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Risk factors associated with glycemic control and metabolic syndrome in patients with type 2 diabetes mellitus. Villavicencio, Colombia

Factores de riesgo asociados al control glucémico y síndrome metabólico en pacientes con diabetes mellitus tipo 2. Villavicencio, Colombia

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Resumen

Introducción: La Diabetes Mellitus tipo 2 (DMT2) es una enfermedad crónica cuya prevalencia elevada hace que sea un importante problema de salud pública, social y económico en los países. **Objetivo:** Identificar factores de riesgo potencialmente asociados al control glucémico y Síndrome Metabólico (SM) de pacientes con DMT2 de una Institución prestadora de Servicios de Salud (IPS) de Villavicencio. **Materiales y métodos:** Estudio analítico transversal a partir de información secundaria. Se establecieron modelos multivariados basados en regresiones binomiales para analizar razones de prevalencia ajustadas en dos variables: síndrome metabólico y control glucémico. **Resultados:** Más del 90% de los individuos eran mayores de 49 años; 50,6% hombres; 46,6% presentó cifras de la prueba de hemoglobina glicosilada (HbA1c) mayor a 7%; 64,5% tenían SM. Los individuos con hiperglicemia tuvieron 3,1 veces más riesgo de tener inadecuado control glucémico (IC 95%:2,28-4,25, p<0,05); aquellos con hipotiroidismo presentaron 1,2 veces más riesgo de desarrollar SM (IC 95%:1,01-1,35; p<0,05) y aquellos con cardiopatía tuvieron 1,3 veces más riesgo de desarrollar SM. **Conclusiones:** A pesar de ser una población controlada y en proceso de monitoreo, alto porcentaje de pacientes presentó inadecuado control metabólico, aumentando el riesgo cardiovascular, esto sugiere optimizar procesos de seguimiento institucional.

Palabras clave: Diabetes mellitus tipo 2; síndrome metabólico; hemoglobina A glucada. (Fuente: DeCS, Bireme).

Abstract

Introduction: Type 2 diabetes mellitus (T2DM) is a chronic disease whose high prevalence makes it an important public, social and economic health problem in countries. **Objective:** To identify risk factors potentially associated with glycemic control and metabolic syndrome (MS) of patients with T2DM of a Health Services Institution (IPS) in Villavicencio, Colombia. **Materials and methods:** A transverse analytical study from secondary information was made. Multivariate models based on binomial regressions were established to analyze reasons of prevalence adjusted in two variables: metabolic syndrome and glycemic control. **Results:** More than 90% of individuals were over 49 years old; 50.6% were men; 46.6% showed the glycosylated hemoglobin test (HbA1c) figures greater than 7%; 64.5% had MS. Individuals with hyperglycemia had 3.1 times the risk of inadequate glycemic control (95% CI: 2.28-4.25, p < 0.05); Those with hypothyroidism presented 1.2 times more risk of developing MS (95% CI: 1.01-1.35; p < 0.05) and those with heart disease had 1.3 times the risk of developing MS. **Conclusions:** Despite being a controlled population and in the process of monitoring, high percentage of patients presented inadequate metabolic control which increases cardiovascular risk. This suggests optimizing institutional follow-up processes.

Key words: Diabetes mellitus, type 2; metabolic syndrome; glycated hemoglobin A. (Source: DeCS, Bireme).

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Introduction

Diabetes mellitus (DM) is a chronic disease with a high prevalence particularly in low- and middle-income countries, based on reports from the World Health Organization (WHO)[1]. According to the WHO and the International Diabetes Federation (IDF), diabetes mellitus is considered a "global epidemic" that affects people at their most productive age, impoverishing families and decreasing their life expectancy. Thus, DM belongs to the diseases with the highest social and health impact. Together with the other three main noncommunicable diseases (NCD) (cancer, cardiovascular, and respiratory diseases), DM represents more than 80% of all premature deaths[2]. The worldwide prevalence of this illness in people older than 18 years of age has increased from 4.7% (1980) to 8.5% (2014)[1]. In Colombia, the prevalence of type 2 diabetes mellitus (T2DM) fluctuates between 4% to 8%[3].

