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ORIGINAL ARTICLE / *ARTIGO ORIGINAL*

Fasting glucose of patients from public health care in the southern region of São Paulo: correlation with glycated hemoglobin and lipid levels

Glicemia de jejum de pacientes da rede pública de saúde na região sul de São Paulo: correlação com hemoglobina glicada e níveis lipídicos

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ABSTRACT: ***Introduction:*** Fasting glucose is a test used for monitoring diabetes mellitus, as well as its screening and diagnosis. The objective of this study was to evaluate fasting glucose results and their correlation with glycated hemoglobin and lipids. ***Methods:*** Cross-sectional study, involving 77,581 patients, attended in 2014. ***Results:*** The majority of the patients are women (65%). The age of the patients ranged from 18 to 115 years (mean of 53 ± 15.5). The agreement between fasting glucose and glycated hemoglobin was moderate (kappa = 0.416); however, it was substantial for the levels used for the diagnosis of diabetes (kappa = 0.689) and poor for pre-diabetes (kappa = 0.188). Fasting glucose ≥ 100 mg/dL was observed in 41.1% of the patients and 61.5% present glycated hemoglobin ≥ 5.7%. Lipid abnormalities are likeliest in patients with elevated fasting glucose. From those 14,241 individuals that had fasting glucose ≥ 126 mg/dL, the microalbuminuria test was performed in only 883 (6.2%) patients, with abnormal results in 201 (22.8%). ***Conclusions:*** The high frequency of fasting glucose with abnormal results may reflect the high proportion of exams performed by individuals with diagnosis of diabetes, to evaluate their glycemic control. The low frequency of requests for microalbuminuria tests in those with probable diagnosis of diabetes reflects the little attention paid for the screening of chronic complications of diabetes. It calls attention the high frequency of dyslipidemia in those individuals, highlighting the fact that this is a population with high cardiovascular risk.

Keywords: Primary Health Care. Blood Glucose. Glycated Hemoglobin. Dyslipidemias.

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RESUMO: ***Introdução:*** A glicemia de jejum é um teste usado para o monitoramento do diabetes mellitus, bem como para seu rastreamento e diagnóstico. O objetivo do estudo foi analisar resultados de glicemia de jejum de pacientes da rede pública e sua correlação com hemoglobina glicada e lipídios. ***Métodos:*** Estudo transversal, com 77.581 pacientes, atendidos em 2014. ***Resultados:*** A maioria é do sexo feminino (65%), com idade entre 18 e 115 anos (53 ± 15,5 anos). A concordância entre glicemia de jejum e hemoglobina glicada foi moderada (Kappa = 0,416), entretanto foi substancial para níveis compatíveis com diabetes (Kappa = 0,689) e pobre para pré-diabetes (Kappa = 0,188). Glicemia de jejum ≥ 100 mg/dL foi encontrada em 41,1% dos pacientes e hemoglobina glicada ≥ 5,7% em 61,5%. As alterações lipídicas são mais frequentes nos indivíduos com alterações na glicemia. Dos 14.241 indivíduos com glicemia de jejum ≥ 126 mg/dL, a microalbuminúria foi pesquisada em apenas 883 (6,2%) indivíduos, com resultado alterado em 201 (22,8%). ***Conclusões:*** Nos indivíduos que realizaram mais de uma dosagem de glicemia de jejum, a maioria permaneceu com exames alterados, principalmente os que apresentavam valores compatíveis com o diagnóstico de diabetes, sugerindo que não conseguem um controle adequado. A baixa frequência de pesquisa de microalbuminúria em indivíduos com glicemia de jejum sugestiva de diabetes reflete a pequena preocupação com o rastreio de suas complicações crônicas. A elevada frequência de dislipidemia nesses indivíduos evidencia ser uma população de elevado risco cardiovascular.

Palavras-chave: Atenção Primária à Saúde. Glicemia. Hemoglobina A Glicada. Dislipidemias.

INTRODUCTION

Appropriate use of laboratory tests promotes efficiency and effectiveness in patient care and safety related to clinical decision making, providing objective data that enable tracking of health risk factors, early diagnoses, severity ratings and better disease management, and enable the construction of indicators that ensure the quality of care provided, especially for disease of high population prevalence, such as diabetes mellitus (DM) and cardiovascular disease, or of high cost to health systems, such as chronic kidney disease[1].

