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POST-COVID PSYCHOLOGICAL WELL-BEING IN PATIENTS WITH CHRONIC DIABETES

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Abstract

One of the most pressing issues facing humanity in recent years has been the COVID-19 pandemic. Individuals with diabetes and its comorbidities face a heightened risk of complications and mortality due to COVID-19. Factors such as hyperglycemia, advanced age, and multiple comorbidities—including heart damage and a significant inflammatory response—are associated with worse outcomes. This situation highlights the complex interaction between COVID-19, diabetes, and its associated consequences. While most COVID-19 patients experience mild illness, those with diabetes are at an increased risk for severe disease. Critical components for managing these patients include optimizing glycemic control and implementing disease-prevention interventions. Research conducted shortly after the onset of the pandemic has examined the effects of COVID-19 on clinical features, patient history, comorbidities, treatment patterns, and health outcomes in individuals with diabetes. Many diabetic patients have faced significant challenges due to COVID-19, including long-term consequences following recovery.

Keywords: COVID-19 pandemic, Post-Covid, Chronic Diabetes,

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Introduction

Living with diabetes presents numerous challenges that can lead to emotional strain, often resulting in feelings of anxiety and depression. These emotional struggles are linked to decreased adherence to treatment, which can worsen glycemic control. There is a notable intersection between diabetes and mental health disorders, with patients experiencing depression and anxiety at rates estimated to be two to four times higher than the general population.

Although further research is needed to fully understand the relationship between diabetes and depression, metabolic dysregulation is known to impact brain function. Disruptions in peripheral glucose regulation may correlate with mood disturbances. In some cases of depression, levels of insulin-like growth factor (IGF) in the brain have been found to be low, and experimental studies have shown antidepressant-like responses to certain treatments.

Additionally, signals from the gut to the brain, activated by nutrients, appear to play a role in the development of depressive symptoms. Among individuals with normal weight, significant associations have been identified between leptin levels, low mood, and sleep disturbances. Furthermore, ghrelin, a hormone known for its appetite-regulating functions, may also exhibit antidepressant effects in males, although suppression of ghrelin appears to occur in some contexts In a stressful environment, the relationship between diabetes and mental health conditions can deteriorate, with psychological distress exacerbating depressive symptoms and negatively impacting diabetes management. The emergence of a potentially life-threatening pandemic has further contributed to feelings of insecurity and anxiety among patients. Since December 2019, when cases of severe coronavirus pneumonia were first reported in Wuhan, China, COVID-19 has rapidly spread across the globe, leading to widespread concern.

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The psychological impact of the pandemic is multifaceted, encompassing responses to social isolation and lockdown measures, diagnostic reactions, and public attitudes towards those affected by COVID-19. The pandemic has presented both psychological and emotional challenges before and after its onset. In India, the initial and most prominent responses to the outbreak included heightened anxiety and a pervasive sense of impending danger.Much of this anxiety was fueled by media coverage, particularly on social media, which ranged from factual reporting to unfounded fears. As we navigate through various levels of consultation and precaution, uncertainty has become a constant factor. Many individuals grapple with what actions to take and what to avoid, leading to a climate of pervasive fear and anxiety.

Responses to this global and local crisis vary widely, resulting in "farmed" individuals—those experiencing heightened mental distress and disruptions to their coping mechanisms. Fear surrounding the virus persists, despite stringent testing and a lack of general symptoms for widespread COVID-19 infection, often manifesting as misunderstandings related to fever or cough.

Concerns extend beyond health, as individuals ponder whether to wear masks, which types are effective, how far to maintain social distance, and which surfaces require disinfection. Moreover, there are real anxieties about job security and the potential for economic downturns during and after the pandemic.

In January 2020, scientists in Wuhan, Hubei Province, China, identified a novel strain of coronavirus, now known as COVID-19, which is related to Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS). The outbreak in Wuhan began in late December 2019, when numerous patients with pneumonia and acute respiratory syndrome presented with unclear origins.

This novel virus primarily targets the respiratory system, with symptoms ranging from mild issues such as dry cough, shortness of breath, sore throat, and fever to severe complications, including moderate to severe bilateral pneumonia and acute respiratory distress syndrome (ARDS).

COVID-19 spreads easily through respiratory droplets from person to person. The virus initially enters the upper respiratory tract via the mucous membranes before affecting the lungs. While COVID-19 is considered a mild illness for most people, some may develop serious respiratory complications. A subset of patients can experience septic shock, respiratory failure, or multi-organ failure. Although less than 5% of those infected progress to severe or critical conditions, this figure may be underestimated due to the prevalence of subclinical infections that often go unrecognized. Additionally, there is concern about the risk of secondary bacterial pneumonia following the viral infection.

