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Managing Type 1 Diabetes among Saudi adults on insulin pump therapy during the COVID-19 lockdown

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ABSTRACT

Background and aims: The coronavirus disease 2019 (COVID-19) pandemic has affected people's lives including patients with type 1 diabetes mellitus (T1DM). We aimed to investigate the impact of the COVID-19 lockdown on psychological status, self-management behaviors, and diabetes care maintenance among Saudi adults with T1DM using insulin pump therapy.
Methods: This cross-sectional study used a web survey to collect data on Saudi adults with T1DM who were treated in the specialized insulin pump clinic at King Abdulaziz Medical City-Jeddah, Saudi Arabia. We used the Patient Health Questionnaire-9 and General Anxiety Disorder-7 scales to measure depression and anxiety.
Results: Of the 70 patients who received the survey, 65 completed it. Overall, 23.1% and 29.2% of the patients reported moderate to severe and mild depression, respectively; 18.5% and 24.6% reported moderate to severe and mild anxiety, respectively. Compared with pre-lockdown, adherence to a healthy diet and regular physical activity decreased in 67.7% and 41.5% of the patients, respectively. Most patients maintained their adherence to insulin pump behaviors; frequent self-monitoring of blood glucose increased in 47% of glucometer users. Most patients benefited from phone visits or virtual education sessions, but 66.2% of the patients reported difficulty obtaining at least one type of insulin pump supply.
Conclusions: Promoting self-management behaviors and psychological wellbeing of patients with T1DM using insulin pump therapy is crucial during a lockdown. Telemedicine is a useful alternative to in-person appointments, but strategies to ensure that patients have access to adequate resources during lockdown must be developed.

1. Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) belongs to coronaviruses, which are classified as positive-sense single-stranded RNA viruses [1]. This virus was first identified in Wuhan City, China, in late 2019, and it has been spreading around the world since then. On March 11, 2020, the World Health Organization declared the outbreak of SARS-CoV-2 and its associated disease, coronavirus disease 2019 (COVID-19), a pandemic [2]. In response to the pandemic, many countries instituted lockdowns and social distancing measures to combat the spread of the virus. Specifically, Saudi Arabia imposed a curfew in late March [3,4], including transportation restrictions, workplace attendance suspension, closure of malls and markets, and constraints on dining in restaurants [5]. Consequently, customers were heavily dependent on delivery services for their habitual needs. On June 21, 2020, the lockdown was completely lifted off the country [6].

Type 1 diabetes mellitus (T1DM) is a chronic disease characterized by the autoimmune destruction of pancreatic beta cells leading to a lack of insulin production. Saudi Arabia has one of the highest incidence rates of T1DM worldwide, with an annual rate of 31.4 cases/100,000 individuals in young children (<15 years old) [7]. Insulin pump therapy and multiple daily injections are the two most common treatments to provide intensive insulin therapy. This therapy is associated with a decrease in HbA1c levels and in micro- and macrovascular complications in patients with T1DM [8].

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The COVID-19 pandemic has negatively affected people's lives due to constant stress and fear of contracting the virus. Patients with diabetes habitually experience an increased level of negative emotions, which may lead to poor glycemic control during the pandemic [9]. Diabetes self-management behaviors—practicing physical exercise, maintaining a healthy diet, monitoring blood sugar levels, and adhering to medications—were expected to be adversely affected during the lockdown. Additionally, the inability to perform routine in-clinic visits and difficulty obtaining medical supplies posed challenges in maintaining optimal diabetes care throughout this period [9,10].

At King Abdulaziz Medical City-Jeddah, we have a specialized insulin pump clinic for the routine care of adults with T1DM using insulin pump therapy. The clinic is operated by a multidisciplinary team, including a certified endocrinologist, a clinical nutritionist, a diabetes educator, and a representative from the insulin pump company, who provide comprehensive diabetes care through education, simulation, and troubleshooting of any insulin pump issues. During the lockdown, we implemented a telemedicine service that served as the primary mean of performing routine visits and education sessions.

This study aimed to investigate the impact of the COVID-19 lockdown on psychological status, self-management behaviors, and maintenance of diabetes care among Saudi adults with T1DM attending the specialized insulin pump clinic at King Abdulaziz Medical City-Jeddah.

2. Subjects, materials, and methods

2.1. Study design and setting

This cross-sectional study included Saudi adults (≥18 years old) with T1DM on insulin pump therapy who were actively attending the specialized insulin pump clinic at King Abdulaziz Medical City-Jeddah. A web survey in Arabic was created using Google Forms and distributed to patients via social media over three days after the lockdown ended in Saudi Arabia (June 21–23, 2020).