With the increase in the number of individuals with DM in recent decades, due to population growth and aging, increased obesity and sedentarism, as well as longer survival of patients with DM, tracking, monitoring and laboratory control are of great clinical and epidemiological importance[2].

There is evidence that metabolic control in patients with diagnosed DM plays an important role in preventing the onset or progressions of its complications[3,4]. The incidence of cardiovascular disease in patients with DM is two to four times higher than those without it. Thus, the American Diabetes Association (ADA)[5] advocates the control of hypertension and the reduction of cholesterol and triglyceride levels as important actions in the prevention and control of chronic complications of DM.

Although systematic population screening for DM detection is not recommended, diagnosis and laboratory control in at-risk patients have been shown to be cost-effective[6]. In Brazil, a DM population screening campaign was conducted in 2001, identifying 1 confirmed

case out of every 58 screened, at a cost of US$ 76 per diagnosed case. Although the authors concluded that the costs were lower or equal to those already described in the literature, there was no consensus on incorporating this type of campaign as a public health policy[7]. The chronic nature of the disease, the severity of the complications and the means to control them make DM a very costly disease, not only for affected individuals and their families, but also for the health care system[8].

Given this scenario, the benefit of adopting effective DM prevention measures, early diagnosis and adequate monitoring is relevant, both in terms of public health and improving the quality of life of patients at risk of or affected by DM. Although there are several epidemiological studies showing correlations between morbidity and mortality due to DM complications and glycemic profile, based on recommendations to be applied in clinical practice, there are no articles published in Brazil on screening and laboratory control practices in patients treated at health services, where opportunistic screening usually occurs[9].

The aim of this study was to analyze the results of fasting blood glucose (FG) examinations, requested from patients attended at the public health network of the Campo Limpo's and M'Boi Mirim's health technical supervisions, in the south of the city of São Paulo, and to correlate the results with glycated hemoglobin (HbA1c) values and serum lipid levels.

METHODS

Cross-sectional study involving 77,581 patients who underwent FG dosages, aged 18 years old or older, attended at health units in the region with a population of 1,233,453 inhabitants in 2014. Health units in the region are: 59 basic health units (*unidades básicas de saúde* – UBS), 12 Outpatient Medical Care Units (*atendimento médico ambulatorial* – AMA), 6 Psychosocial Care Centers (*centros de atenção psicossocial* – CAPS), 2 Specialized Care Services (*serviços de assistência especializada* – SAE) and 4 Specialty Outpatient Services (*ambulatórios de especialidades* – AE)[10].

All laboratory tests related to these health units were performed in the laboratory unit of Dr. Moysés Deutsch Municipal Hospital — M'Boi Mirim, managed by *Hospital Israelita Albert Einstein*, in a public-private partnership, according to the project "Support to the municipal health network of São Paulo to perform laboratory tests in the regions of M'Boi Mirim and Campo Limpo", developed under the Support Program for the Institutional Development of the Unified Health System (*Programa de Apoio ao Desenvolvimento Institucional do Sistema Único de Saúde* – PROADI), whose objective is to strengthen laboratory assistance in the southern part of the city of São Paulo.

All patients who had FG and HbA1c dosing requested on the same medical order were included in this study.

The variables included in the study were: gender, age, frequency of tests performed on the same patient, type of laboratory test — FG, HbA1c, total cholesterol and fractions, triglycerides, albuminuria — and category of the exam requesting unit.

LABORATORY ANALYSIS METHODS

Patients were instructed to go on a 12-hour fasting period. The biological sample collection, storage and transport processes followed the laboratory's operating procedures, ensuring the pre-analytical quality of the sample.

The equipment used for laboratory dosing is certified and calibrated according to international quality standards. Dosing of HbA1c was performed by high pressure liquid chromatography on the Automated Glycohemoglobin Analyzer HLC-723G7™ (TOSOH Corporation). FG, total cholesterol and fractions and albuminuria dosages were performed on the Fusion 5600™ Ortho Clinical Diagnostics. FG and total cholesterol and fractions were measured by enzymatic method and albuminuria by turbidimetric method.