According to the WHO Global Action Plan for the Prevention and Control of NCDs[4], a relative reduction of 25% in premature mortality due to cardiovascular diseases, including DM, has been proposed for 2020. This plan includes an adequate glycemic control as its main goal. The American Diabetes Association (ADA) and the Latin American Diabetes Association (from the Spanish ALAD)[5] have set as their main goal to control glycosylated hemoglobin at levels ≤7%. They also suggest that this goal can be further reduced in newly diagnosed patients with unknown complications and long-life expectancies. However, stricter controls should be implemented for patients with severe vascular complications and in situations in which the replacement (e.g., hemolytic anemia and renal failure) and formation (e.g., after iron administration) of erythrocytes increase[6,7]. In Colombia, these references are described in the Clinical Practice Guidance (CPG) for diagnosis, treatment and follow-up of type 2 diabetes mellitus for people over 18 years of age. Finally, in relation to glycemia values, the ALAD has set as its goal to have fasting values between 70 to 120 mg/dl.

Other important aspects frequently associated with DM are obesity, lipid and protein metabolism disorders, pulmonary arterial hypertension (PAH), and other cardiovascular disorders, which lead to what is known as metabolic syndrome (MS)[8]. The most appropriate definition of MS is described by the National Cholesterol Education Program and the Adult Treatment Panel III (ATP III), which is based on clinical criteria and simple laboratory assays. For a general population, MS is defined by three or more of the following criteria: (i) glycemia ≥100 mg/dl or history of DM; (ii) waist circumference of men ≥102 cm, or women ≥88 cm; (iii) blood pressure ≥130/85 mmHg, regardless of gender; (iv) high density lipoproteins (c-HDL) <40 mg/dl or <50 mg/dl for men or women, respectively; and (v) triglycerides ≥150 mg/dl for both male and female patients[9].

Kidney failure is commonly assessed via the Chronic Kidney Disease (CKD) classification that is based on the glomerular filtration rate (GFR). It involves a simple assay to estimate CKD severity according to the stages of T2DM in patients[10]. In Colombia, the glutamate-pyruvate transaminase (GPT) analysis is used to calculate GFR through various formulas, including MDRD, Cockroft or CKD-Epi, which take into account serum creatinine, age, and weight. Calculations are finally adjusted for gender and race[11].

The Colombian Administrative Act 117 of 1998 included DM in the group of diseases of public health concern. In this context, they should be subjected to timely attention and follow-up in order to ensure their control and reduce avoidable complications. Currently, all DM patients must be enrolled in the Cardiovascular Risk Program (CVRP), which has become one of the main strategies of the Colombian Ministry of Health to reduce the morbimortality associated with cerebrovascular events (CVE). Thus, the main purpose of this program is to incorporate a global cardiovascular (CV) risk approach into the management of people in treatment. Likewise, the 2012-2021 Ten-Year Public Health Plan (TYPHP) has aimed to achieve a 25% reduction in premature mortality due to DM in the Colombian population aged 30-70 years old[12]. The accomplishment of this goal requires the implementation of Integral Routes of Health Care (IRHC) that define the necessary

conditions to ensure comprehensive health care in Colombia.

Meta is one of the departments (states) with the highest DM prevalence compared to other Colombian populations. According to the recent Analysis of the Health Situation in the Department of Meta, the age-adjusted DM mortality rate was 31.1 per 100,000 inhabitants in 2013, which is almost two times higher than the national value (16.43%)[13]. Since 2010, Villavicencio (the capital of Meta) has had the largest portion of the mortality/year seen in the department, with a mortality rate of 39.8% per 100,000 inhabitants in 2013[14]. In conclusion, it is important to clinically control this population since there is no information about the characteristics of the patients that should be enrolled in follow-up programs. Thus, this study was carried out to identify potential risk factors associated with glycemic control and metabolic syndrome in patients with T2DM at a Health Care institution (HCI) from Villavicencio in 2016. For this reason, we used sociodemographic and clinical variables commonly assessed within follow-up programs.

Materials and methods

An analytical cross-sectional study was conducted to analyze sociodemographic and clinical information of T2DM patients extracted from periodic control records of a group of patients who were treated in the CVRP of a HCI in 2016. Relevant data was collected during the second trimester of 2017.

The population of our study included people with T2DM who were enrolled and who were active participants of the cardiovascular risk program of a primary care private HCI. Patients who attended follow-up appointments from January to December 2016 were included. The follow-up database included 539 individuals, 453 of which were selected for this study according to our inclusion criteria.

