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Type 2 Diabetes at a Military Health Centre in Brazil: Clinical and Pharmacotherapeutic Profile

ABSTRACT

Objective: To analyze the clinical and pharmacotherapeutic profile of people with type 2 diabetes (T2D) at a military health center in Brazil.

Materials and methods: This is a cross-sectional study. The sample of 170 medical records was selected by means of probabilistic sampling. The data collected were sociodemographic, clinical and laboratory data related to diabetes, as well as prescribed medications.

Results: Most of the subjects were male (57.6%), elderly (64.7%) and inactive military (55.2%). Adequate glycemic control was observed in 75.9% of the subjects, which was positively associated with multimorbidity and mono-therapeutic treatment (p < 0.05). Negative associations were observed in those subjects attending medical appointments less frequently and using prescribed insulin (p < 0.05). Medications prescribed for treatment of T2D were the following: metformin (90.6%), sulfonylureas (22.9%), dipeptidyl peptidase inhibitors-4 (16.5%) and sodium-glucose 2 co-transporter inhibitors (10.0%), in which 50.6% were monotherapy. Multimorbidity was 97.6%, in which systemic arterial hypertension (71.8%), lipid disorders (65.9%) and cardiovascular diseases (26.5%) were the main clinical conditions.

Conclusions: The frequency of inadequate glycemic control among subjects using prescribed insulin shows the importance of monitoring this population by means of insulin dosage adjustment, stimuli for pharmacological measures, including education on diabetes. (Clin Diabetol 2024; 13, 1: 60–66)

Keywords: diabetes mellitus, military health, chronic disease, multimorbidity, drug utilization

Introduction

Diabetes mellitus (DM) constitutes a public health problem. It is estimated that the worldwide prevalence of DM is around 10.5%, with a trend towards an increase in the coming decade. Brazil is currently ranked sixth in the world regarding the number of people with diabetes aged 20–79 years old, with this population being estimated at 15.7 million people. The disease has an impact on direct health costs, which increased from 232 billion dollar in 2007 to 966 billion dollar in 2021 worldwide [1].

DM has obesity, physical inactivity and inadequate nutrition as the main risk factors leading to metabolic syndrome (MS), which has been observed even in more controlled occupational settings, such as the armed forces, where the prevalence of DM is around 17.6% among the military personnel [2, 3], what indicates

the need for surveillance and attention concerning DM risk factors.

The health status of the Brazilian military personnel, particularly, lacks information. In this way, studies on this theme are necessary for supporting the health service planning in military corporations. In this context, the present study aims to analyze the clinical and pharmacotherapeutic profile of people with type 2 diabetes (T2D) at a military healthcare center in Brazil, to contribute to the enhance of knowledge on health military personnel in this health unit allowing, in the future, necessary interventions, in the health service to improve it.

Methods

This is a cross-sectional descriptive survey study using medical records from a military healthcare center located in the State of São Paulo, Brazil. The study included male and female individuals diagnosed with T2D, aged 30 years or older, using medications prescribed for diabetes and attending at least one medical appointment in 2019. Pregnant women were excluded.

The search for subjects was performed from a list of individuals who underwent glycated hemoglobin test (HbA1c) at the local clinical analysis laboratory in 2019 by randomly selecting those who met the eligibility criteria. The minimum sample size was calculated as 168 subjects, considering 80-percent rate of people with diabetes using medications [4], acceptable absolute error of 5% and confidence coefficient of 95%.

The following data were collected: age, color/race, schooling level, gender, and recipient's status (social-economic); number of outpatient appointments and rate of emergency care in the year of 2019 (use of healthcare services); and glycated hemoglobin, fasting plasma glucose, systemic arterial hypertension, levels of non-HDL cholesterol, LDL cholesterol, triglycerides and serum creatinine, and identification of the most frequent conditions (clinical and laboratory diseases). It was considered specifically LDL cholesterol less than 50 mg/dL as a category, in accordance with the Brazilian Diabetes Society guidelines, aiming this target to the very high-risk patients with T2D. The parameters outpatient appointments and access to emergency care were stratified into the following groups: 1–4 times, 5–8 times and more than 9 times to reduce considerable variations of the data collected.