2.2. Compliance with ethical standards

Before conducting the study, we obtained the approval of the Institutional Review Board of the King Abdullah International Medical Research Center, National Guard Health Affairs, Riyadh, Saudi Arabia, with Memorandum Reference No. IRBC/0904/20 dated June 17, 2020. Participants provided informed consent before responding to the survey.

2.3. Data collection

The survey contained five parts. The first part included demographic data such as age, sex, level of education, occupation, marital status, smoking history, mental health history, height, and current weight. The second part contained questions about diabetes and insulin pump history, including the type of insulin pump currently used and blood glucose monitoring method.

The third part referred to difficulties faced in maintaining routine care, including virtual appointments, virtual education, and availability of insulin pump-related supplies. Patients were asked if they had a scheduled phone appointment with a physician during the lockdown period, and whether the encounter was beneficial; whether they received virtual education by a diabetic educator or physician, the method of communication used, and whether the encounter was beneficial; which insulin pump supply they had difficulty obtaining, if any, and whether they had to use multiple daily injections instead of the insulin pump due to lack of supplies.

The fourth part assessed the impact of the lockdown on different self-management behaviors. Patient were asked to report any perceived weight change in kilograms and to rate the following behaviors in comparison with the pre-lockdown period: ability to follow a healthy diet, ability to maintain physical activity, and experience of hyperglycemia or hypoglycemia symptoms. In addition, patients were asked to report any change in the adherence level to different insulin pump behaviors: carbohydrate counting, use of bolus wizard during mealtimes, use of bolus wizard for correction of hyperglycemia, and frequent self-monitoring of blood glucose (≥4 times/day) for glucometer users.

The fifth part assessed the psychological status during the lockdown. We used the Arabic versions of the Patient Health Questionnaire-9 (PHQ-9) and General Anxiety Disorder-7 (GAD-7) scales to measure depression and anxiety, respectively. Pre-lockdown HbA1c level was obtained from the hospital's electronic medical record system.

2.4. Measures of psychological status

The PHQ-9 and GAD-7 scales are validated tools for the screening of depression and anxiety in clinical practice [11,12]. The Arabic versions of both questionnaires were previously validated based on a sample of Saudi adults [13].

The PHQ-9[11] contains nine questions pertaining depression symptoms included in the Diagnostic and Statistical Manual of Mental Disorders (4th edition) diagnostic criteria for major depressive disorder. Patients were asked how often they experienced any depression symptom in the past 14 days. The responses for each question were "not at all", "several days", "more than half the days", and "nearly every day", with a corresponding score of 0, 1, 2, and 3, respectively. The total score was the sum of the scores of all the questions. Cut-off points of 5, 10, 15, and 20 were used to represent mild, moderate, moderately severe, and severe depression, respectively. A PHQ-9 score ≥10 was used to define moderate to severe depression.

The GAD-7[12] uses seven questions to evaluate the presence and severity of generalized anxiety disorder in clinical practice. Patients were asked how often they experienced any anxiety symptom in the past four weeks. The responses for each question were "not at all", "several days", "more than half the days", and "nearly every day", with a corresponding score of 0, 1, 2, and 3, respectively. The total score was the sum of the scores of all the questions. Cut-off points of 5, 10, and 15 were used to represent mild, moderate, and severe anxiety, respectively. A GAD-7 score ≥10 was used to define moderate to severe anxiety.

2.5. Statistical analysis

Descriptive data were presented as mean (±standard deviation). Categorical variables were presented as frequencies and percentages. To determine associations between different self-management behavioral changes that occurred during the lockdown, we combined "greatly increased" with "somewhat increased", and "greatly decreased" with "somewhat decreased" ratings to facilitate interpretation. Differences between groups were analyzed using the chi-squared test or Fisher's exact test for categorical data. A P-value <0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics software, version 23.0 (IBM Corp, Armonk, New York, USA).

