Original Article

Characterization of Patients with Type 2 Diabetes Mellitus and COVID-19 in Primary Care

Caracterización de pacientes con diabetes mellitus tipo 2 y COVID-19 en atención primaria

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Summary

Objectives: To describe the characteristics of the population diagnosed with type 2 Diabetes Mellitus (DM2) infected by SARS-CoV-2, and to evaluate whether there is an association between DM2 history and COVID-19 severity. **Methods:** non-probabilistic by convenience sampling, information was obtained from the Online Notification System for Epidemiological Surveillance (SINOLAVE) of the Family Medicine Unit No. 28 of the Mexican Institute of Social Security. A total of 1688 confirmed cases of COVID-19 were identified and grouped into patients with and without DM2. Bivariate statistical analysis was performed with Excel 2019 and Stata v. 15.1 programs; measures of association were used using Poisson logistic regression and χ^2 test with statistical significance <0.05. **Results:** it was observed that, in patients with COVID-19 and DM2, the prevalence ratio of severe acute respiratory infection, diagnosis of pneumonia, hospitalization, and death were higher compared to the group without DM2. **Conclusion:** the frequency, of unfavorable characteristics, was higher in the group of patients with DM2. Health conditions caused by COVID-19 reinforce the relevance of an intentional search for undiagnosed diabetic patients, untreated or under treatment with poor glycemic control, in order to avoid major health complications.

Keywords: COVID-19, Type 2 Diabetes Mellitus, Complications; Primary Care

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Resumen

Objetivos: describir las características de la población con diabetes mellitus tipo 2 (DM2) infectada por SARS-CoV-2 y evaluar si existe asociación entre antecedente de DM2 y severidad a COVID-19. **Métodos:** muestreo no probabilístico por conveniencia, se obtuvo información del Sistema de Notificación en Línea para la Vigilancia Epidemiológica (SINOLAVE) de la Unidad de Medicina Familiar No. 28 del Instituto Mexicano del Seguro Social. Se identificaron 1688 casos confirmados de COVID-19 y se agruparon en pacientes con y sin DM2. Se realizó análisis estadístico bivariado con los programas Excel 2019 y Stata v. 15.1; se utilizaron medidas de asociación mediante regresión logística de Poisson y prueba de χ^2 con significancia estadística <0.05. **Resultados:** se observó que, en los pacientes con COVID-19 y DM2, la razón de prevalencia de infección respiratoria aguda grave, el diagnóstico de neumonía, la hospitalización y defunción fueron mayores en comparación con el grupo sin DM2. **Conclusión:** la frecuencia de características desfavorables fueron mayores en el grupo de pacientes con DM2. Las condiciones sanitarias ocasionadas por la COVID-19 refuerzan la pertinencia de realizar una búsqueda intencionada de pacientes diabéticos no diagnosticados, sin tratamiento o bajo tratamiento con mal control glucémico, a fin de evitar complicaciones mayores de salud.

Palabras clave: COVID-19, diabetes mellitus tipo 2, complicaciones, atención primaria

Introduction

According to the National Institute of Statistics and Geography, Type 2 Diabetes Mellitus (DM2) is one of the main public health problems in our country, since 2000 it has occupied the first place in the causes of death registry.[1] In 2016, the National Center for Preventive Programs and Disease Control[2] ratified the epidemiological emergency before this disease;[3] subsequently in 2021, in the epidemiological panorama of non-communicable diseases in Mexico it was reported that this diagnosis continues in the first places of morbidity.[1,4]

It has been reported that COVID-19 has affected patients with DM2 more severely due to the deregulated response of the immune system, the high risk of uncontrolled inflammatory response, as well as a state of hypercoagulability,[5-8] which results in the so-called "cytokine storm" characteristic of acute respiratory distress syndrome in patients with COVID-19.[9-12]

International organizations[13-15] have identified that among the risk factors for increased mortality is pre-existing diabetes.[16-23] In the report of the characteristics of deaths registered in Mexico during 2020, the three leading causes of death from health problems were heart disease (20.2%), COVID-19 (18.5%) and diabetes mellitus (13.9%).[1,24,25]

In Mexico, SARS-CoV-2 cases are reported by conducting an epidemiological study of suspected cases to COVID-19, to be subsequently registered in the Online Notification System for Epidemiological Surveillance (SINOLAVE).[26]

Studies by Guo W. et al.[12] and McGurnaghan et al.[27] report that patients with diabetes and COVID-19 have a worse prognosis, a higher incidence of pneumonia with severe symptoms, the need for intensive care unit management and higher mortality. Likewise, a study by Treviño[28] observed that the estimated risk of presenting COVID-19, in relation to the comorbidities preexisting the infection, is 73% for patients with diabetes.