Multimorbidity was defined as the presence of two or more conditions in the same individual [5], with these conditions being classified into concordant (related to a similar pathophysiology with T2D) and discordant (not related to a similar pathophysiology with T2D) in relation to T2D [6, 7]. The prescribed

medications were classified according to the Anatomical Therapeutic Chemical (ATC) classification system set by the World Health Organization. Polypharmacy was defined as being the concomitant use of five or more medications [8].

The result data were analyzed by means of descriptive statistics with distribution of absolute and relative frequencies. Odds ratio and 95% confidence interval (95% CI) were calculated by using conditional method [9]. In the present study, the use of regression adjustment is related to the Poisson model for binary response in the analysis of the effect of each independent variable on the presence of glycemic control. The adjusted analysis was initially used to investigate the effect of each independent variable in a regression, including all variables selected from the data set, before being performed in two steps: (i) regression adjustment with two independent variables (bivariate model) and (ii) greater model adjustment containing an independent variable and those identified as statistically significant ($p < 0.05$) in the bivariate modelling [10].

Ethical considerations

The present study was approved by the ethics research committee of the São Paulo Armed Force Hospital according to the protocol number 37488620.7.0000.8928.

Results

The resulting sample had 170 subjects whose characteristics are listed in Table 1. The majority were male, the average age was 63.3 years [standard deviation (SD) = 8.9], 27.1% had completed secondary school and 38.2% were dependent, that is, partners, parents and/or children of the military who are also users of the health system.

About the use of healthcare services, the rate of outpatient appointments was stratified into the following groups: 1–4 times, 5–8 times and more than 9 times, for which the prevalence found were 41.2%, 28.2% and 30.0%, respectively. On average, each subject had 6.5 appointments (SD = 4.5).

The access to emergency care was also stratified into the same groups of 1–4 times, 5–8 times and more than 9 times for which the prevalence found were 60.0%, 10.6% and 6.5%, respectively. The mean rate was 2.8 times (SD = 3.4). Emergency care was not used by 22.9% of the subjects.

Table 2 shows the results of the clinical and laboratory tests of the study subjects.

The presence of multimorbidity was observed in 97.6% of the subjects, with the majority (57.6%) having from 2 to 4 conditions. The conditions occurring

Table 1. Social-Demographic Characteristics of the Study Sample (n = 170) (Air Force Health Centre, Pirassununga, SP, Brazil, 2019)

Variable	Result
Gender	
Male (n, %)	98 (57.6%)
Female (n, %)	72 (42.4%)
Mean age ± standard deviation [years]	63.3 ± 8.9
Color/race	
White (n, %)	131 (77.1%)
Non-white (n, %)	39 (22.9%)
Schooling level	
Complete elementary school (n, %)	19 (11.2%)
Complete secondary school (n, %)	46 (27.1%)
Complete higher school (n, %)	26 (15.3%)
Not informed (n, %)	79 (46.5%)
Recipient's status	
Active (n, %)	6 (3.5%)
Reserve[1] (n, %)	64 (37.6%)
Retired[2] (n, %)	30 (17.6%)
Dependent[3] (n, %)	65 (38.2%)
Pensioner[4] (n, %)	5 (2.9%)

[1]Reserve: inactive military, that no longer performs his/her functions, but can be recalled to the active service if necessary; [2]Retired: inactive military who is definitively out of service; [3]Dependent: partners, parents and/or children of the military who are also users of the health system; [4]Pensioner: widow/widower of the deceased military

most simultaneously with T2D were systemic arterial hypertension (71.8%), lipid disorders (65.9%) and cardiovascular diseases (26.5%). As for the classification of the subjects in relation to concordant, discordant, and concordant/discordant conditions, the prevalence was 31.3%, 3.6% and 65.1%, respectively.

Among the subjects with adequate glycemic control, the highest rate (70.3%) was found in the category of subjects with both concordant and discordant conditions. This rate was followed by that of the categories of subjects with concordant diseases only (25.8%) and of those with discordant diseases only (3.9%).

As for the subjects who had inadequate glycemic control, it was found that 50.0% belonged to the concordant category, 47.4% to the concordant/discordant category and 2.6% to the discordant category.