3. Results

3.1. Demographic characteristics

Of 70 patients attending the specialized insulin pump clinic who received the survey, 65 completed the questionnaire. Among those who did not complete it, four did not respond and one refused to participate. Table 1 summarizes the participants' demographic characteristics. The mean age of participants was 30 ± 7.88 years, and the majority (70.8%) were females. The average duration of diabetes was 17.67 ± 6.89 years, and the average duration of insulin pump use was 5.69 ± 3.7 years. Pre-lockdown, the mean HbA1c level was 7.44 ± 1.01%. Of the 45 patients (69.2%) using the Medtronic MiniMed Paradigm Real Time 722 insulin pump, 34 (75.6%) used a glucometer for monitoring blood sugar, and 11 (24.4%) used flash glucose monitoring with the Freestyle Libre sensor. Of the 20 patients (30.8%) using Minimed 640G insulin pump with SmartGuard®, 100% used continuous glucose monitoring with the Enlite™ sensor.

Table 1
Demographic characteristics of Saudi adults with T1DM on insulin pump therapy (N = 65).

Characteristics	Descriptive statistics
Age, years	30 ± 7.88
Sex	
Male	19 (29.2)
Female	46 (70.8)
Marital status	
Single	37 (56.9)
Married	28 (43.1)
Height, cm	162.5 ± 8.93
Weight, kg	71.59 ± 18.72
BMI, kg/m^2	26.87 ± 5.55
Occupation	
Employed	33 (50.8)
Unemployed	17 (26.2)
Student	13 (20)
Retired	2 (3.1)
Duration of diabetes, years	17.67 ± 6.89
Duration of insulin pump use, years	5.69 ± 3.7
Pre-lockdown HbA1c, %	7.44 ± 1.01
Type of insulin pump currently in use	
Medtronic MiniMed Paradigm Real Time 722	45 (69.2)
Minimed® 640G with SmartGuard®	20 (30.8)
Blood sugar monitoring method	
SMBG (glucometer)	34 (52.3)
FGM (Freestyle Libre sensor)	11 (16.9)
CGM (Enlite™ sensor)	20 (30.8)
Diabetes complications	
Diabetic retinopathy	5 (7.7)
Diabetic nephropathy	3 (4.6)
Diabetic neuropathy	0 (0.0)
ASCVD (stroke, CAD, PVD)	0 (0.0)
Associated comorbidities	
Hypertension	3 (4.6)
Hypothyroidism	12 (18.5)
Hyperthyroidism	1 (1.5)
Celiac disease	4 (6.2)
Smoking history	
Nonsmoker	56 (86.2)
Cigarette smoking	3 (4.6)
E-cigarette smoking	2 (3.1)
Ex-smoker	4 (6.2)
Mental health history	
Previously diagnosed with mental disorder	6 (9.2)
Not known to have any mental disorder	59 (90.8)

Abbreviations: T1DM, type 1 diabetes mellitus; SMBG, self-monitoring of blood glucose; FGM, flash glucose monitoring; CGM, continuous glucose monitoring, ASCVD, atherosclerotic cardiovascular disease; CAD, coronary artery disease, PVD, peripheral vascular disease.
Data are expressed as mean ± SD or n (%).

3.2. Psychological status during lockdown

Overall, 15 patients (23.1%) had moderate to severe depression (PHQ-9 score ≥ 10), and 12 patients (18.5%) had moderate to severe anxiety (GAD-7 score ≥ 10). Additionally, 9 patients (13%) had combined moderate to severe depression and anxiety (scored ≥ 10 in PHQ-9 and GAD-7). Those who reported a previous diagnosis of mental disorder (6 patients, 9.2%) were significantly more likely to have moderate to severe depression (66.7% vs. 18.6%, P = 0.022) and moderate to severe anxiety (66.7% vs. 13.6%, P = 0.009) than those who did not have a history of mental disorders. Furthermore, 19 patients (29.2%) had mild depression (PHQ-9 score 5–9), and 16 patients (24.6%) had mild anxiety (GAD-7 score 5–9). Table 2 shows the distribution of depression and anxiety by severity degree in the participants of our study.

3.3. Self-management behaviors

Tables 3 and 4 summarize the self-management behavioral changes during lockdown reported by the study participants.

3.3.1. Weight changes

During the lockdown, 23 patients (35.4%) reported weight gain (mean: 4.96 ± 2.1 kg), while 19 patients (29.2%) reported weight loss (mean: 3.38 ± 1.45 kg).

3.3.2. Physical activity and dietary changes

During the lockdown, the level of physical activity decreased in 44 patients (67.7%), increased in 15 patients (23.1%), and remained unchanged in 6 patients (9.2%). The ability to follow a healthy diet decreased in 27 patients (41.5%), increased in 20 patients (30.8%), and remained unchanged in 18 patients (27.7%). Moreover, participants who reported an increase in physical activity levels were more likely to report weight loss (60.0% vs. 18.2%, P = 0.004), an increase in the ability to follow a healthy diet (73.3% vs. 13.3%, P = 0.001), and a decrease in experiencing hyperglycemia (46.7% vs. 9.1%, P = 0.002) compared with those who reported a decrease in physical activity levels.