Subjects were chosen from a census of people with T2DM who remained as active participants of the previously described program. The study inclusion criteria were: active users of the CVRP program in the HCI with a cut-off as of December 2016. In addition, patients should have had (i) records in the chronic patient follow-up database, (ii) follow-up assessments by the program as demonstrated by clinical follow-up history, and (iii) biochemical profile reports from the previous 12 months. Sociodemographic and clinical variables were studied to achieve the objectives.

The information sources included secondary data registries of patients stored in monitoring and follow-up formats. They were complemented with a review of clinical histories of follow-up care and a software containing the records of biochemical profile results of HCI users.

Independent variables:

- Sociodemographic: age, gender, marital status, and area of residence
- Clinical: weight, body mass index, triglyceride serum levels, HDL cholesterol, LDL cholesterol, total cholesterol, HbA1c, fasting blood glucose, creatinine, systolic and diastolic blood pressure, glomerular filtration rate (using the formula of Cockcroft-Gault), risk factors (e.g., smoking, alcoholism, dyslipidemia), comorbidities, and complications.

Dependent variables:

- Glycemic control: individuals with HbA1c values ≤ 7 % (control) and higher values (no control)[5,6].
- Metabolic syndrome according to the Third Adult Treatment Panel (III). Here, it is important to mention that the abdominal perimeter variable was not included because of insufficient data in the analyzed sample. The applied criteria were: triglycerides values ≤150 mg/dl; HDL cholesterol <50 mg/dl and <40 mg/dl for men and women, respectively; blood pressure ≥130/85 mmHg or history of arterial hypertension. Patients were included into the metabolic syndrome group if they presented at least 2 of the previous criteria since they were already diagnosed with diabetes.

Frequencies and percentages were calculated for the analysis of categorical variables. Chi square test was used to compare the proportion of patients according to each of the dependent variables, by different categories of independent variables. This approach was used to identify significant differences with a *p* value <0.05.

Subsequently, brute prevalence reasons (PR) were established with their respective 95% confidence intervals (95% CI) and a significance level <0.05 for all independent variables (0 and 1). "0" and "1" categories represented "low risk or absence of exposition" and "higher risk or presence of exposition" based on scientific evidence, respectively.

Finally, we conducted a multiple analysis through a binomial regression model controlled by potentially confusing variables to obtain PRs adjusted with 95% CI and a significance level <0.05. The variables incorporated into this model were either those that had *p* values <0.05 in the bivariate analysis (based on Hosmer Lemeshow) or those previously reported to be related to the dependent variable. Database processing and statistical analyses were performed with Stata version 12[15] and SPSS version 22[16].

Ethical considerations

This study was classified as "risk free" research according to the Resolution 8430 of 1993 by the Colombian Ministry of Health. We followed the Helsinki Declaration because the information obtained throughout this study from secondary sources was treated with confidentiality. Subsequently, to verify missing data in different information sources, the database was anonymized. The research protocol was approved by the Ethics Committee of the University of Los Llanos.

Results

The present work included 453 subjects, 50.6% of which were male; 91.3% of men and 93.8% of women were 50 years of age or older. Only 394 individuals provided information regarding their marital status, who were predominantly married or common law, whereas the remaining patients were not willing to share their marital status. 3.9% and 3.1% of male and female participants resided in rural areas, respectively. There were no differences in the sociodemographic characteristics studied on the basis of gender (*p*>0.05) (Table 1).

With respect to clinical characteristics, the predominant fasting glycemia values were hyperglycemia (>130 ml/dl), in 65.4% of men and 57.0% of women (*p*=0.067). Regarding the lipid profile, 69% and 56.2% of male and female participants, showed hypercholesterolemia (total cholesterol >200 mg/dl), respectively. 53.7% of men and 63.8% of women had low c-HDL values, whereas 49.8% of men and 58.9% of women showed high c-LDL figures (>100 mg/dl). Thus, these characteristics displayed differences based on gender. On the other hand, abnormal levels of triglycerides and hyperglyceridemia, did not reveal differences by gender (*p*=0.548) (data not shown).

Glycemic control in T2DM population

46.6% of the individuals presented HbA1c levels greater than 7%. This population also displayed some differences regarding sociodemographic and clinical variables. For instance, we observed that the risk of an inadequate glycemic control was lower in women compared to men (PR: 0.79; 95% CI: 0.64-0.96; *p*=0.021). In addition, there was a 3.17 higher risk of an inadequate glycemic control in cases of fasting hyperglycemia. Table 2 shows all characteristics analyzed according to glycemic control.