Literature Review

Melissa Philip (2020) notes that the COVID-19 pandemic represents a significant global health crisis. The epidemic has led to substantial behavioral changes and considerable psychological stress, highlighting the importance of social and psychological insights in aligning human behavior with the recommendations of epidemiologists and public health experts. Effective disease prevention relies on disseminating information about the illness, its symptoms, and transmission pathways.One of the most effective strategies for preventing COVID-19 is promoting hand hygiene through regular washing or using alcohol-based sanitizers, along with minimizing face touching, particularly of the nose. The current pandemic poses a global threat with the potential for widespread morbidity and mortality, adversely impacting both the economy and social cohesion.Concerns regarding mental health are escalating among various groups, including the

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general public, COVID-19 patients, their close contacts, the elderly, children, and healthcare professionals. This paper aims to raise awareness and highlight the diverse mental health challenges faced by different populations during the COVID-19 pandemic

Akhtar Hussain (2020) aims to provide a concise overview of coronavirus diseases in patients with diabetes, highlighting the general characteristics of the novel coronavirus. The clinical manifestations of COVID-19 can range from mild flu-like symptoms to severe conditions, including multiple organ failure, acute respiratory distress syndrome (ARDS), and even death. Key predictors of illness severity and mortality include age, diabetes, and other comorbidities.Caution is advised when using chloroquine due to its potential hypoglycemic effects in diabetic patients. Tailoring therapeutic options for these individuals, along with diligent glucose monitoring and careful assessment of medication combinations, may help mitigate adverse effects.The paper also suggests exploring the potential pathophysiological mechanisms linking diabetes and COVID-19, although current evidence is limited and does not allow for definitive conclusions. Further research is essential to enhance understanding and clinical management of this connection

slam Galal (2021) highlights that as a recently emerging condition, the long-term effects of COVID-19 remain largely unknown. This study aims to investigate the incidence, patterns, and indicators of persistent symptoms following COVID-19, as well as the utility of a newly proposed COVID-19 score.

A cross-sectional study was conducted involving patients with confirmed COVID-19 from a hospital registry. Data on patient demographics and comorbid conditions were collected, along with the median duration from the onset of symptoms, acute treatment history, and symptoms experienced before and after recovery.

The findings indicate a wide range of long-term symptoms that can persist after COVID-19. Higher severity of acute phase symptoms, along with the presence of comorbid conditions and symptoms lasting beyond 18 days, significantly increase the likelihood and severity of ongoing post-COVID-19 manifestations.

Farhana Akter (2020) conducted research on COVID-19 patients in the southern region of the country, specifically examining clinical symptoms, outcomes, and long-term complications, with a focus on those with diabetes. The study included 734 COVID-19 patients, among whom 19.8% had diabetes, and 76% were male.The findings revealed significantly elevated levels of plasma glucose, D-dimer, and Troponin-I among the diabetic patients. Additionally, the number of insulin-requiring patients increased threefold during the SARS-CoV-2 infection. Notably, 1.4% of the patients developed new-onset diabetes mellitus.Many COVID-19 patients experienced post-recovery complications such as pain, discomfort, and sleep disturbances, with those having diabetes reporting more severe symptoms and lasting effects following their illness. To gain a deeper understanding of these associations, further research involving larger sample sizes is necessary.

Objectives

1. To examine the psychological challenges faced by patients with diabetes
2. To assess the patterns observed in diabetes patients following their recovery from COVID-19.

Diabetes and Its Associated Risks from COVID-19

The risk of severe illness from COVID-19 is higher for individuals with diabetes (PWD). Additionally, COVID-19 presents significant indirect threats to PWD due to disruptions in health and lifestyle. Understanding both the short-term and long-term risks associated with these factors, along with effective mitigation strategies, will help facilitate informed decision-making during and

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after the COVID-19 pandemic.Current evidence regarding the interplay between COVID-19 and diabetes remains modest but is continuously evolving. This perspective summarizes findings from rapid reviews on the treatment concerns for PWD, both with and without COVID-19 infection, assessing the direct and indirect risks they face. We are also collaborating with diabetes treatment experts from countries heavily affected by COVID-19, such as Italy, France, China, the UK, and the USA, to acknowledge the limitations of existing evidence and to share insights from their experiences.

Whether individuals with diabetes (PWD) will contract COVID-19 remains uncertain. PWD are generally considered to be at an increased risk for COVID-19 infection. However, there is still minimal community testing for COVID-19, leading to data primarily derived from hospitalized cohorts. Systematic studies, mainly from China, estimate the prevalence of diabetes among hospitalized COVID-19 patients to be around 8% (95% CI, 6%–11%), 7.87% (95% CI, 6.5%–9.2%), and 9.7% (95% CI, 6.9–12.5%).