To classify FG and HbA1c alterations, the ADA[11] criteria adopted by the Brazilian Society of Diabetes (*Sociedade Brasileira de Diabetes* – SBD)[12] were used, classifying the results as:

- according to FG: normal (FG <100 mg / dL); altered (FG between 100 and 125 mg/dL); and DM (FG ≥ 126 mg/dL, with confirmation in new measure).
- according to HbA1c: high risk for developing DM (HbA1c between 5.7 and 6.4%) and DM (HbA1c ≥ 6.5%, with confirmation in a new measure).

To assess the lipid profile, the criteria of the V Brazilian Dyslipidemia Guideline 2013[13] were used. Desirable values are: total cholesterol lower than 200 mg/dL, low density lipoprotein (LDL cholesterol) between 100 and 129 mg/dL, high density lipoprotein (HDL) cholesterol greater than 60 mg/dL, triglycerides less than 150 mg/dL, and non-HDL cholesterol between 130 and 159 mg/dL.

DATA ANALYSIS

Categorical variables are described by absolute and relative frequencies. To verify association between variables, χ^2 tests were used and, when the association was significant and the variables involved had more than two categories, Holm-corrected χ^2 partition was used.

FG and HbA1c levels were compared regarding their agreement by Kappa coefficient[14], which was presented with 95% confidence intervals (95%CI).

In the analysis of the evolution of the exams over time, for patients with more than one exam, the first exam performed in the year was considered as baseline, and as follow-up exam:

- the exam that indicated some worsening;
- If there was no worsening within the year, the exam showed some improvement;
- if there was no change, the next exam performed in the year.

The software used was R 3.2.1[15]. The significance level adopted was 0.001[16,17].

ETHICAL ASPECTS

The project was approved by the Research Ethics Committees of the Municipal Health Secretariat of São Paulo and *Hospital Israelita Albert Einstein*, Opinions No. 949.664/2015 and 1.011.816/2015, respectively.

RESULTS

Results of FG, HbA1c, total cholesterol and fractions and albuminuria of 77,581 patients performed between January and December 2014 were analyzed. Most patients were females (65%) and age ranged from 18 to 115 years (mean 53 ± 15.5 years). The number of exams performed in the period per patient ranged from 1 to 5, provided 89.5% of the patients underwent only 1 exam. The frequency of exam requests by health unit category were: UBS (98.83%), AE (0.83%), AMA (0.26%), and CAPS (0.08%).

Almost all patients (99.6%) have some lipid alteration, unrelated to age or gender (Tables 1 and 2). Regarding lipid changes, it is observed that 40.5% of patients have undesirable values of total cholesterol, 66.8% of LDL cholesterol, 86.1% of HDL cholesterol, 70.4% of non-HDL cholesterol and 41.2% have elevated triglycerides.

Table 1 shows that 58.9% of patients have FG values <100 mg/dL and this proportion is higher in women (61.8 *versus* 53.3%). The frequency of HbA1c values <5.7% is 38.5%, corresponding to 39.1% in women and 37.5% in men. With increasing age, the proportion of altered exams increases (Table 2). The frequency of altered FG and HbA1c values is higher among men.

Table 1. Number and percentage of fasting glucose, glycated hemoglobin and lipid tests, by gender. Campo Limpo and M'Boi Mirim Health Technical Supervisions (São Paulo, SP), 2014.

Variable		Total	Female	Male	p
FG (mg/dL)	< 100	45,660 (58.9)	31,169 (61.8)	14,491 (53.3)	< 0.001
	100 to 125	17,679 (22.8)	10,807 (21.4)	6,872 (25.3)	
	≥ 126	14,241 (18.4)	8,427 (16.7)	5,814 (21.4)	
HbA1c (%)	< 5.7	29,881 (38.5)	19,686 (39.1)	10,195 (37.5)	< 0.001
	5.7 to 6.4	28,332 (36.5)	18,681 (37.1)	9,651 (35.5)	
	≥ 6.5	19,360 (25.0)	12,029 (23.9)	7,331 (27.0)	
Dyslipidemia	Yes	77,284 (99.6)	50,166 (99.5)	27,118 (99.8)	< 0.001
	No	297 (0.4)	237 (0.5)	60 (0.2)	

FG: fasting glucose; HbA1c: glycated hemoglobin. P-values for the χ^2 test. For FG and HbA1c comparisons, all χ^2 partitions obtained $p < 0.001$ when the FG and HbA1c categories were accumulated.