Metabolic syndrome in T2DM population

Although 64.5% of participants had MS, the bivariate analysis did not show an association between this syndrome with sociodemographic characteristics (*p*>0.05). On the other hand, the analysis of comorbidities revealed that obese patients had a 1.22 higher risk of developing MS (95% CI: 1.07-1.40; *p*=0.003), while hypothyroidism increases the same risk 1.21 times (95% IC: 1.05-1.40; *p*=0.009). In relation to diabetic complications, the risk to develop MS is 1.23 times higher in patients with cardiopathy compared to those without a history of heart disease (95% CI: 1.02-1.48; *p*=0.033). The description of the variables and brute PRs reached in relation to MS syndrome can be seen in Table 2.

Table 1. Sociodemographic and clinical characteristics based on glycemic control of people with T2DM

Variables	n	Glycemic control (HbA1c)		Brute PR 95% CI	*p* value
		Control (Hba1c ≤ 7%) [242] 53.4%	**No control (Hba1c > 7%)** [211] 46.6%		
Sociodemographic					
Age					
< 50 years	34	19 {7.9}	15 {7.1}	Reference	0.770
> 50 years	419	223 {92.1}	196 {92.9}	1.06 (0.72 – 1.57)	
Gender					
Male	229	110 {45.5}	119 {56.4}	Reference	0.021
Female	224	132 {54.5}	92 {43.6}	0.79 (0.65 – 0.97)	
Area of residence					
Urban	437	232 {95.9}	205 {97.2}	Reference	0.493
Rural	16	10 {4.1}	6 {2.8}	0.80 (0.42 – 1.52)	
Marital status[a]					
With partner	244	127 {60.2}	117 {63.9}	Reference	0.450
Without partner	150	84 {39.8}	66 {36.1}	0.92 (0.73 – 1.15)	
Clinical					
Metabolic syndrome					
No	161	89 {36.8}	72 {34.1}	Reference	0.559
Yes	292	153 {63.2}	139 {65.9}	1.06 (0.86 – 1.31)	
BP values in consultation					
< 130/85 mmHg	400	209 {86.4}	191 {90.5}	Reference	0.201
≥ 130/85 mmHg	53	33 {13.6}	20 {9.5}	0.79 (0.55 – 1.13)	
Fasting glycemia[a, b]					
70-120 mg.dl	175	140 {58.1}	35 {16.7}	Reference	< 0.001
> 120 mg/dl	276	101 {41.9}	175 {83.3}	3.17 (2.33 – 4.32)	
Obesity (BMI ≥ 30 Kg/m²)					
No	287	151 {62.4}	136 {64.5}	Reference	0.652
Yes	166	91 {37.6}	75 {35.5}	0.95 (0.78 – 1.17)	
CKD[c]					
Stages I-III	443	238 {98.3}	205 {97.2}	Reference	0.324
Stages IV-V	10	4 {1.7}	6 {2.8}	1.30 (0.77 – 2.17)	
Dyslipidemia[d]					
No	112	59 {24.4}	53 {25.1}	Reference	0.855
Yes	341	183 {75.6}	158 {74.9}	0.98 (0.78 – 1.23)	
History of HBP					
No	170	85 {35.1}	85 {40.3}	Reference	0.253
Yes	283	157 {64.9}	126 {59.7}	0.89 (0.73 – 1.09)	
Hyperuricemia					
No	436	231 {95.5}	205 {97.2}	Reference	0.388
Yes	17	11 {4.5}	6 {2.8}	0.75 (0.39 – 1.44)	
Hypothyroidism					
No	358	193 {79.8}	165 {78.2}	Reference	0.682
Yes	95	49 {20.2}	46 {21.8}	1.05 (0.83 – 1.33)	
Heart disease					
No	417	220 {90.9}	197 {93.4}	Reference	0.366
Yes	36	22 {9.1}	14 {6.6}	0.82 (0.54 – 1.26)	
Nephropathy					
No	421	224 {92.6}	197 {93.4}	Reference	0.745
Yes	32	18 {7.4}	14 {6.6}	0.93 (0.62 – 1.40)	

