DOI: 10.5455/msm.2022.34.272-277
Received: Sep 02 2022; Accepted: Oct 14, 2022

ORIGINAL PAPER Mater Sociomed. 2022 Dec; 34(4): 272-277

Impact of COVID-19 on Patients with Diabetes Standard of Care in the Jazan Region, Saudi Arabia

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ABSTRACT

Background: COVID-19 patients with DM have increased mortality and severity of the disease. Although telemedicine helps to minimize the impact of COVID-19 on the DM standard of care, it is increasingly evident that COVID-19 has a significant impact on DM standards of care, especially in areas where telemedicine is not available. **Objective:** The study aimed to assess the impact of COVID-19 on patients with diabetes standard of care in the Jazan region, Saudi Arabia. **Methods:** A cross-sectional study using an online pretested questionnaire targeted adult diabetic patients living in the Jazan region between December 2021 to March 2022. The participants were selected through a random sampling method. They completed self-administered questionnaires that included demographic variables. **Results:** A total of 258 study subjects participated in this study. In comparison to DM standards of care before and during COVID-19, there was no clinically significant difference in medication compliance, blood glucose checking, or experiencing blood glucose extrusion. However, with the spread of the corona pandemic and the closure of clinics, the percentage of those who have difficulty controlling blood sugar levels has increased to 22%, despite the availability of telemedicine. **Conclusion:** DM standards of care have not been affected and were not statistically significant, which could be explained by the rapid adoption of telemedicine during the lockdown. However, as corona spread participants had difficulty controlling blood sugar levels. This indicates that governmental multidisciplinary work limits the COVID-19 impact; however, further work is still needed to ensure that DM care is not compromised.

Keywords: Diabetes Mellitus, COVID-19, Telemedicine.

1. BACKGROUND

Diabetes mellitus (DM) is a group of heterogenous disturbances of the metabolism caused by either a defect in insulin secretion or a defect in insulin action, or both, leading to chronic elevation of blood glucose (1). DM is associated with multisystemic complications that carry high mortality and morbidity rate, including diabetic ketoacidosis, a non-ketotic hyperosmolar state that is considered an acute complication; other long-term complications are cerebrovascular and cardiovascular complications; diabetic retinopathy, which may progress into blindness; nephropathy, which may progress into renal failure; and neuropathy, with high susceptibility to infections, foot ulcer, and eventually amputation (2, 3).

According to a study published on November 12, 2020, by J.C.N. Chan, the estimated prevalence of DM is approximately 463 million worldwide, rapidly increasing in low- and middle-income countries (4). According to a Knowledge, Awareness, and Practice (KAP) study conducted in Jazan by Ibrahim A. Bani in 2015, DM is becoming more common in Arabian Gulf countries. Saudi Arabia is the country with the seventh most significant number of diabetics between 2000 and 2030 (5). In Saudi Arabia, the estimated prevalence was 18.3%, as documented by the International Diabetes Federation (IDF) (6). The estimated prevalence of DM in Jazan province in 2015 was 12.3% (5).

On December 31, 2019, pneumonia with unknown origin began in China's Hubei province (7). The disease is a novel coronavirus of 2019 (COVID-19) that is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (8). Pneumonia was the first clinical symptom of the SARS-CoV-2-linked disease COVID-19 that permitted case discovery. More recent findings, particularly among young children, indicate gastrointestinal symptoms and silent infections (9).

From the initial period of the pandemic, multiple factors have been linked to a higher risk for mortality from COVID-19, including male gender, old age, obesity, DM, hypertension (HTN), cancer, chronic obstructive pulmonary disease, and cardiovascular diseases (10).

DM is considered one of the commonest comorbid conditions contributing to severe outcomes in patients with COVID-19 (11). Because of hyperglycemia, reduced immune function, vascular problems, and comorbidities such as HTN, obesity, and cardiovascular disease, DM is one of the key risk factors for catastrophic outcomes from COVID-19 (12) when an outbreak of pneumonia cases emerged in Wuhan, China. The COVID-19 pandemic has led to a global health crisis, devastating the social, economic and political aspects of life. Many clinicians, health professionals, scientists, organizations, and governments have actively defeated COVID-19 and shared their experiences of the SARS-CoV2. Diabetes is one of the major risk factors for fatal outcomes from COVID-19. Patients with diabetes are vulnerable to infection because of hyperglycemia; impaired immune function; vascular complications; and comorbidities such as hypertension, dyslipidemia, and cardiovascular disease. In addition, angiotensin-converting enzyme 2 (ACE2. Compared to nondiabetic patients, there is a two- to four-fold increase in mortality and severity among diabetic patients with COVID-19. COVID-19 patients with DM have severe clinical issues, increased frequency of ICU admissions, need for machine-assisted ventilation, and a significant increase in inflammatory markers (13).