The agreement observed between FG and HbA1c levels to identify the categories of glycemic alterations was moderate, with a Kappa agreement coefficient of 0.416 (95%CI 0.411 – 0.421). However, the agreement between the levels compatible with the diagnosis of diabetes (FG ≥ 126mg/dL and HbA1c ≥ 6.5%) was substantial (Kappa = 0.689; 95%CI 0.682 – 0.696), however poor (Kappa = 0.188; 95%CI 0.181 – 0.195) for suggestive levels of prediabetes (FG: 100 to 125mg/dL and HbA1c: 5.7 to 6.4%).

When assessing the relationship between glycemic condition and dyslipidemia, it appears that the frequency of dyslipidemia is high in all FG and HbA1c categories, with a tendency to be higher in groups with alterations in FG (100 to 125 and ≥ 126 mg/dL) and with HbA1c ≥ 6.5% in both genders (Table 3).

There are few requests for albuminuria research in patients with FG (9.2%) or HbA1c (7.7%) alterations. Observing the results of the exams, it is noted that the highest percentage of albuminuria occurs in patients with FG ≥ 126 mg/dL, being positive in 22.8%, or HbA1c ≥ 6.5%, being positive in 24.2% of exams. It should be noted that albuminuria research also occurred in the other categories of FG or HbA1c, presenting a lower proportion of positivity, which may suggest that they derive from patients with diabetes, controlled blood glucose or kidney problems (Table 4).

When analyzing the evolution of test results that were performed on more than one occasion during the year 2014, with at least three months between exams, it can be noted that the majority kept the results of FG and HbA1c. In individuals who initially had some alteration in FG, the proportion of improvement exceeded that of worsening, whereas for HbA1c alterations this occurred only for those with values ≥ 6.5%. However, for most of those with FG and HbA1c results consistent with the diagnosis of diabetes, the results remained unchanged (Table 5).

Table 2. Number and percentage of fasting glucose, glycated hemoglobin and lipid tests, by age group. Campo Limpo and M'Boi Mirim Health Technical Supervisions (São Paulo, SP), 2014.

Variable		< 40 years	40 to 59 years	> 59 years	p
FG (mg/dL)	< 100	13,467 (86.2)	19,758 (58.2)	12,435 (44.4)	< 0.001
	100 to 125	1,324 (8.5)	7,967 (23.5)	8,388 (29.9)	
	≥ 126	829 (5.3)	6,201 (18.3)	7,211 (25.7)	
HbA1c (%)	< 5.7	11,378 (72.9)	12,856 (37.9)	5,647 (20.1)	< 0.001
	5.7 to 6.4	3,217 (20.6)	13,091 (38.6)	12,024 (42.9)	
	≥ 6.5	1,023 (6.6)	7,975 (23.5)	10,362 (37.0)	
Dyslipidemia	Yes	15,582 (99.8)	33,789 (99.6)	27,913 (99.6)	0.006
	No	38 (0.2)	137 (0.4)	122 (0.4)	

FG: fasting glucose; HbA1c: glycated hemoglobin. P-values for the χ^2 test. For FG and HbA1c comparisons, all χ^2 partitions obtained p < 0.001 when the FG and HbA1c categories were accumulated.

DISCUSSION

The results of GJ, HbA1c and serum lipid levels of patients treated at the public health system in the southern region of São Paulo were analyzed in the present study. As there was no access to the clinical data of these patients, there are some limitations on the interpretation of laboratory results. Previously well-controlled diabetic patients may have been classified as non-glycemic. The same can happen with patients with controlled dyslipidemia. Due to this limitation, patients were categorized as having abnormal or normal values in FG, HbA1c and cholesterol levels, and were not classified according to the probable clinical diagnosis. However, for those with only one measure, it can be

Table 3. Relationship between dyslipidemia and fasting glucose and glycated hemoglobin, total and by gender. Campo Limpo and M'Boi Mirim Health Technical Supervisions (São Paulo, SP), 2014.