[a]n can be less than 453 due to missing or non-plausible data. With partner: married/common law; without partner: single/widow(er); [b]ALAD reference; [c]CKD: Stages I to III: GFR ≥ 30 ml/min/1.73 m²; Stages IV and V: < 30 ml/min/1.73 m²; [d]Dyslipidemia: presence of any of the following conditions: a) hypercholesterolemia (TC > 200 mg/dl, or c-LDL > 100 mg/dl); b) hyperglyceridemia (TG ≥ 150mg/dl); c) hyperlipidemia; d) c-HDL deficiency
BP: Blood pressure, HBP: High blood pressure TC: Total cholesterol, TG: Triglycerides

Table 2. Sociodemographic and clinical characteristics based on MS of people with T2DM

Variables	n	Metabolic Syndrome[a]		Brute PR 95% CI	*p* value
		No [161] 35.5%	Yes [292] 64.5%		
Sociodemographic					
Age					
< 50 years	34	14 {8.7}	20 {6.8}	Reference	0.505
> 50 years	419	147 {91.3}	196 {93.2}	1.10 (0.83 – 1.47)	
Gender					
Male	229	84 {52.2}	145 {49.7}	Reference	0.608
Female	224	77 {47.8}	147 {50.3}	1.04 (0.90 – 1.19)	
Area of residence					
Urban	437	158 {98.1}	279 {95.5}	Reference	0.054
Rural	16	3 {1.9}	13 {4.5}	1.27 (1.00 – 1.63)	
Marital status[a]					
With partner	244	84 {59.6}	160 {63.2}	Reference	0.478
Without partner	150	57 {40.4}	93 {36.8}	0.95 (0.81 – 1.10)	
Clinical					
Glycemic control (HbA1c)					
≤ 7%	242	89 {55.3}	153 {52.4}	Reference	0.555
>7%	211	72 {44.7}	139 {47.6}	1.04 (0.91 – 1.19)	
Fasting Glycemia[a]					
70-120 mg/dl	175	70 {43.8}	139 {36.1}	Reference	0.119
> 130 mg/dl	276	90 {56.2}	147 {63.9}	1.12 (0.97 – 1.30)	
Obesity (BMI ≥ 30 Kg/m²)					
No	287	116 {72.0}	171 {58.6}	Reference	0.003
Yes	166	45 {28.0}	121 {41.4}	1.22 (1.07 – 1.40)	
CKD					
Stages I-III	443	157 {97.5}	286 {97.9}	Reference	0.779
Stages IV-V	10	4 {2.5}	6 {2.1}	0.93 (0.56 – 1.55)	
Hyperuricemia					
No	436	156 {96.9}	280 {95.9}	Reference	0.556
Yes	17	5 {3.1}	12 {4.1}	1.10 (0.80 – 1.51)	
Hypothyroidism					
No	358	137 {85.1}	221 {75.7}	Reference	0.009
Yes	95	24 {14.9}	71 {24.3}	1.21 (1.05 – 1.40)	
Heart disease					
No	417	153 {95.0}	264 {90.4}	Reference	0.033
Yes	36	8 {5.0}	28 {9.6}	1.23 (1.02 – 1.48)	
Nephropathy					
No	421	148 {91.9}	273 {93.5}	Reference	0.558
Yes	32	13 {8.1}	19 {6.5}	0.92 (0.68 – 1.23)	

[a] n can be less than 453 due to missing or non-plausible data.

Multivariate analysis

Tables 3 and 4 show the results from the binomial logistic regression analysis, presenting adjusted PRs for the independent variables: glycemic control and MS. Regarding glycemic control, individuals with hyperglycemia had a 3.12 times higher risk to have HbA1c > 7 (95% CI: 2.28-4.25, $p<0.05$); these results were adjusted by age, gender and blood pressure figures.

The analysis of MS shows that individuals who lived in rural areas had a 1.48 times higher risk (95% CI:1.30-1.56) to develop this disorder ($p<0.001$); this data was adjusted by age, gender, zone of residence, obesity, hypothyroidism, and heart disease. Also, there were statistically significant findings in obesity, hypothyroidism and heart disease in terms of developing MS.