3.3.3. Symptoms of hyperglycemia and hypoglycemia

Compared with the pre-lockdown period, 26 patients (40%) experienced increased hyperglycemia symptoms, while 12 (18.5%) and 27 patients (41.5%) experienced decreased and unchanged symptoms, respectively. Additionally, 13 patients (20%) experienced increased hypoglycemia symptoms, while 18 (27.7%) and 34 patients (52.3%) experienced decreased and unchanged symptoms, respectively.

3.3.4. Adherence to insulin pump behaviors

During the lockdown, most participants reported no change in adherence to carb counting (69.2%), bolus wizard during mealtime (72.3%), and bolus wizard for hyperglycemia correction (61.5%). Of the 34 glucometer users, 16 (47.1%) reported increased adherence to frequent self-monitoring of blood glucose, while 15 (44.1%) reported no change in behavior.

3.4. Maintaining diabetes care

3.4.1. Communication

During the lockdown, 26 patients (40%) had scheduled phone call appointments with a physician. Of these, 25 (96.2%) benefited from the appointment, while 1 patient (3.8%) did not. In contrast, 20 patients (30.8%) had no scheduled appointments during the lockdown period. Appointments were rescheduled for 14 patients (21.5%), and 5 patients (7.7%) missed their physician's phone call.

Table 2
Severity distribution of depression and anxiety.

Measure N(%)	
Depression severity (PHQ-9 score range)	
None or minimal (0–4)	31 (47.7)
Mild (5–9)	19 (29.2)
Moderate (10–14)	10 (15.4)
Moderately severe (15–20)	4 (6.2)
Severe (20–27)	1 (1.5)
Anxiety severity (GAD-7 score range)	
None or minimal (0–4)	37 (56.9)
Mild (5–9)	16 (24.6)
Moderate (10–14)	7 (10.8)
Severe (15–21)	5 (7.7)

Abbreviation: PHQ-9, Patient Health Questionnaire-9; GAD-7, General Anxiety Disorder-7.

Table 3
Reported weight changes during the lockdown.

Response	Descriptive statistics
Increased	23 (35.4)
Weight increased, kg	4.96 ± 2.1
Decreased	19 (29.2)
Weight decreased, kg	3.38 ± 1.45
No change	23 (35.4)

Data are expressed as mean ± SD or n (%).

Moreover, 24 patients (36.9%) received virtual education from a physician or diabetic educator during the lockdown. The virtual education session was considered beneficial by 23 patients (95.8%) and non-beneficial by 1 patient (4.2%). Methods of contact were phone calls (66.7%), messages (20.8%), and video-assisted calls (12.5%).

3.4.2. Insulin pump supplies

During the lockdown, 43 patients (66.2%) reported difficulty obtaining at least one type of insulin pump supply. Twelve patients (60%) using continuous glucose monitoring and seven (63.3%) using flash glucose monitoring had difficulty obtaining sensor supplies. Among all patients, difficulty obtaining medical supplies was reported in 24 patients (36.9%) for insulin, 26 patients (40%) for insulin reservoir, 26 patients (40%) for infusion set, 11 patients (16.9%) for lancets, test strips, and/or alcohol swabs, and 5 patients (7.7%) for glucometer device. The frequency of using multiple daily injections (insulin pen/syringe) for blood sugar control during lockdown due to lack of insulin pump resources was “never” for 56 patients (86.2%), “rarely” for 3 patients (4.6%), “some of the time” for 3 patients (4.6%), and “most of the time” for 3 patients (4.6%).

4. Discussion

This study explored the impact of the COVID-19 lockdown on different aspects of the lives of T1DM patients using insulin pump therapy in Saudi Arabia. T1DM is a demanding chronic endocrine disorder that influences the patient’s physical, psychological, and social wellbeing; moreover, individuals with T1DM have higher rates of depression and anxiety compared with those without T1DM [14,15]. During the COVID-19 lockdown, these rates are expected to increase because of fear of contracting the disease and social isolation causing the separation of families and loved ones.

