication (74.8%). The most commonly used oral antidiabetic was metformin, which is consistent with current treatment guidelines. However, the findings show inappropriate medication use among older people, more specifically the use of sulfonylureas on their own. The findings of this study highlight the important role played by the public health service in providing medications for type 2 diabetes.*

**Key words** *Drug utilization, Pharmacoepidemiology, Health services accessibility, Health of the elderly, Primary health care*

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## Introduction

Diabetes is a public health problem<sup>1-3</sup>. In Brazil, estimates show that the number of cases increased by 60% between 2006 and 2018 and that the most common form of the disease in the country is type 2 diabetes (T2D)<sup>4</sup>. The prevalence of the disease among older people is around 20%<sup>5</sup>, which is associated with the physiological changes that occur with aging, unhealthy diet, and reduced physical activity<sup>2,3,5</sup>. It is predicted that diabetes will become the seventh leading cause of mortality worldwide within the next ten years<sup>6</sup>.

Treatment of T2D, involving educational, self-monitoring, and pharmacological strategies<sup>2,3</sup>, is essential to control the disease. Although medication use is an important issue for all people with diabetes, it is especially important in older people given the particularities of this age group<sup>7,8</sup>. Aging can lead to pharmacokinetic changes, such as the accumulation of toxic substances in the organism and worsening of adverse events<sup>8</sup>. Thus, pharmacologic approaches to the treatment of T2D should consider biopsychosocial and clinical factors, risk-benefit ratio, and access to medicines<sup>2,3,7,8</sup>. A comprehensive approach can contribute to the reduction of morbidity and mortality and improvements in quality of life<sup>6</sup>.

Surveys of medication use among older people are needed to understand care at both an individual and collective level. They provide a wide range of data on the implementation of public policies and help guide new programs and projects directed at the elderly population. In view of the above, this study analyzed the use and access to medications for T2D among older people registered in the Family Health Strategy (FHS) in Ribeirão Preto, São Paulo.

## Methods

The data on the use and access to medications used by this study came from a cross-sectional household survey on adherence to drug therapy for T2D among older people living in Ribeirão Preto conducted between March and October 2018.

Ribeirão Preto is located in the northwest of the State of São Paulo and had a population of 682,302 inhabitants in 2017<sup>9</sup>. The population coverage rate of the FHS at the time of the study was 22.4%, comprising 45 health teams distributed across five health districts<sup>9</sup>. The study pop-

ulation comprised noninstitutionalized adults aged 60 years and over diagnosed with T2D registered in a family health center (FHC) and using medication to treat the disease on a long-term basis ( $n = 2,766$ )<sup>9</sup>.

The sample size was 338, calculated based on an estimated adherence to drug therapy rate of 50%, tolerable absolute error of 5%, and 95% confidence interval. The sample was selected using two-stage cluster sampling where the sampling unit was the total number of older adults covered by a particular family health team. In the first stage, a simple random sample of 16 sampling units was selected from the 45 teams distributed across the five health districts<sup>9</sup>. A random sample of study participants was then taken from each unit selected in stage one in a number proportional to the number of older people with T2D in that unit. Sample losses and refusals were replaced by randomly selecting other participants from individuals who had not yet been selected.

Data was collected using a structured questionnaire previously tested in a pilot study. The questionnaires were administered via face-to-face interviews and the answers were entered into the data entry software REDCap using a tablet<sup>10</sup>. The respondents self-reported antidiabetic drugs use. Where doubts arose, the interviewers asked to see the prescriptions, patient information leaflets, or medication packaging.

The following variables were used to identify the characteristics of the sample: age group (60-69, 70-79, and 80 years and over); sex (male or female); socioeconomic status (A/B, C, D/E, based on the Economic Classification Criteria Brazil established by the Brazilian Market Research Association)<sup>11</sup>; level of education (number of years of education completed: never studied, 1-4 years, at least 5 years); private health insurance (yes or no); self-reported diseases (systemic hypertension, dyslipidemia, and overweight); number of diseases associated with T2D (none, 1-2, and 3 or more); and polypharmacy, defined as the concurrent use of five or more medications<sup>12</sup>.

The theoretical model used to assess access to medications was that proposed by Penchansky and Thomas<sup>13</sup> adapted by Luiza and Bermudez<sup>14</sup>. We used two variables: access and means of payment. Access was defined as the acquisition of medicines prescribed for T2D during the 30 days prior to the interview, categorized as follows: full (when the respondent had access to all the prescribed medicines); partial (when the respondent was unable to access a medicine); and zero (none of the prescribed medicines were obtained).

Means of payment was classified into three categories: free of charge (the respondent did not pay for any of the medicines); mixed (at least one of the medicines was paid for by the respondent); and own resources (the respondent paid for all of the prescribed medicines).