As for prescribed medications, it was found that 5.7 drugs were prescribed per subject. In addition, 39.4% of the subjects were prescribed 1 to 4 drugs, whereas 60.6% were prescribed more than 5 drugs. The pharmacotherapy used for treatment of T2D is shown in Table 3.

Metformin was the main medication prescribed in the monotherapy treatment, corresponding to 90.5% of this group of drugs (metformin, insulin, or sulfonylureas). In addition, it was observed that in the category "metformin and other oral anti-diabetic drugs", the most frequent association was that of metformin and sulfonylureas, with 9.4% in relation to the total of subjects.

Metformin was also used in dual therapy in combination with sodium-glucose 2 co-transporter inhibitors (SGLT2i) (dapagliflozin or empagliflozin), dipeptidyl peptidase inhibitors-4 (DPP-4) (sitagliptin, vildagliptin, alogliptin) or tiazolidinediones (pioglitazone), corresponding to 17.6% of the sample. In this category, it was also found that 10% of the subjects used triple and quadruple therapy using oral anti-diabetic drugs in several combinations with metformin, sulfonylureas, SGLT2i, DPP-4 inhibitors and tiazolidinedione.

In the category "insulin and oral anti-diabetic drugs", the most frequent combination was that in which 7.6% of the sample used insulin and metformin, whereas other combinations involving insulin, metformin, and other oral anti-diabetic drugs such

Table 2. Clinical and Laboratory Results of the Study subjects (n = 170) (Air Force Health Centre, Pirassununga, SP, Brazil, 2019)

Variable	n	Mean ± standard deviation
Glycated hemoglobin [%]	170	6.5 ± 1.0
Fasting plasma glucose [mg/dL][1]	166	129.6 ± 48.5
Systolic arterial hypertension [mmHg][2]	107	126.0 ± 15.6
Diastolic arterial hypertension [mmHg][3]	107	80.4 ± 9.2
Non-HDL cholesterol [mg/dL][4]	158	182.4 ± 47.8
LDL cholesterol [mg/dL][5]	154	101.3 ± 40.1
Triglycerides [mg/dL][6]	158	175.7 ± 118.8
Men's serum creatinine [mg/dL][7]	86	1.09 ± 0.7
Women's serum creatinine [mg/dL][8]	66	0.9 ± 0.2

The missing data: [1]Fasting plasma glucose = 4; [2]Systolic arterial hypertension = 107; [3]Diastolic arterial hypertension = 63; [4]Non-HDL cholesterol = 12; [5]LDL cholesterol = 16; [6]Triglycerides = 158; [7]Men's serum creatinine = 12; [8]Women's serum creatinine = 6
HDL — high-density lipoproteins; LDL — low-density lipoproteins

Table 3. Pharmacotherapy Used for Treatment of Type 2 Diabetes in the Study Sample (n = 170). (Air Force Health Centre, Pirassununga, SP, Brazil, 2019)

Category	Result
Metformin (n,%)	86 (50.6%)
Metformin and other oral anti-diabetic drugs (n, %)	46 (27.1)
Insulin and oral anti-diabetic drugs (n, %)	22 (12.9%)
Insulin only (n, %)	5 (2.9%)
Sulfonylureas only (n, %)	4 (2.4%)
Other classes and combinations (n, %)	7 (4.1%)

as sulfonylureas (glibenclamide or gliclazide), DPP-4 inhibitors (vildagliptin) and SGLT2i (dapagliflozin or empagliflozin) corresponded to 5.3% of the subjects. In the category "other classes and combinations", DPP-4 inhibitors (vildagliptin, linagliptin and, sitagliptin) and SGLT2i (empagliflozin) were also prescribed.

Among the classes of medications prescribed for other conditions rather than T2D, one can highlight the angiotensin receptor antagonists (44.8%), diuretics (44.1%), angiotensin-converting enzyme inhibitors (18.3%) and calcium channel blockers (15.3%).

Table 4 shows the results of association tests performed between dependent (glycemic control control) and independent variables (gender, age, color/race, recipient's status, medical appointments, emergency care, multimorbidity, number of diseases, systemic arterial hypertension, dyslipidemia, overweight/obesity, hypothyroidism, psychiatric disorders, polypharmacy, medications for T2D and monotherapy for T2D).