Table 3. Multivariate model based on glycemic control of people with T2DM who belong to a CVRP program

Variable	Adjusted PR[a]	95% CI	*p* value
Gender			
Male	Reference	0.70 -0.99	0.048
Female	0.84		
Age			
< 50 years	Reference	0.75 – 1.49	0.733
> 50 years	1.06		
Arterial blood pressure values in consultation			
< 130/85 mm/Hg	Reference	0.66 – 1.21	0.485
≥ 130/85 mm/Hg	0.90		
Fasting glycemia			
70-120 mg/dl	Reference	2.29 – 4.25	0.0001
> 120 mg/dl	3.12		

[a]PR adjusted by age, gender, values of arterial blood pressure in consultation, fasting glycemia

Table 4. Multivariate model based on metabolic syndrome condition of people with T2DM who belong to a CVRP program

Variable	Adjusted PRa	95% CI	*p* value
Gender[a]			
Male	Reference	0.86 – 1.13	0.823
Female	0.98		
Age[b]			
< 50 years	Reference	0.79 – 1.36	0.782
> 50 years	1.04		
Area of residence[c]			
Urban	Reference	1.39 – 1.59	< 0.001
Rural	1.48		
Obesity (BMI ≥ 30 Kg/m²)[d]			
No	Reference	1.11 – 1.30	< 0.001
Yes	1.20		
Hypothyroidism[e]			
No	Reference	1.01 – 1.35	0.031
Yes	1.17		
Heart disease			
No	Reference	1.04 – 1.52	0.019
Yes	1.26		

[a]PR adjusted by age, hypothyroidism, and obesity
[b]PR adjusted by gender, hypothyroidism, and obesity
[c]PR adjusted by gender, age, hypothyroidism, and obesity
[d]PR adjusted by gender, age, area of residence, and hypothyroidism
[e]PR adjusted by gender and age

Discussion

In this study, we sought to identify some clinical and sociodemographic factors potentially associated with a population with T2DM who participated in a Cardiovascular Program from Villavicencio (Capital of Meta). This work was aimed at analyzing the behavior of variables that are routinely assessed in individuals under periodic follow-up care. Specifically, we monitored metabolic syndrome and glycemic control with two dependent variables.

With respect to the sociodemographic characteristics, males were predominant (50.6%), which is contrary to previous reports which show a higher predominance of female participants[17,18]. The latter have shown a stronger susceptibility to genetic, environmental, and other factors[19]. In relation to marital status, our data revealed that there is no

relation between this variable and an adequate management of glycemia in a diabetic population. This outcome is similar to what has been published by Mexican researchers. They studied family cohesion and adaptability and their relationship with HbA1c in MD patients[20] and the health needs of diabetic patients treated at first level health care institutions[21]. On the other hand, another study has shown that T2DM individuals with a stable partner received social support three times more frequently than those without partners[22]. These observations require further analyses.

In relation to the area of residence, we presented evidence showing that individuals who lived in rural areas had a 1.42 higher risk of developing MS, which disagrees with previous findings. For instance, a study in Spain revealed that there were no significant differences in MS prevalence between rural and urban areas[23]. Similarly, a research study conducted in the Andean region of Colombia reported no significant differences in MS prevalence between women from those two areas. However, this same study indicated that MS prevalence was four times lower in men from rural areas compared to those from rural regions[24].

In relation to clinical characteristics, we did not have enough information to determine diagnosis time, T2DM evolution, and its complications. For this reason, we established HbA1c values equal to or less than 7% as a parameter for glycemic control. The reasoning behind this figure was that we were not able to control for the underestimation in patients with a short time of pathology development or the overestimation in patients with renal failure or anemia[9-11]. Despite this limitation, HbA1c is currently the best parameter to assess the quality of metabolic control in a diabetic population, especially in patients with fasting glycemia values of <180 mg/dl. Since fasting glycemia figures cannot be used to monitor glycemic control on their own, HbA1c assessments every three months should be included in all health care programs[6,25,26].

Our study indicated that obese patients had a 1.2 times higher risk of developing MS compared to those with a BMI < 30 Kg/m^2, which is in line with previous studies presenting evidence that correlates obesity and MS in T2DM patients. This association can be explained by the fact that these two disorders share similar onsets and development mechanisms that lead to cardiovascular complications[27]. However, it is important to bear in mind that this obesity value is not a specific indicator of fat accumulation in the abdominal region that is actually an important parameter of MS. Indeed, central or visceral obesity is determined via waist circumference (WC), waist-hip index (WHI) or waist-height index (WHI)[28,29].