The following categories were used for medication sources: public pharmacies, private pharmacies accredited by the “Popular Pharmacy Program” (PPP), private pharmacies, and mixed sources (public pharmacies and/or private pharmacies accredited by the PPP and private pharmacies)<sup>15</sup>.

The data was analyzed using the free software R. The variables were described using absolute frequencies, relative frequencies, means, and standard deviation (SD). ANOVA was performed to compare the means. Pearson’s chi-squared test was used to determine whether there were any statistically significant differences between the subgroups of older people adopting a significance level of 0.05.

The survey was approved by the Research Ethics Committee of the Dr. Joel Domingos Machado School Health Center belonging to the Ribeirão Preto Medical School at the University of São Paulo. All respondents signed an informed consent form.

## Results

The sample was made up predominantly of women and individuals with low socioeconomic status and a low level of education across all age groups. The majority of respondents did not have private health insurance and relied exclusively on the public health service for treatment. Over 50% of respondents reported having three or more diseases associated with T2D. The most frequent diseases were systemic hypertension, dyslipidemia, and overweight. Polypharmacy was reported by 73.7% of the respondents (Table 1).

With regard to pharmacotherapy, respondents predominantly used only oral antidiabetic agents (OAAs) across all age groups. Frequency of insulin use was greatest in the 80 years and over age group (Graph 1).

The number of medicines used to treat T2D ranged between one and four. The average number of medicines used was 1.64 (SD = 0.73) in the 60 to 69 years age group, 1.58 (SD = 0.76) in the 70 to 79 years group, and 1.59 (SD = 0.70) in the 80 years and over group. These differences were not statistically significant ( $p = 0.800$ ).

Table 2 shows that the medicine most commonly used on its own or in combination with other OAAs was metformin across all age groups. Sulfonylureas were used on their own by 9.8% of respondents. The most commonly used medicine from this class of drugs was gliclazide (62% of respondents), followed by glibenclamide (28%), and glimepiride (10%). The findings also show that the use of dipeptidyl peptidase-4 (DPP-4) inhibitors was more commonly associated with the use of other OAAs.

The larger majority of respondents reported having full access to medicines (96.4%; 95%CI: 94.4-98.4), with just 3.6% (95%CI: 1.5-5.5) having only partial access. Means of payment was predominantly free of charge (78.1%; 95%CI: 73.6-82.5), followed by mixed (13.6%; 95%CI: 9.9-17.2) and own resources (8.3%; 95%CI: 5.3-11.2). The main medication sources were public pharmacies, followed by private pharmacies accredited by the PPP across all age groups (Graph 2).

## Discussion

The sociodemographic characteristics of the sample resemble those of the users of FHCs<sup>9</sup>. It is a well-known fact that women seek health services more than men, thus providing more opportunity for diagnosing disease<sup>16</sup>. Data from the municipality’s electronic health information system (Hygia<sup>®</sup>) show that there were 2,766 older people with T2D registered in the FHCs included in this study in 2017, 64.9% of whom (1,797) were women, compared to 66.3% in the present study.

The majority of respondents were of low socioeconomic status. The literature shows that this is one of the key factors influencing the provision of medicines<sup>15</sup>. Bearing in mind that most respondents rely exclusively on the public health service for treatment, it is important to emphasize the importance of Federal Law 11.347 created in 2006, which provides that the government shall ensure access to medications and supplies necessary for the treatment of diabetes<sup>17</sup>.

The findings show that the low levels of education characteristic across groups was more pronounced in the 80 years and over group. This may be related to the characteristics of the older people in the sample, who at the time when they were of school age typically substituted school with work<sup>12</sup>. It is known that low levels of education can hinder understanding of the prescrip-

**Table 1.** Sociodemographic and health characteristics of respondents by age group. Family Health Strategy, Ribeirão Preto, São Paulo, 2018 (n = 338).