Discussion

Although the proportion of men in the population is 48.2% [11], in the present study it was observed that most of the subjects were male (57.6%), possibly due to the high rate of men serving in the Air Force (81.0%) [12]. The users of the healthcare center were military personnel who were active, inactive (retired/reserve), dependent and pensioners. However, it was found that the great majority of the subjects were inactive military personnel and their dependents, which can be partially explained by their older age compared to active ones [13]. It's necessary to highlight that inactive militaries have already completed their career in the military organization. Therefore, they are older compared to the active militaries who are still developing their career.

A systematic review study with meta-analysis of the prevalence of MS among personnel of the armed forces and military corporations of several countries found a proportion of 8.3% [14]. Another study of the Brazilian Navy personnel detected a prevalence of

Table 4. Glycemic Control (Glycated Hemoglobin Less than 7.0%) of the Subjects According to Social-Demographic and Clinical Variables (n = 170) (Air Force Health Centre, Pirassununga, SP, Brazil, 2019)

Variable	Adjusted analysis[1]	
	PR (95% CI)	p-value
Gender		
Female	—	—
Male	0.95 (0.81–1.13)	0.62
Age group [years]		
30–49	—	—
50–59	0.85 (0.47–1.53)	0.55
60–69	0.82 (0.46–1.44)	0.45
70–79	0.93 (0.54–1.59)	0.78
Color/race		
Non-white	—	—
White	1.11 (0.89–1.39)	0.28
Recipient's status		
Inactive	—	—
Active	1.13 (0.89–1.44)	0.49
Medical appointments (2019)		
1–4	0.66 (0.48–0.91)	< 0.05
5–8	0.85 (0.61–1.18)	0.29
≥ 9	—	—
Emergency care (2019)		
0	0.79 (0.44–1.45)	0.37
1–4	0.91 (0.63–1.32)	0.65
5–8	0.96 (0.58–1.60)	0.88
≥ 9	—	—
Multimorbidity [5]		
No	—	—
Yes	3.98 (0.63–24.90)	<0.05
Number of diseases		
1–3	—	—
4–5	1.18 (0.98–1.42)	0.06
≥ 6	1.19 (1.05–1.34)	<0.05
Systemic arterial hypertension		
No	—	
Yes	1.11 (0.89–1.39)	0.30
Dyslipidemia		
No	—	—
Yes	1.05 (0.86–1.27)	0.60
Overweight/obesity		
No	—	—
Yes	1.12 (0.92–1.35)	0.31
Hypothyroidism		
No	—	—
Yes	1.22 (1.06–1.41)	0.06
Psychiatric disorders		
No	—	—
Yes	1.18 (1.01–1.39)	0.14
Polypharmacy [8]		
No	—	—
Yes	0.94 (0.79–1.11)	0.49
Medications for T2D		
Oral anti-diabetic drugs	—	—
Oral anti-diabetic drugs and insulin	0.23 (0.09–0.55)	< 0.05
Insulin only	0.31 (0.07–1.32)	< 0.05
Monotherapy for T2D		
No	—	—
Yes	1.34 (1.09–1.65)	< 0.05

[1]Adjusted analysis by medical appointments, multimorbidity, number of diseases, use of oral anti-diabetic drugs and insulin, insulin only and monotherapy

CI — confidence interval; PR — prevalence ratio; T2D — type 2 diabetes

17.6% for MS [2], whereas a cross-sectional study of the Brazilian general population estimated a prevalence of 38.4% [15]. Therefore, military personnel are less likely to develop T2D compared to the general population since the former are required to practice physical activities regularly.

About the utilization of healthcare services, it was observed that there was a relationship between inadequate glycemic control and low rate of medical visits, thus indicating that individuals with chronic conditions (e.g., T2D) can benefit from the care provided by the health team as they need a minimum number of accesses to healthcare services. In fact, there is evidence that the care provided by a multiprofessional team for management of T2D favors the outcome of the patient. The inclusion of a pharmacist in the team should also be emphasized as such a professional can contribute to achieving the glycemic goals of these people with diabetes [16, 17]. In the present study, the reference value of HbA1c for an adequate glycemic control was below 7.0% [18, 19]. Therefore, 75.9% of the subjects in our sample had an adequate glycemic control, which is corroborated by another study reporting a rate of 62.0% among individuals living in the south-eastern region of the country [20].