Regarding the presence of CKD, the Clinical Practice Guide for diagnosis, treatment, and monitoring of T2DM in populations that are older than 18 years of age[11] establishes that diabetic nephropathy is diagnosed when, in addition to the presence of microalbuminuria, the GFR falls below 60 ml/min calculated through formulas such as MDRD (Modification of Diet in Renal Disease), Cockroft, or CKD-Epi (Chronic Kidney Disease Epidemiology Collaboration). It has been shown in older adults that the GFR estimated by the Cockcroft-gault formula is not the best indicator of renal function in this population. The reason behind this observation is that from the age of 60 there is a progressive reduction in the urinary excretion of creatinine as a consequence of a muscular mass decrease associated with aging.

The CKD-Epi equation using standardized creatinine methods has additional advantages over MDRD. For instance, it has a greater accuracy and improves the predictive capacity of: (i) glomerular filtration (especially with values between 60 and 90 ml/min/1.73 m^2), (ii) cardiovascular and global mortality, and (iii) risk of having terminal CKD. It is for these reasons that we think that CKD-EPI should replace the other formulas[10,30]. As in other studies, we analyzed CKD without considering criteria such as microalbuminuria (which is a renal marker of endothelial damage and early artherosclerosis[31]) because sub-registration of this variable was observed. A similar situation of poor registration was seen with the report of the abdominal circumference measurement.

In our study, 64.5% of the analyzed individuals suffered MS, which is not a simple disease but a group of health problems caused by a combination of genetic and life style factors, as shown by several studies[8,32]. The latter elements are especially related to overeating and lack of physical activity that markedly increase cardiovascular risk.

Regarding complications, it was determined that the risk to develop MS given the presence of coronary disease was 1.26 (p=0.019) but, due to the type of study, it was difficult to conclude which condition came first. Several groups have reached the conclusion that dyslipidemia represents a risk factor for both MS and coronary disease. Those studies include one carried out in La Havana, Cuba about characteristics of patients aged 50 years old or younger subjected to coronary intervention during 2006 – 2015. A similar conclusion was made by Vedanthan *et al*., who analyzed "Global perspective on acute coronary syndrome: a burden on the young and poor". Thus, lipid disorders, obesity, and insulin resistance are more frequent in patients with family history of these two conditions or with history of premature coronary disease[33,34].

The most common comorbidity we identified was PAH, which agrees with what has been reported by Roessler[35]. Our reports of blood pressure indicated that more than 85% of participants had normal pressure. However, it is important to mention that this information was obtained from a single consultation and does not determine follow-up care of blood pressure values during a specific time period. T2DM and PAH are risk factors that increase cardiovascular risks and, if they coexist, have a stronger effect on both macro- and microvascular complications. Finally, we were able to estimate that subjects with hypothyroidism had a higher risk to develop MS (PR: 1.17). Based on previous reports, the presence of hypothyroidism is significantly associated with individual components of metabolic syndrome[36,37].

Scope and limitations of the study

Because of the design and collection methods used, this study cannot establish cause-and-effect relationships. However, we were able to hypothesize about the variables presented here. Similarly, the fact that our findings are limited to the secondary information extracted from three different sources, increases the possibility of potential measurement errors. Thus, we were not able to verify variable assessment methods, including the technique used to register blood pressure and body weight, which would otherwise prevent observer-dependent variations. However, this is a potential risk present in any study that is based on secondary information, such as this one. Despite this limitation, our findings can be added to the body of evidence supporting the potential risks of diabetic patients under follow-up care. Similar studies or research with a comparable design are required to establish types of population interventions.

Conclusions

This is a cross-sectional study of a sample of patients from a HCI of Villavicencio. Even though this group of patients is periodically seen for follow-up and monitored, the prevalence of an inadequate glycemic control was close to 47%. This figure was higher in men than in women and was associated with the presence of fasting hyperglycemia.

The prevalence of MS was greater than 60% and was mostly associated with rural zones of residence, obesity, hypothyroidism and history of cardiopathy, after adjusting for gender and age. This is evidence that a large percentage of patients do not reach optimal levels of glycemic control and supports that the presence of conditions such as metabolic syndrome increases cardiovascular risks. These problems emerge even if patients are in periodic follow-up programs. These findings, if corroborated with similar studies, would indicate that greater rigor and quality of follow-up care required for T2DM patients monitored in outpatient programs such as the one described above.

Conflict of interests

The authors declare that there is no conflict of interests of any kind, real or potential, regarding the results presented here.

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