Given the above, the objectives of the present study focused on describing the characteristics of a population with DM2 infected by SARS-CoV-2, and evaluating whether there is an association between a DM2 history and severity of COVID-19.

Methods

Cross-sectional study conducted in a population over 20 years of age assigned to the Family Medicine Unit No. 28 of the Mexican Institute of Social Security in Mexico City; from February 1, 2020 to February 1, 2021. A non-probabilistic by convenience sampling was performed; in an initial analysis, all patients registered in the SINOLAVE database were included and a total population of 4118 cases was obtained, of which 1688 were confirmed, 1606 discarded, and 824 were registered as a suspected case of COVID-19. Patients who met the operational definition of a confirmed COVID-19 case were included, and two groups were formed: with diabetes (n=224) and without diabetes (n=1464).

A database extracted from SINOLAVE was used for data collection and the information was complemented with electronic clinical records. Classification of the disease was made according to the guidelines for sentinel surveillance of Influenza-Like Illness (ILI) and Severe Acute Respiratory Infection (SARI) issued by the National Epidemiological Surveillance System.[29]

The processing of results was filtered in the Excel program; subsequently, two types of analysis were performed for the evaluation of the results: 1. Descriptive Univariate, in which measures of central

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tendency, dispersion for quantitative variables, and frequencies for qualitative variables were obtained, and 2. Bivariate for the statistical description of the association found between the variables gender, mean age, and divided into age groups from 20 to 59 and >60 years, comorbidities, clinical data, treatment, vaccination, operational definition, type of management and reason for discharge with the DM2 variable. For comparison of the variables between both groups with contingency tables, the χ^2 test was used assuming statistical significance $p<0.05$ and for the measure of association, the prevalence ratio was used by means of a Poisson Regression model (95% CI). Statistical analysis was performed using the Stata v. 5.1 statistical package.

The research protocol was approved by the corresponding ethics and research committee.

Results

The main characteristics of this population were described, through univariate analysis, including a higher proportion of women with 55.8%, the age range with the highest prevalence was 30 to 34 years, with a mean age of 42.6 ±14.69 years. The most reported comorbidities were systemic arterial hypertension with 16.17% (n=666), obesity with 12.72% (n=524), DM2 with a proportion of 10.56% (n=435), asthma with 5.61% (n=231) and cardiovascular disease with 1.75% (n=72), see Table 1.

In the bivariate analysis, patients classified as a confirmed case of COVID-19 were stratified by DM2 history. Of these patients, the highest proportion were women in the group without diabetes compared to the group with this entity (52.2% vs 54.5%). It was observed that the proportion of patients >60 years was

Table 1. Characteristics of the Total Population Treated for Respiratory Symptoms in the Medical Unit

	Total (n=4118) %	Suspects (n=824) %	Discarded (n=1606) %	Confirmed (n=1688) %	p
Gender					
Women	55.88	55.83	57.60	54.27	0.15
Non-pathological History					
Received anti-influenza vaccine	24.19	13.83	26.21	27.31	0.01
Smoking	11.36	7.04	13.70	11.26	0.01
Comorbidities					
Arterial Hypertension	16.17	6.43	17.62	19.55	0.01
Obesity	12.72	8.62	13.64	13.86	0.01
Diabetes	10.56	5.22	10.46	13.27	0.01
Asthma	5.61	3.28	6.79	5.63	0.01
Immunosuppression	0.92	0.12	1.00	1.24	0.02
Cardiovascular disease	1.75	0.73	1.87	2.13	0.04
COPD	1.53	0.49	1.99	1.60	0.02
HIV	1.36	0.61	1.87	1.24	0.04
Initial Symptoms					
Headache	74.04	48.18	81.07	79.98	0.01
Cough	67.97	42.96	70.73	77.55	0.01
Odynophagia	57.87	37.14	66	60.25	0.01
Myalgia	59.20	39.44	61.15	67	0.01
Arthralgia	52.11	32.77	54.3	59.48	0.01
Fever	44.80	32.16	40.97	54.62	0.01
Dyspnea	22.97	11.17	24.35	27.43	0.01
Anosmia	0.46	6.43	15.07	28.26	0.02
Dysgeusia	16.61	14.38	14.38	23.46	0.01
Diagnosis of Pneumonia					
Clinical Pneumonia	5.34	1.09	4.36	8.35	0.01
Radiographic pneumonia	4.66	1.09	3.92	7.11	0.01
Case Definition					
ILI (Influenza-Like Illness)	84.12	56.18	94.58	87.80	0.01
SARI	5.10	0.49	2.74	9.60	
Management					
Outpatient	93.69	99.27	96.51	88.27	0.01
Hospitalization	6.31	0.73	3.49	11.73	
Discharge					
Improvement	96.06	99.27	98.07	92.59	0.01
Death	3.40	0.37	1.44	6.76	