About systemic arterial hypertension, it was observed that this condition was highly prevalent in the population studied, reaching 25.9% in the south-eastern region [21]. This finding points to the opportunity of improving the treatment of the disease on a continuous basis.

As for the lipid profile, the parameters analyzed were found to be adequate only for approximately half of the sample, thus making this finding an important point of attention for patients with T2D. Regarding renal function markers in patients with T2D, it is known that the measurement of serum creatinine level is a very used parameter in the initial examination, although more parameters are required to obtain a precise diagnosis [22].

As for multimorbidity, other authors also reported a simultaneous prevalence of T2D and other conditions such as systemic arterial hypertension, lipid disorders and cardiovascular diseases [23, 24], which is in accordance with the present study.

It should be emphasized that the subjects of the present study had an average of 3.3 diseases, a figure close to that reported in the literature (i.e., 3.1 diseases per individual) [25]. This demonstrates the association between T2D and multimorbidity and reinforces the discussion on providing multi-professional care for these individuals on an integral basis through qualified healthcare providers [5]. As well as other studies

[25, 26], a relationship between multimorbidity and adequate glycemic control was also found here. One can conclude that a higher number of medical appointments is related to a better provision of care for individuals so that they can control their T2D adequately.

Another important aspect in the analysis of multimorbidity was the stratification of subjects into those who had concordant, concordant-discordant, and discordant diseases. Our results were like those of another study using real-life data from primary health care [6], showing that many individuals with adequate glycemic control were those with concordant and discordant conditions. Nevertheless, another issue raised in the present study is that the hypertension rates as well as the lipid parameters, in general, were not adequate for most of the sample studied, differently from what occurs with HbA1c. Therefore, a strategic planning should be proposed to implement health actions aimed at the integrity of care.

Metformin was the mostly widely prescribed medication in the monotherapy for T2D. The prescription rate of metformin is coherent with the medical recommendations as the first line pharmacotherapeutic schemes for treatment of T2D due to its efficacy, good security profile, cardiovascular protection, reduced rate of hypoglycemia and weight gain neutrality, besides being easily available and free of charge from the Brazilian public health system [18, 27].

The current pharmacotherapeutic recommendations have been guiding the treatment with the aim to reduce the glycemia as well as to prevent cardiovascular and renal damage, regardless of the levels of HbA1c, since individuals with T2D are more likely to develop cardiovascular diseases and renal harm compared to those not affected by this condition. This is why one of the principles for combining other oral anti-diabetic drugs lies in their cardiovascular and renal protective effects [18, 27]. The prescribed combination of insulin and oral anti-diabetic drugs is justifiably aimed at minimizing adverse events of the treatment with insulin, that is, hypoglycemia and weight gain. The concomitant use of insulin with metformin can lead to an adequate glycemic control and result in less hypoglycemic events and less weight gain compared to treatment with insulin only [28].

Polypharmacy is frequent in a scenario of multimorbidity, which can have negative consequences as it is associated with all causes of mortality, including acute myocardial infarction [29]. Therefore, it is important to review the prescribed medications periodically based on the best evident available in the literature.

About limitations, it was not possible to determine the causality between the variables analyzed because

this is a cross-sectional study. Furthermore, this is a single-center study performed in a military environment, thus the findings observed may be limited to other health units based in Brazil or in other countries. Another limitation is the quality of the information, as a high number of medical records lacked data on anthropometric measurements such as height, weight, and abdominal circumference. Moreover, failures in the recording of blood pressure as well as in the laboratory results were noted.

The present study has shown the clinical and pharmacotherapeutic profile of the people attending a military healthcare center, with most of the subjects having an adequate glycemic control and metformin being the most prescribed medication for control of T2D. However, the glycemic control was found to be inadequate for those subjects who used insulin. In addition, high rates of multimorbidity and polypharmacy were also observed.

Article information
Data availability statement
Data from this study can be requested from the corresponding author.

Author contributions
The authors approved the final version of the article after contributing to the conception and planning of the study, data analysis and interpretation, and writing of the manuscript.

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Conflict of interest
The authors declare no conflict of interest.

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