We evaluated the psychological status of participants based on depression and anxiety symptoms using the PHQ-9 and GAD-7 scales. Our patients had varying degrees of depression and anxiety during the COVID-19 lockdown. Over 50% had mild to severe depression, and over 40% had mild to severe anxiety, despite only 9.2% reporting a history of mental disorder diagnosis. In addition, those who had a mental disorder diagnosis were more likely to have moderate to severe depression and anxiety symptoms. In Italy, a study including 48 adults with T1DM on flash glucose monitoring (18.7% insulin pump users) reported that half the participants were at risk of mild psychological distress during the lockdown, as measured by the General Health Questionnaire-12 [16]. In contrast, a Saudi study including 394 patients with type 2 diabetes reported that the COVID-19 lockdown had minimal impact on psychological health as measured by the Kessler Psychological Distress Scale [17]. Finally, a study involving 1160 Saudi adults from the general population reported that 28.3%, 24%, and 22.3% of the participants experienced moderate to severe depressive, anxiety, and stress symptoms, respectively, as assessed by the Depression, Anxiety, and Stress Scale at the beginning of the pandemic [18].

Although the psychological distress rates found in our study seem similar to those of the Saudi general population, it is still unclear whether the mental status of the participants was negatively affected by the lockdown because of the lack of baseline psychological assessment. Moreover, the survey was distributed after the end of the lockdown, which may have relieved some stress due to the impression that the COVID-19 outbreak was under control. Nevertheless, we emphasize the importance of incorporating psychological evaluation and support in the routine care of T1DM patients during times of increased stress.

Physical activity improves cardiorespiratory health and insulin sensitivity, while healthy eating behaviors improve glycemic control, and limit weight gain and hypoglycemia in patients with T1DM [19,20]. An Italian study including 55 adults with diabetes (nearly 50% on insulin pump therapy) reported that glycemic control was not significantly affected during the first 14 days of lockdown. The authors hypothesized that improved self-management behaviors occurred through better eating habits and increased free time to manage diabetes [21]. Moreover, a small study involving 13 participants with T1DM on the Medtronic MiniMed™ 670G insulin pump noted additional glycemic control improvements in adolescents who maintained physical activity during the lockdown [22]. Stay-at-home orders were expected to increase sedentary behaviors and unhealthy eating habits. Accordingly, in our study, many participants reported a decrease in physical activity and ability to follow a healthy diet, and an increase in weight and hyperglycemia

Table 4
Reported self-management behavioral changes during the lockdown compared with before the lockdown.

Behavior	Greatly decreased	Somewhat decreased	No change	Somewhat increased	Greatly increased
Maintaining physical activity	27 (41.5)	17 (26.2)	6 (9.2)	10 (15.4)	5 (7.7)
Ability to follow healthy diet	8 (12.3)	19 (29.2)	18 (27.7)	13 (20)	7 (10.8)
Experiencing symptoms of hyperglycemia	5 (7.7)	7 (10.8)	27 (41.5)	22 (33.8)	4 (6.2)
Experiencing symptoms of hypoglycemia	6 (9.2)	12 (18.5)	34 (52.3)	10 (15.4)	3 (4.6)
Adherence to carbohydrate counting	2 (3.1)	5 (7.7)	45 (69.2)	7 (10.8)	6 (9.2)
Adherence to Bolus Wizard during mealtime	1 (1.5)	5 (7.7)	47 (72.3)	6 (9.2)	6 (9.2)
Adherence to Bolus Wizard for correction dose for hyperglycemia	3 (4.6)	8 (12.3)	40 (61.5)	9 (13.8)	5 (7.7)
For glucometer users (n = 34), adherence to SMBG ≥ 4 times per day	1 (2.9)	2 (5.9)	15 (44.1)	11 (32.4)	5 (14.7)

Abbreviation: SMBG, self-monitoring of blood glucose. Data are expressed as n (%).

symptoms during the lockdown. However, some participants reported an increase in physical activity, improved diet compliance, weight loss, and decrease in hyperglycemia symptoms during the same period.

Adherence to insulin pump behaviors is essential for optimal glucose control. Behaviors such as carbohydrate counting, use of bolus wizard, and frequency of blood sugar measurements are associated with better glycemic control [23,24]. In this study, the level of adherence to insulin pump behaviors was largely not adversely affected compared with pre-lockdown behaviors (Table 4). Additionally, the majority of glucometer users reported increased adherence to self-monitoring of blood glucose 4 or more times daily. In contrast, a cross-sectional telephone-based study in India that interviewed 30 young adults with T1DM using multiple daily injections found that one third of the participants self-monitored blood glucose less frequently during the lockdown because of financial issues or limited accessibility to glucometers. They also reported that most participants had a decrease in physical activity and an increase in glucose level readings during the same period, despite their routine diet remaining unchanged [25]. The positive changes observed in our study may be attributed to increased spare time to manage diabetes and a personal desire to stay active and healthy. In addition, the local media raised awareness about the importance of maintaining adequate glucose control to reduce the severity of COVID-19 infection in patients with diabetes [26], which may have motivated our patients to adapt a healthier lifestyle and better self-management behaviors.