Variable		Dyslipidemia	Yes (n = 77,284)	No (n = 297)	p
Overall	FG (mg/dL)	< 100	45,447 (58.8)	213 (71.7)	< 0.001
		100 to 125	17,630 (22.8)	49 (16.5)	< 0.001[a]
		≥ 126	14,206 (18.4)	35 (11.8)	0.004[a]
	HbA1c (%)	< 5.7	29,749 (38.5)	132 (44.4)	0.001
		5.7 to 6.4	28,213 (36.5)	119 (40.1)	0.041[a]
		≥ 6.5	19,314 (25.0)	46 (15.5)	< 0.001[a]
Variable		Dyslipidemia	Yes (n = 50,166)	No (n = 237)	
Female	FG (mg/dL)	< 100	30,998 (61.8)	171 (72.2)	
		100 to 125	10,770 (21.5)	37 (15.6)	0.005
		≥ 126	8,398 (16.7)	29 (12.2)	
	HbA1c (%)	< 5.7	19,583 (39.0)	103 (43.5)	
		5.7 to 6.4	18,583 (37.0)	98 (41.4)	0.007
		≥ 6.5	11,993 (23.9)	36 (15.2)	
Variable		Dyslipidemia	Yes (n = 27,118)	Não (n = 60)	
Male	FG (mg/dL)	< 100	14.449 (53,3)	42 (70,0)	
		100 to 125	6.860 (25,3)	12 (20,0)	0,024
		≥ 126	5.808 (21,4)	6 (10,0)	
	HbA1c (%)	< 5,7	10.166 (37,5)	29 (48,3)	
		5,7 to 6,4	9.630 (35,5)	21 (35,0)	0,119
		≥ 6,5	7.321 (27,0)	10 (16,7)	

FG: fasting glucose; HbA1c: glycated hemoglobin. Values expressed as absolute and relative frequency. P-values for the χ^2 test. [a]P-values associated to χ^2 partitions that accumulate the categories of FG or HbA1c.

Table 4. Number and percentage of albuminuria research requests and relationship of their presence (≥ 30 mg/g) with fasting glucose and glycated hemoglobin. Campo Limpo and M'Boi Mirim Health Technical Supervisions (São Paulo, SP), 2014.

	n	Research request			Albuminuria		
		Yes	No	p	Present	Absent	p
FG (mg/dL)							
< 100	45,660	526 (1.2)	4,513 (98.8)	< 0.001	75 (14.3)	451 (85.7)	< 0.001
100 to 125	17,679	535 (3.0)	17,144 (97.0)		68 (12.7)	467 (87.3)	0.019[a]
≥ 126	14,241	883 (6.2)	13,358 (93.8)		201 (22.8)	682 (77.2)	< 0.001[b]
HbA1c (%)							
< 5.7	29,881	267 (0.9)	29,614 (99.1)	< 0.001	25 (9.4)	242 (90.6)	< 0.001
5.7 a 6.4	28,332	551 (1.9)	27,781 (98.1)		47 (8.5)	504 (91.5)	< 0.001[a]
≥ 6.5	19,360	1,126 (5.8)	18,234 (94.2)		272 (24.2)	854 (75.8)	< 0.001[b]

FG: fasting glucose; HbA1c: glycated hemoglobin. Values expressed as absolute and relative frequency. P-values for the χ^2 test. *All χ^2 partitions obtained p < 0.001 when accumulating the FG or HbA1c. [a]Compare categories < 100 mg/dL with ≥ 100 mg/dL (FG) or < 5.7% with ≥ 5.7% (HbA1c); [b]compare categories ≤ 125 mg/dL or > 125 mg/dL (FG) or ≤ 6.4% or > 6.4% (HbA1c).

Table 5. Evolution of glycemic condition of patients with more than one exam at least three months apart (n = 7,415 patients). Campo Limpo and M'Boi Mirim Health Technical Supervisions (São Paulo, SP), 2014.