Table 2. Characteristics of COVID-19 Patients Categorized with Respect to Type 2 Diabetes History

	Total (n=1688) %	Confirmed with diabetes (n=224) %	Confirmed without diabetes (n=1464) %	p
Age in years*	44.7 ± 15.2	59.1±13.1	42.5±14.2	<0.001
Age %				
20 a 59	82.46	52.68	87.02	<0.001
> 60	17.54	47.32	12.98	
Gender				
Women	54.27	52.23	54.58	0.512
Men	45.73	47.77	45.42	
Non-pathological History				
Received anti-influenza vaccine	27.31	25.58	27.53	0.609
Smoking	11.26	14.73	10.72	0.077
Comorbidities				
Hypertension	19.55	52.23	14.55	<0.001
Obesity	13.86	22.65	77.35	<0.001
Asthma	5.63	5.36	5.67	0.850
Cardiovascular Disease	2.13	4.91	1.71	0.002
COPD	1.60	4.46	1.16	<0.001
Immunosuppression	1.24	2.68	1.02	0.038
HIV	1.24	1.34	1.23	0.890
Initial Symptoms				
Headache	79.98	71.43	81.28	0.001
Cough	77.55	80.36	77.12	0.279
Odynophagia	60.25	59.82	60.31	0.888
Myalgia	67.00	67.86	66.87	0.770
Arthralgia	59.48	58.04	59.70	0.637
Fever	54.62	62.50	53.42	0.011
Anosmia	28.26	23.21	29.03	0.072
Dyspnea	27.43	44.20	24.86	<0.001
Dysgeusia	23.46	23.66	23.43	0.939
Diagnosis of Pneumonia				
Clinical Pneumonia	8.35	18.75	6.76	<0.001
Radiographic Pneumonia	7.11	16.96	5.60	<0.001
Case Definition				
ILI (Influenza-Like Illness)	87.80	74.55	89.82	<0.001
SARI	9.60	25.45	7.17	
Not accomplish	2.61	0.00	3.01	
Management				
Outpatient	88.27	68.75	91.26	<0.001
Hospitalization	11.73	31.25	8.74	
Discharge				
Improvement	92.59	83.04	94.06	<0.001
Death	6.75	16.96	5.19	

*t –student test

higher in the group with DM2 compared to the group without DM2 (47.3% vs 12.9% p= 0.512). In non-pathological history, smoking was more prevalent in the group with DM2 (14.7%). Patients with DM2 had a higher prevalence of hypertension (52.2%), cardiovascular disease (4.9%) and COPD (4.46%); the prevalence of obesity was higher in the group without this disease (77.3%), see Table 2.

Patients with DM2 had a higher tendency to present dyspnea (p<0.001), headache (p= 0.001) and fever (p=0.011) compared to patients without the DM2. A higher proportion of clinical pneumonia diagnosis (18.7% vs. 6.7%, p<0.001) and radiographic pneumonia (16.9% vs. 5.6%, p<0.001) was found in patients with diabetes. Based on case definition classification, the proportion of patients with SARI (Severe Acute Respiratory Infections) was greater in the group with DM2 (25.4% vs 7.1%, p<0.001).

Regarding the management patients received, the proportion of hospitalization was higher in diabetic patients (31.2% vs 8.7%, p<0.001). The proportion was higher in the death category, as a reason for discharge, in the group with diabetes (16.9% vs. 5.1%, p<0.001).

The characteristics of patients with COVID-19 and DM2 were adjusted for recorded comorbidities (arterial hypertension, obesity, COPD, asthma, immunosuppression, and HIV). The SARI prevalence ratio was higher in the group with diabetes 1.16 (CI: 95%1.10-1.22) compared to patients without this disease 1.02 (CI: 95% 1.01-1.04). Hospitalization, and discharge due to death had a higher prevalence ratio in the group with DM2 0.79 (CI: 95% 0.72-0.87), and 1.59 (CI: 95% 1.06-2.38) respecti-

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Table 3. Association Between Type 2 Diabetes and Main Characteristics of Patients with COVID-19