Variable	Age group (years)			Total n (%)	p*
	60-69 n (%)	70-79 n (%)	≥ 80 n (%)		
Sex					0.596
Female	111 (63.8)	73 (69.5)	40 (67.8)	224 (66.3)	
Male	63 (36.2)	32 (30.5)	19 (32.2)	114 (33.7)	
Socioeconomic status**					0.159
A/B	32 (18.4)	20 (19)	8 (13.6)	60 (17.8)	
C	99 (55.6)	47 (44.8)	29 (49.2)	175 (51.8)	
D/E	43 (24.7)	38 (36.2)	22 (37.3)	103 (30.5)	
Level of education (years)					0.001
0	14 (8)	19 (18.1)	20 (33.9)	53 (15.7)	
1-4	84 (48.3)	67 (63.8)	31 (52.5)	182 (53.8)	
≥ 5	76 (43.7)	19 (18.1)	8 (13.6)	103 (30.5)	
Private health insurance					0.310
Yes	45 (25.9)	27 (25.7)	21 (35.6)	93 (27.5)	
No	129 (74.1)	78 (74.3)	38 (64.4)	245 (72.5)	
Hypertension					0.073
Yes	136 (78.2)	30 (85.7)	53 (89.8)	279 (82.5)	
No	38 (21.8)	15 (14.3)	6 (10.2)	59 (17.5)	
Dyslipidemia					0.180
Yes	94 (54)	61 (58.1)	40 (67.8)	195 (57.7)	
No	80 (46)	44 (41.9)	19 (32.2)	143 (42.3)	
Overweight					0.097
Yes	47 (27)	28 (26.7)	8 (13.6)	83 (24.6)	
No	127 (73)	77 (73.3)	51 (86.4)	255 (75.4)	
Number of diseases associated with T2D***					0.512
0	14 (8)	5 (4.8)	2 (3.4)	21 (6.2)	
1-2	66 (37.9)	39 (37.1)	27 (45.8)	132 (39.1)	
≥ 3	94 (54)	61 (58.1)	30 (50.8)	185 (54.7)	
Polypharmacy					0.216
Yes	122 (70.1)	79 (75.2)	48 (81.4)	249 (73.7)	
No	52 (29.9)	26 (24.8)	11 (18.6)	89 (26.3)	

\*Chi-squared test. \*\* Brazilian Market Research Association 11. \*\*\* Type 2 diabetes.

Source: Authors' elaboration.

tion of medication and treatment for T2D. In view of this, access to medication therapy management services should be expanded within the FHS. Evidence shows that a multiprofessional approach including pharmaceutical care contributes to favorable clinical outcomes in people with chronic diseases<sup>18,19</sup>.

There was a predominance of systemic hypertension and dyslipidemia in the sample and the prevalence of overweight was around 25%. It is known that the concurrence of these conditions

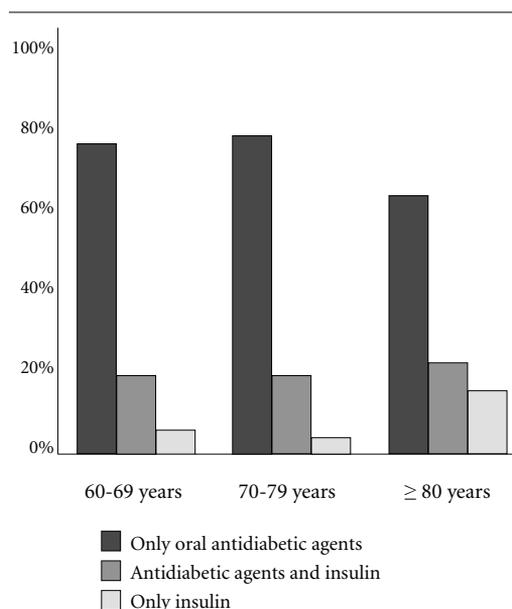
is a predictor of more severe clinical outcomes such as macrovascular and microvascular complications<sup>20</sup>. More research is therefore needed to assess geriatric pharmacotherapies that provide cardiovascular and renal benefits without increasing the risk of hypoglycemia<sup>20,21</sup>.

The prevalence of long-term use of five or more medicines was high among the respondents. In this regard, population-based studies in Brazil point to a significantly increased risk of polypharmacy among people with diabetes in

this age group<sup>21,22</sup>. Polypharmacy is an important indicator to be considered in the comprehensive care of older people in order to avoid adverse events, functional deterioration, and iatrogeneses<sup>23</sup>. Although the present study did not assess polypharmacy associated with multimorbidity,

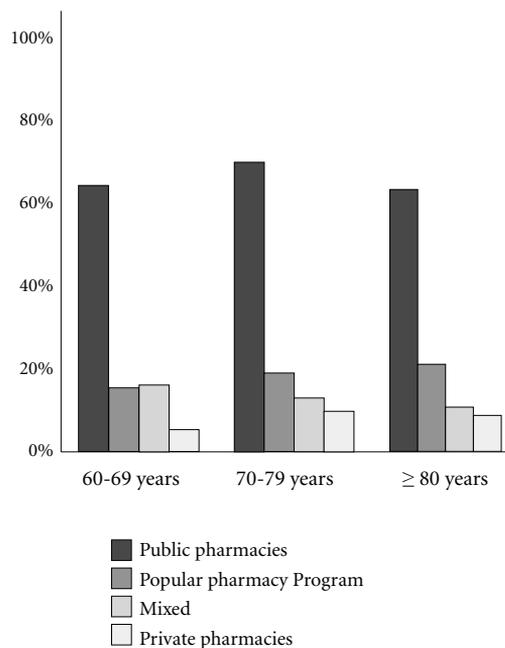
the results showed that respondents who reported other diseases tended to use more medicines.