	Basal level	Improved	Unchanged	Worsen	p
FG (mg/dL)	< 100	0 (0.0)	1,904 (79.5)	491 (20.5)	< 0.001
	100 to 125	786 (33.8)	1,111 (47.8)	429 (18.4)	
	≥ 126	751 (27.9)	1,913 (71.0)	30 (1.1)	
HbA1c (%)	< 5.7	0 (0.0)	878 (71.4)	351 (28.6)	< 0.001
	5.7 to 6.4	211 (8.3)	1,936 (75.8)	407 (15.9)	
	≥ 6.5	316 (8.7)	3,306 (91.0)	10 (0.3)	

FG: fasting glucose; HbA1c: glycated hemoglobin. Values expressed as absolute and relative frequency. P-values for the χ^2 test. For FG and HbA1c comparisons, all χ^2 partitions obtained p < 0.001 when the FG or HbA1c categories were accumulated.

assumed that they were screened for DM and dyslipidemia. For those with more than one measure of FG and HbA1c, it can be considered that they were follow-up values collected after diagnosis, corroborated by albuminuria requests. However, there were 11,547 patients with FG ≥ 126 mg/dL and 15,728 patients with HbA1c ≥ 6.5% who did not have their measurements repeated, suggesting that both diagnosis and monitoring of these patients may be missed.

In Brazil, in the late 1980s, the prevalence of DM in the adult population was estimated at 7.6%, and a positive correlation between age and prevalence of DM was also found, with 2.7% in the age range from 30 to 59 years and 17.4% in the 60 to 69 years, that is, an increase of 6.4 times[18]. Surveillance of risk and protective factors for chronic diseases by telephone survey (VIGITEL)[19], conducted in the Brazilian capitals by the Ministry of Health, there was a 61.8% increase in the prevalence of self-reported DM, rising from 5.5% in 2006 to 8.9% in 2016. In the National Health Survey (*Pesquisa Nacional de Saúde* – PNS)[20], a household survey conducted in 2013 on representative samples of the Brazilian population aged 18 years old or older, by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – IBGE) in partnership with the Ministry of Health and the *Instituto Oswaldo Cruz* Foundation, the prevalence of self-reported DM was 6.2%, 5.4% in men and 7.0% in women. The Health Survey (*Inquérito de Saúde* – ISA) Capital 2015[21], a household survey conducted in the capital of São Paulo, still showed a prevalence of 22.5% among the population over 60 years of age and 7.4% in the municipality, but higher in the population of the South, region of this study, in which a prevalence of 8.2% of self-reported DM was observed.

The Longitudinal Study of Adult Health (*Estudo Longitudinal de Saúde do Adulto* – ELSA Brazil)[22] found, in a cohort of 15,102 individuals, active or retired employees of public educational institutions of 6 capitals, high prevalence of DM (19.7%) and intermediate glycemic alterations (52.6%) according to the ADA/SBD criteria. In this study, we found altered FG values in 41.2% of the patients, 18.4% with values above or equal to 126 mg/dL. When HbA1c values were evaluated, 61.5% of patients had altered values and 25%, values above or equal to 6.5%.

The measurement of HbA1c as a screening or even diagnostic test for DM, as a possible substitute for FG and oral glucose tolerance testing, has been advocated. However, some studies have shown that the limitation of this proposal is not related to the fact that high HbA1c values indicate the presence of DM, but to the fact that a "normal" result does not exclude diabetes[23]. The results presented here are in accordance with the recommendations of the World Health Organization (WHO)[24], that the dosage of HbA1c can be used for the diagnosis of DM, as the agreement between FG values ≥ 126 mg/dL and HbA1c ≥ 6.5% is good (Kappa = 0.689). For prediabetes (GJ: 100 to 125 mg/dL and HbA1c: 5.7 to 6.4%), agreement was poor (Kappa = 0.188), which is also in line with WHO recommendations, which indicate that the use of HbA1c should be complemented by additional studies to identify this condition, and in disagreement with the ADA, which indicates that HbA1c measurement may replace FG[25].

In the present study, it was observed that men present higher frequency of FG ≥ 100 mg/dL, HbA1c ≥ 6.5% and dyslipidemia compared to women. The literature has pointed to differences in the frequency of glycemic alteration between the genders, without being able to affirm the existence of a clear tendency regarding it[26].

Albuminuria is a finding indicative of kidney impairment and is present in the early stage of renal disease before the impairment is detected. Loss of renal function is directly related to the amount of proteinuria and, when associated with hypertension and/or DM, aggravates the prognosis of kidney disease[27].

The Kidney Disease Outcomes Quality Initiative (KDOQI)[28] recommends that individuals at risk of developing chronic kidney disease should be routinely screened for proteinuria.