Variable	ADJUSTED PR *	(CI 95%)
Age % (Ref. 20 a 59)		
> 60		
With diabetes	2.31	1.84-2.91
Without diabetes	0.1	0.09-0.12
Gender (Ref. Men)		
Women		
With diabetes	0.97	0.84-1.12
Without diabetes	0.04	0.51-0.57
Non-pathological History		
Smoking (Ref. No)		
With diabetes	1.31	0.92-1.88
Without diabetes	0.1	0.08-0.12
Initial Symptoms		
Headache (Ref. No)		
With diabetes	0.9	0.82-0.98
Without diabetes	0.81	0.79-0.83
Fever (Ref. No0)		
With diabetes	1.11	0.99-1.25
Without diabetes	0.51	0.49-0.54
Dyspnea (Ref. No)		
With diabetes	1.45	1.20-1.75
Without diabetes	0.22	0.20-0.24
Case Definition (Ref. ILI)		
SARI		
With diabetes	1.16	1.10-1.22
Without diabetes	1.02	1.01-1.04
Diagnosis of Pneumonia		
Clinical Pneumonia (Ref. No)		
With diabetes	2.08	1.42-3.06
Without diabetes	0.05	0.04-0.06
Radiographic pneumonia (Ref. No)		
With diabetes	2.32	1.49-3.61
Without diabetes	0.05	0.04-0.06
Management (Ref. Outpatient)		
Hospitalization		
With diabetes	0.79	0.72-0.87
Without diabetes	0.05	0.04-0.07
Discharge (Ref. Improvement)		
Death		
With diabetes	1.59	1.06-2.38
Without diabetes	0.05	0.04-0.07

PR: Poisson Regression model. *Adjusted to comorbidities: arterial hypertension, COPD, asthma, immunosuppression, HIV, obesity, and cardiovascular risk.

vely, compared to patients without this disease 0.05 (CI: 95% 0.04-0.07).

Discussion

An association was found between severity by COVID-19, diagnosis of pneumonia, types of management, and discharge in patients with DM2 history. In the studied population, the highest proportion of patients attended were women (55.88%) aged between 30 and 34 years, and mean age of 42.6 ±14.69. These values were different from those reported by Treviño,[28] who identified a higher incidence in the age range of 40 to 49 years and mean age of 64.3 years. This difference may be due to the characteristics of the population assigned to our Family Medicine Unit, as well as to other variables not included in this study.

On the other hand, in the study of patients with COVID-19 by Solís and Carreño,[30] a prevalence of arterial hypertension (20.61%), obesity (19.4%), type 2 Diabetes (16.7%), and smoking (9.4%) was reported; these results are comparable to those obtained in the present study and may therefore reflect an important behavior of the metabolic diseases treated mainly at the first level of care and the affectation by COVID-19.

In the comparative analysis of the initial symptomatology reported in patients with and without DM2, the most prevalent symptom was dyspnea. This is similar to that reported by Guo et al.[12], and Ciardullo et al,[31] who found dyspnea in patients with and without DM2 and with COVID-19 with a higher proportion in the group of patients with diabetes (p=0.01).

When evaluating the diagnosis of pneumonia, it was determined that the highest proportion of clinical pneumonia (18.75%, p<0.001), and radiographic pneumonia (16.96%, p<0.001) was present in patients with DM2, which is consistent with previous reports.[32-34] This correlation of results presents evidence that patients with DM2 infected with SARS-CoV-2 are at higher risk for complications and a fatal outcome, the mechanisms underlying this disease behavior are still under investigation.

In the present study it was found possible associations between DM2 and mortality due to COVID-19; this has been confirmed in other studies in which the increase in hospitalization rates, days of hospital stay, ICU admissions, and risk of death increase in persons with both diseases.[33-36] It can be seen in different studies that there is an association between a history of DM2 and an increased risk of severe complications, the need for management at a second or third level of care, and a higher prevalence of mortality due to COVID-19; therefore, primary care level should be alert in the management and control of metabolic diseases that potentiate the effects of other emerging diseases.

The strength of this study comes from the similarity of the found data with those reported at the national level.[37] The limitations are in the recording of the information in the epidemiological study, which was incomplete in some cases, and in the lack of recording of the DM2 diagnosis in the electronic file.

Conclusion

The proportion and prevalence of characteristics that can modify the evolution and outcome of COVID-19 disease unfavorably were higher in the group of patients with DM2 history. It is necessary to reinforce the intentional search for patients with undiagnosed type 2 diabetes, untreated and/or with poor glycemic control in order to propose strategies to mitigate their vulnerability to COVID-19, and other infectious diseases, through a comprehensive approach from the primary care level.

Authors' contributions

E M-G: conceptualization, analysis, and discussion of results, and writing; G V-M: data analysis; V C S-E, conceptualization, development, and writing.

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