A cross-sectional study enrolling 1,124 subjects in Indonesia from July 21, 2020, to August 4, 2020 determined that COVID-19 had influenced diabetes management. The responses showed that 30.07%, 12.37%, and 9.52% of patients had difficulties attending diabetes consultations, accessing medications, and checking blood glucose levels, respectively. Furthermore, patients with difficulties during the pandemic had an increased risk of diabetic complications by 1.4 times. Fewer than half had utilized the available online resources and attended online meetings with their doctors to minimize the impact of the COVID-19 pandemic (14).

Another survey showed that glucose metabolism was impaired during the lockdown, and the level of HbA1c had increased owing to physical inactivity and consumption of sugary food (15,16). Regarding telemedicine's effectiveness, randomized controlled telemedicine trials involving 2,768 subjects showed a reduction of HbA1c in patients on telemedicine by (−0.37%). A review of 46 studies, including 2,052 patients with T1DM and 24,000 with T2DM, showed that the mean reduction in HbA1c in telemedicine is (−0.12% and −0.86%) in T1DM and (−0.01% to −1.13%) in T2DM. However, telemedicine cannot help in physical examination (17). In a cross-sectional study in Jeddah, Saudi Arabia involving 394 patients, the authors concluded that Saudi diabetes patients' levels of compliance, medical treatment, and lifestyle habits were significantly reduced as a consequence of the COVID-19 lockdown (18).

Although telemedicine helps to minimize the impact of COVID-19 on the DM standard of care, it seems to be more evident that COVID-19 had a significant impact on DM standards of care, especially in an area where telemedicine was not available.

2. OBJECTIVE

This study's authors aimed to assess the impact of the COVID-19 pandemic on diabetic patients living in Jazan province regarding their medication compliance, and extent of provided care.

3. MATERIAL AND METHODS

This was an observational cross-sectional study of adult patients with diabetes to assess the impact of COVID-19 on patients with diabetes standard of care in the Jazan region, Saudi Arabia between December 2021 to March 2022. Jazan city's population is 1.568 million, of whom more than 39,000 are diabetic patients. This study included all adult with diabetes aged 16–75 in the Jazan region.

The data was collected using the Arabic language self-administered electronic questionnaire that requires acceptance by the participants, based on the previous study. This questionnaire is divided into 3 sections; The first section concerns sociodemographic factors, the second section concerns compliance with medications and lifestyle habits before and during the pandemic, and the third section assesses the impact of COVID-19 on the extent of care provided to diabetic patients.

Data are presented as frequencies and valid percentages for categorical variables. Analysis of variance (ANOVA) was used to compare means across the different groups. All P values < 0.05 were considered statistically significant. IBM SPSS (Statistical Package for the Social Science), version 23 for Microsoft Windows, was used to perform all the statistical calculations. The analysis was conducted by calculating means, percentages (%), and ± standard deviation (SD) for the data. The Chi-square test was used for comparison among the variables.

4. RESULTS

Patients' demographic characteristics

The number of 285 responses to an online survey were included in the research. Males represented most participants (56.1%), while 43.9% were female. Most participants had a healthy body mass index (BMI) and were not smokers, 34.2% and 73.3%, respectively. Ages were classified into 6 subgroups, including all adults from less than 20 years old to over 60 years old. The age of about a third of the participants fit into the group of 20–30 years (27%). The study was conducted on the residents of the Jazan region, and 97.9% were Saudis. Regarding marital status, more than half of the participants was married (57.7%). A large percentage of participants, including both genders, was educated. Finally, only 11.9% worked on the frontline against COVID-19, and

Variables	Frequency	Percent
Gender		
Male	160	56.1
Female	125	43.9
Age group (years)		
⩽20	32	11.2
20–30	78	27.4
31–40	38	13.3
41–50	66	23.2
51–60	52	18.2
⩾60	19	6.7
Nationality		
Saudi	279	97.9
Non-Saudi	6	2.1
Educational level		
High school and below	108	37.9
Bachelor's degree	166	58.2
Postgraduate degree	11	3.9
BMI (kg/m2)		
Underweight	21	7.5
Healthy	96	34.2
Overweight	87	31
Obese	77	27.4
Smoking		
Ex-smoker	27	9.5
Non-smoker	210	73.7
Smoker	48	16.8
Working on the frontline against COVID-19		
Yes	34	11.9
No	251	88.1
Marital status		
Single	100	35.1
Married	164	57.5
Widow/Widower	10	3.5
Divorced	11	3.9
Presence of comorbidities in addition to DM		
Yes	43	15.1
No	242	84.9

Table1. Patients' demographic characteristics. BMI: Body Mass Index, MD: Diabetes Mellitus.

the majority of the participants, representing 84.9%, did not have comorbidities in addition to diabetes (Table 1).