As observed in this study, a small portion (6.2%) of patients with high FG had albuminuria request, being present in 22.8% of the exams. It should be noted that albuminuria research also occurred in the other categories of FG or HbA1c, with a lower proportion of positivity, which may suggest that they derive from patients with diabetes, controlled blood glucose or other kidney problems. This result is concerning, provided the high cost involved in renal replacement therapy (RRT) for patients who develop dialytic chronic kidney disease (CKD), as early identification of renal changes may prevent or delay the progression of this DM complication. In the Unified Health System (SUS), the costs of RRT were estimated at 1.5% of the total budget. A study with primary health care physicians in Fortaleza showed that albuminuria was low in patients at high risk of developing CKD, as well as low referral to specialists, even with altered exams, showing impairment of glomerular filtration rate[29].

Of the total of patients, 7,415 (9.5%) performed more than one test during 2014, and most remained unchanged, suggesting that the control of glycemic alterations in these patients may not have been effective.

Results of lipid levels show that almost all patients have dyslipidemia. Data from the Framingham, Multiple Risk Factor Intervention Trial (MRFIT), and the Prospective Cardiovascular Munster (PROCAM) studies have demonstrated the undisputed role of dyslipidemias, elevated LDL cholesterol, decreased HDL cholesterol, systemic hypertension, smoking, age, and DM as independent risk factors for atherosclerosis and consequent ischemic coronary disease[30].

Coronary artery disease is the leading cause of mortality in the country and high cholesterol is one of the modifiable risk factors[13,30]. The PNS 2013[31] shows that 12.5% of the population reported having a medical diagnosis of high cholesterol, a prevalence that rises to 13.3% in the southeast region. In this study, the lipid profile was altered in 99.6% of the collected samples.

This result possibly reflects a sedentary lifestyle, which associated with poor quality of food, will exert strong pressure on the health system in the near future, with increased hospitalizations and mortality, especially due to cardiovascular disease, hypertension and DM.

Besides the lack of clinical information already mentioned, another limitation is the lack of socioeconomic and demographic information of these patients, factors that may

interfere with the high frequencies of laboratory alterations found. It can be assumed that most patients belong to lower socioeconomic strata, as the data come from public care units. Thus, higher strata should be underrepresented in this series, as well as older age groups, since in the 2010 census, the southern zone of São Paulo had 82.6% of the population with income of up to 5 minimum wages and lowest aging rate of the municipality, with only 8.6% of the population over 60 years[32].

The current health care model has not been decisive for the care of noncommunicable chronic diseases, which corroborates these results. Further discussion should be undertaken by society, as scarce health resources could be better targeted through the application of institutional screening and control protocols for this group of diseases. High frequency of poor glycemic control and low frequency of screening for potential DM complications were observed in this study, particularly nephropathy, which generate high cost to the health system and loss of quality of life for patients, such as dialysis CKD.

CONCLUSION

The studied population has high proportions of alterations in the results of FG, HbA1c, triglycerides, total cholesterol and fractions. The results presented here cannot be compared with those of population-level prevalence described in the literature, as they are patients who sought health services and were opportunistically screened or monitored.

Finding good agreement between FG and HbA1c for values compatible with the diagnosis of DM is in line with current WHO and ADA recommendations. However, poor agreement for pre-diabetes compatible levels reinforces the WHO recommendation that HbA1c should not be used to identify this condition.

The high frequency of altered FG values reflects the large proportion of tests performed by individuals diagnosed with DM to assess glycemic control. Of the individuals who performed more than one FG dosage in the period, whose initial values were altered, the majority remained with altered exams, especially those with initial values compatible with the diagnosis of DM, suggesting that these individuals are unable to adequately control the disease. The low frequency of requested albuminuria screening in individuals with high FG reflects low concern with screening for chronic DM complications, particularly nephropathy. Attention is drawn to the high frequency of dyslipidemia in individuals who underwent GJ examination, evidencing a population with high cardiovascular risk and requiring interventions aimed at reducing this risk.

In the specific case of SUS, which suffers from underfinancing problems and the efficiency of the use of available resources, there are reasons for concern, as demand and, consequently, cost increase are predicted. Measures aimed at increasing the efficiency of screening and control of patients treated in the health system, as well as strategies for prevention and promotion of population health are more than urgent in the Brazilian public health context.

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