Across all groups, the medicine that was most commonly used on its own or in combination with other OAA was metformin. This is in line



**Graph 1.** Pharmacotherapy for type 2 diabetes by age group. Family Health Strategy, Ribeirão Preto, São Paulo, 2018.

Source: Authors' elaboration.



**Graph 2.** Main sources of medication for type 2 diabetes by age group. Family Health Strategy, Ribeirão Preto, São Paulo, 2018.

Source: Authors' elaboration.

**Table 2.** Medicines for treatment of Type 2 diabetes reported by respondents by age group. Family Health Strategy, Ribeirão Preto, São Paulo, 2018 (n = 338).

Medicine	Age group (years)			Total n (%)
	60-69 n (%)	70-79 n (%)	≥ 80 n (%)	
Only metformin	63 (36.2)	45 (42.8)	20 (33.9)	128 (37.9)
Metformin and sulfonylureas	40 (23.0)	20 (19.0)	7 (11.9)	67 (19.8)
Insulin and OAA*	34 (19.5)	19 (18.1)	14 (23.7)	67 (19.8)
Only sulfonylureas	15 (8.6)	11 (10.5)	7 (11.9)	33 (9.8)
Only insulin	11 (6.4)	5 (4.8)	9 (15.2)	25 (7.4)
DPP-4** inhibitors and other OAAs	8 (4.6)	4 (3.9)	2 (3.4)	14 (4.1)
Only DPP-4 inhibitors	3 (1.7)	1 (0.9)	0 (0.0)	4 (1.2)
Total	174 (100)	105 (100)	59 (100)	338 (100)

\*OAA: oral antidiabetic agents. \*\*dipeptidyl peptidase.

Source: Authors' elaboration.

with current therapeutic guidelines for T2D recommending this biguanide as a drug of first choice for older people<sup>2,3</sup>. It is important to note, however, that metformin is contraindicated in individuals with chronic kidney failure due to the possible build up of the drug or its metabolites in the body, consequently compromising patient safety<sup>3</sup>.

The use of chlorpropamide and glibenclamide for the treatment of T2D in geriatric patients is considered inappropriate since the risks outweigh the benefits<sup>23</sup>. In the present study, none of the respondents reported using chlorpropamide. It is important to stress that the long-term use of sulfonylureas should be avoided in older people due to the risk of serious hypoglycemic events<sup>2,3</sup>. Awareness and application of lists of inappropriate medications for older people assists in identifying potentially hazardous drugs and establishing safety standards for this age group<sup>23</sup>.

Insulin use was more frequent in the respondents aged 80 years and over. A study conducted in the United States showed that risk of hospitalization due to insulin use was greater in this age group<sup>24</sup>. The main factors leading to hypoglycemia highlighted by the researchers were reduced food intake and medication errors (dosage errors and insulin type changes). It is therefore recommended that multiprofessional FHS teams adopt strategies to guarantee the safe use of insulin by older people and provide guidance to patients on dietary and physical activity regimens<sup>2,3</sup>.

Prevalence of full access to medicines for T2D was high, which is consistent with the suggestions proposed by the National Survey on Access, Use and Promotion of Rational Use of Medicines<sup>25</sup>.

Another study reported that the use of public pharmacies as the sole source of medication was greatest among people with T2D and systemic hypertension<sup>26</sup>, which is consistent with the findings of the present study. Thus, it is important to highlight that securing funding for pharmaceutical care can contribute to promoting equal access to health services among older people with T2D.

One of the limitations of this study is that it relied on information reported by the interviewees, who may have omitted the use of certain medications. However, this memory bias was taken into account in the sampling design. Another limitation was that some OAs were not available in the municipality's public pharmacies during the study period, meaning that these medicines were probably bought using the patient's own resources or obtained from private pharmacies accredited by PPP, thus overestimating the use of these medication sources.

This overview of the use of medicines for the treatment of T2D shows that the majority of older people had full access to medication via the public health system. The findings show that the most commonly used OA was metformin, which is consistent with current treatment guidelines. However, the findings show inappropriate medication use among older people, more specifically the use of sulfonylureas on their own. It is important to stress that older adults with T2D deserve medication therapy management that is tailored to their individual needs. In this regard, the FHS should promote T2D monitoring and control by developing actions to promote the rational use of medicines directed at both professionals and patients.

## Collaborations

All the authors contributed to the conception, planning, analysis and interpretation of the results, as well as the critical review of the content and participated in the approval of the final version of the manuscript.

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