Medication compliance and lifestyle habits before and during pandemic

Diabetic patients who responded were asked about medication compliance, blood glucose extrusion, hypoglycemia or hyperglycemia, and lifestyle habits before the COVID-19 pandemic. Most of the patients took their medications and checked their blood glucose regularly, 79.3% and 76.8%, respectively. More than half of the studied participants experienced glucose extrusion, 56.1% with hypoglycemia,

Variables	Before the pandemic		During the pandemic	
	N	%	N	%
BMI during the pandemic (kg/m2)				
Underweight	22	7.8	21	7.5
Healthy	98	34.6	96	34.2
Overweight	86	30.4	87	31
Obese	77	27.2	77	27.4
Medication compliance				
Yes	226	79.3	225	78.9
No	12	4.2	11	3.9
Sometimes	47	16.5	49	17.2
Blood glucose monitoring				
Glucometer	219	76.8	206	72.3
Continuous glucose monitoring	35	12.3	44	15.4
None	31	10.9	35	12.3
Experiences symptoms of hypoglycemia				
Yes	160	56.1	146	51.2
No	125	43.9	139	48.8
Experiences symptoms of hyperglycemia				
Yes	174	61.1	168	58.9
No	111	38.9	117	41.1
Commits to participation in physical activity				
Yes	101	35.4	76	26.7
No	42	14.7	83	29.1
Sometimes	142	49.8	126	44.2
Commits to a specific diet				
Yes	63	22.1	99	34.7
No	88	30.9	47	16.5
Sometimes	134	47	139	48.8

Table 2. The compliance with medications and lifestyle habits before and during the pandemic. BMI: Body Mass Index

and 61.1% with hyperglycemia. As for as lifestyle habits are concerned, we asked about body mass index (BMI), and we found that 34.6% attempted to maintain a healthy BMI, while 30.4% were overweight and 27.2% were obese. Furthermore, 49.8% of patients were sometimes committed to participating in physical activities, while 35.4% were committed to participating regularly. Patients committed to a specific diet before the pandemic represented 47%, respectively, as shown in Table 2.

Following the COVID-19 pandemic, the same set of questions was asked to patients. As for lifestyle habits, 34.2% of patients had healthy BMI, 31% were overweight, and 27.4% were obese. Additionally, patients who sometimes participated in physical activities represented 44.2%, while 26.7% were dedicated to regularly participating in physical activities. Following the pandemic, 48.8% of the patients sometimes committed to participating in a specific diet. Regarding medication compliance after the pandemic, 78.9%

	Yes		No		Sometimes	
	N	%	N	%	N	%
Since the start of the pandemic, have you been getting all your diabetes medicines without any delay?	171	60	22	7.7	92	32.3
Is the way to dispense the new medicines better and more comfortable, and do you find it easy?	189	66.3	37	13	59	20.7
Do you have enough blood glucose reading supplies at home?	200	70.2	85	29.8		
Do your health care providers review your blood glucose readings regularly?	135	47.4	65	22.8	85	29.8
With the outbreak of the COVID-19 pandemic and the closure of clinics, do you find it difficult to control your sugar levels?	64	22.5	149	52.3	72	25.3
Before the pandemic, did regular clinic visits make you feel better?	140	49.1	39	13.7	106	37.2
Do you feel that your health has started to decline since the pandemic?	40	14	192	67.4	53	18.6
Since the beginning of the pandemic, have you been complaining of any complications of diabetes?	61	21.3	224	78.3		

Table 3. Assessment of the impact of COVID-19 on the extent of care for diabetic patients.

of patients routinely took their prescribed medication, and 72.3% frequently used glucometers to check their blood glucose levels. Additionally, more than half of the patients had hyperglycemic symptoms (58.9%) or hypoglycemic symptoms (51.2%), as demonstrated in Table 2.

Assessment of the impact of COVID-19 on the extent of care for diabetic patients

To better understand the impact of COVID-19 on the extent of health care provided to patients with diabetes, it was essential to ask the participants if they could receive all diabetes medications without delay; 60% of them received the medication on time, and 66.3% felt it was comfortable and convenient despite their medication using the new way of medication dispensation. Over two-thirds, 70% of patients, confirmed that they had the supplies to read glucose at home regularly. However, only 47.7% of them received regular follow-ups from health care providers to review their glucose readings. Surprisingly, more than half of the participants (52.3%) did not find it difficult to control their blood glucose levels. Meanwhile, with the spread of the corona pandemic and the closure of clinics, the percentage of those who had difficulty controlling blood sugar levels was 22%. Most patients felt better when visiting clinics before the outbreak of the pandemic, and it was an influential factor, in that 49.1% of them said yes, and 37.2% sometimes felt relieved. In comparison, 13.17% did not feel better when visiting the clinic before the pandemic. Many participants had a deterioration in their health or the emergence of new complications, as documented in Table 3.