The continuous spread of the virus required the implementation of telemedicine services to replace in-person routine appointments, impacting the maintenance of optimal diabetes care. Scientific evidence supports the use of telemedicine for patients with diabetes; moreover, patients were able to easily contact their health care providers from their home, decreasing hospital visits and, consequently, the risk of contracting the virus [27]. In the first two weeks of lockdown, the specialized clinic temporarily closed and appointments were rescheduled for the next available slots. In the following weeks, physicians attended routine phone call appointments as scheduled for most cases, although a few patients missed the physician's call. During the phone call, the patient and physician discussed several aspects, including reviewing the patient's insulin pump parameters and glucose level charts through self-monitoring of blood glucose logbooks and flash or continuous glucose monitoring reports that were shared with the physician via e-mail or social media platforms. Additionally, they discussed the patient's eating, sleeping, and physical activity patterns during the lockdown. When necessary, insulin pump settings were adjusted to fit these patterns with the intent of reaching target glycemic control while minimizing the risk of hypoglycemia. Most patients were satisfied with the phone call appointment and found it beneficial.

In addition to routine appointments, all patients had direct access to diabetic educators and were encouraged to seek assistance for problems or inquiries during the lockdown. Upon the patient's request, a physician or diabetic educator administered virtual education sessions regarding insulin pump or sensor use, adjustment of insulin dosages, and/or other self-management behaviors using the technology that best fit the patient's personal needs. Most of those who received virtual education considered their experience beneficial. Similarly, a large multinational cross-sectional survey study including 7477 patients with T1DM (56% insulin pump users) reported that most of those who had remote appointments during the COVID-19 outbreak found it helpful and planned on using this mode of healthcare in the future [28].

Access to medical supplies was another challenge during the lockdown. In a cross-sectional Indian study including 52 young patients with T1DM using multiple daily injections, lack of insulin and glucostrips was associated with impaired glycemic control during the first 15 days of lockdown, which was presumably attributable to inadequate stock of supplies and limited transportation [29]. As expected, around 66% of participants experienced difficulty obtaining insulin pump resources. Specifically, those using flash or continuous glucose monitoring were more affected than glucometer users because sensor supplies were likely to be depleted sooner. Participants also frequently reported difficulty obtaining infusion sets, insulin reservoirs, and insulin. Movement restrictions and fear of getting infected when leaving the house contributed to this situation. Despite these difficulties, most patients were adequately stocked on supplies before the lockdown, and very few had to frequently use multiple daily injections for blood sugar control due to lack of supplies. The fact that insulin pump supplies are regularly provided free of charge to patients in our specialized clinic may have contributed to this.

Our findings should be interpreted carefully because of the study limitations, such as the small sample size and susceptibility to recall bias [30]. Nonetheless, our study had an excellent response rate, because many patients were interested in sharing their experience during the lockdown. To the best of our knowledge, our study was the first to explore the impact of the COVID-19 lockdown on the adherence to insulin pump behaviors and the availability of supplies in patients with T1DM on insulin pump therapy. Furthermore, conducting the study immediately after the end of the lockdown helped illustrate the overall personal lockdown experience of the participants, including thoughts, feelings, and behaviors.

In conclusion, Saudi adults with T1DM on insulin pump therapy routinely followed up in a specialized insulin pump clinic at King Abdulaziz Medical City-Jeddah showed varying levels of depression and anxiety during the COVID-19 lockdown. Although a few patients were able to increase their adherence to a healthy diet and physical exercise during this period, many patients reported a decrease in healthy diet and physical exercise behaviors. Adherence to insulin pump behaviors was largely not adversely affected. Those who received routine diabetes care through phone visits or virtual education sessions found it beneficial, and many patients had difficulty obtaining insulin pump supplies. We emphasize the role of healthcare workers in promoting self-management behaviors and improving the psychological wellbeing of patients with T1DM using insulin pump therapy. Telemedicine is a useful alternative to in-person routine appointments, but strategies to ensure that patients have access to adequate resources during a lockdown must be developed.

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