5. DISCUSSION

DM is a persistent illness that burdens people and the health care system (18). We noticed that the effect of the COVID-19 pandemic on the DM standard of care remains unclear. In this study we aimed to assess the impact of COVID-19 on patients with diabetes standard of care in the Jazan region. We found the risk of complications significantly increased during COVID-19 in areas where telemedicine was unavailable.

According to our research findings, patients in the Jazan region who had diabetes before and during COVID-19 showed no change in their medication compliance, blood glucose monitoring, or experience of blood glucose extrusion (Table 2) compared to a similar study (14, 15). However, some patients began to have difficulty controlling their blood glucose levels owing to the closure of clinics. At the same time, more than half of the participants did not find it difficult to regulate their blood glucose levels. The compliance levels of diabetic patients during lockdowns were evaluated. In a study conducted in India, the authors developed a prediction model for the impact of lockdowns on diabetic patients and the incidence of complications related to diabetes. They found a direct relationship between lockdown length and noncompliance, associated with increased diabetes-related complications and uncontrolled glycemia (19). Our findings show patients' compliance with medical treatment was not significantly affected during the lockdown, and this could be explained by the rapid adoption of telemedicine during the lockdown.

Regarding lifestyle, the COVID-19 pandemic has increased the number of patients not participating in physical exercise. During the COVID-19 pandemic, engagement in physical activity decreased compared to the commitment to a healthy diet, which improved in lockdown.

Lockdown policies established to prevent the spread of SARS-CoV-2 may result in a deterioration of diabetes control in people with diabetes owing to difficulty in accessing the health care system, a lack of physical activity, and increased stress or anxiety (19–21). Anxiety has been linked to less frequent blood glucose testing and inadequate glycemic management (22).

Furthermore, a study assessing the impact of lockdown policies during the COVID-19 pandemic on glycemic control was evaluated using data from 307 patients with type 1 diabetes. It was shown, via a follow-up of patients' glycated hemoglobin levels and random blood sugar measurements, that the lockdown affected the improvement of glycemic control after 8 weeks of lockdown (23). Also, another study conducted in Jeddah, Saudi Arabia, showed lower levels of compliance during the lockdown (18). The present study conducted on patients from Jazan province and showed no change in blood glucose levels before and after the pandemic (Table 2).

Regarding the importance of maintaining a healthy weight to improve the glycemic level, during the lockdown, some people found it difficult to maintain (Table 2). A sur-

vey involving 1,200 subjects, both diabetic and nondiabetic participants, showed that the prolonged lockdown during COVID-19 had caused an increase in body weight in both groups based on several factors such as lack of physical activity and post-dinner snacking (24). Lack of physical activity and consumption of sugary food have been risk factors in increasing blood glucose and body weight during the COVID-19 pandemic (15, 16). Interestingly, this study did not show a significant increase in BMI during the pandemic (Table 2). Although physical activity plays a role in glycemic control, in this study we found that 29% of subjects had not participated in physical activity during the pandemic (Table 2). This result was similar to previous studies; authors of a study enrolling 1,124 participants found that 36.48% had difficulties exercising regularly (18). Another study involving 150 participants showed that 66.1% of patients had decreased their physical activity during the lockdown (25).

This study has several limitations. First, our study population was diabetic patients in Jazan region, so the generalizability of our results is limited. Second, data were collected via self-administered questionnaires, which depended predominantly on the patients' honesty and subjective opinions; this may result in inaccurate answers owing to the interview-based study design.

6. CONCLUSION

The study has demonstrated that in adult patients with diabetes in the Jazan region, their DM standards of care before and during COVID-19 have not been affected and were not statistically significant. This care includes medication compliance, blood glucose checking, or experiencing blood glucose extrusion, regarding which the rapid adoption of telemedicine during the lockdown could explain these findings. However, with the spread of the corona pandemic and the closure of clinics, some patients started noticing difficulty controlling their blood glucose levels. Thus, these findings highlight the tremendous effort of the Saudi government, the Ministry of Health, and other health sectors to minimize the effect of the lockdown on health care services and how quickly all health care sectors were able to adopt telemedicine and provide the maximum possible service with no delay or interruption. However, despite all the efforts, some patients had difficulty accessing telemedicine, which may affect their health. We highly recommend further studies in Saudi Arabia to build a strategic plan in which the health care service will not be affected.

- **Author's contribution:** All authors were involved in all steps of preparation this article. Final proofreading was made by the first author.
- **Conflict of interest:** None declared.
- **Financial support and sponsorship:** Nil.

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