In the U.S., this percentage is higher; from February 12 to 28, 2020, PWD accounted for 10.9% of all COVID-19 patients, 24% of all hospitalized cases (excluding ICU admissions), and 32% of ICU admissions. The relationship between blood glucose management and COVID-19 outcomes has been explored only to a limited extent. A retrospective study involving individuals with type 2 diabetes in China indicated that well-controlled blood glucose levels are associated with better outcomes for infected patients. However, poor infections may lead to higher blood glucose levels, making it unclear how the relationship between glucose control and COVID-19 outcomes is established.

Diabetes and Its Aftermath Following COVID-19.

There remains considerable uncertainty regarding the lasting impact of the COVID-19 pandemic. Disruptions caused by domestic crises may lead to an increase in HbA1c levels among affected individuals, potentially lasting up to 16 months, particularly for those from lower socioeconomic backgrounds and those receiving insulin treatment. A failure to access regular healthcare is a significant contributor to morbidity and mortality following crises; once the immediate threat has passed, there has been an uptick in strokes, acute myocardial infarctions, and complications related to diabetes. Ongoing risks of transmission can be mitigated by services such as workplace diabetes clinics.

Case-control studies during the pandemic have suggested that the development of COVID-19 in individuals may be influenced by comorbidities. Although data remains somewhat limited, recent studies indicate that diabetes mellitus (DM) prevalence and elevated blood glucose levels may serve as independent factors for morbidity and mortality associated with COVID-19. This is partly due to individuals with diabetes experiencing longer recovery times from viral infections due to compromised immune systems, as well as the virus's behavior itself.

Furthermore, several recent studies have identified long-term concerns linked to COVID-19, which require further investigation to fully understand their implications.

India, the ninth most populous country in the world, has more than 161 million inhabitants. As of September 24, 2020, SARS-CoV-2 infections in India had reached approximately 352,287, with a reported death toll of 5,044. The prevalence of diabetes is rising alarmingly in India, with around 8.4 million cases among adults, according to data from the International Diabetes Federation (IDF). Numerous scientific studies have been conducted and published regarding the clinical characteristics of COVID-19. However, the relationship between COVID-19 and diabetes, along with the disease's impact on individuals after recovery, remains an area for further exploration.

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Research Methodology

This cross-sectional study aimed to evaluate the incidence of mental health issues during the social distancing phase of COVID-19 among a cohort of patients with diabetes. Conducted in the Endocrinology Department of a public hospital in India, electronic medical records were used to identify individuals with diabetes. Patients who met the inclusion criteria were invited to participate via phone, along with a request for informed consent. Those who consented were contacted again for data collection.

All data were gathered within eight days to ensure consistency across all subjects during the same epidemic timeframe. To minimize social exposure, all interactions were conducted by trained researchers over the phone. Information collected during these calls was promptly recorded in a computer database validated by the research staff.

Patients eligible for inclusion had received medical treatment for at least one year for type 1 or type 2 diabetes, or three years for type 1 diabetes, based on data from the endocrinology outpatient clinic's electronic database for regular follow-ups between 2016 and 2019. Inclusion criteria included being aged 18 years or older, having HbA1c test results collected at the hospital laboratory between January and March 2020, and possessing a valid electronic medical record with a phone number. Individuals with physical or cognitive impairments that hindered their ability to respond to study questions, as well as patients hospitalized during the study period, were excluded. Statistical analyses were performed using IBM SPSS Statistics version 20. Categorical data were presented as counts and percentages, while continuous data were described using the Shapiro-Wilk test as means ± SD and/or medians (min-max) to assess normality. The Mann-Whitney and Kruskal-Wallis tests were used to compare symptom scores across various factors, as the symptom scores were not normally distributed. Spearman's correlation was employed to assess the relationship between acute and post-COVID-19 phases in relation to symptom scores. Receiver Operating Characteristic (ROC) curve analysis was conducted to determine the sensitivity and accuracy of acute phase symptoms in predicting long-term complications following COVID-19. A p-value of 0.05 was considered statistically significant for all tests.

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Data Analysis

Table 1 Patients with chronic post-COVID-19 symptoms

	N (%)	Mean score	*P* value*
Age (years)			
< 25	58 (13.5%)	12.9 ± 13.5	0.393
25–40	227 (52.8%)	12.6 ± 12.3	
> 40	145 (33.7%)	14.0 ± 12.7	
Gender			
Male	156 (36.3%)	13.2 ± 12.5	0.998
Female	274 (63.7%)	13.1 ± 12.6	
BMI			
Underweight	147 (34.2%)	11.9 ± 13.6	0.107
Normal	120 (27.9%)	13.6 ± 11.4	
Overweight	52 (12.1%)	14.4 ± 15.2	
Obese	66 (15.3%)	14.5 ± 12.6	
Smoking			
Nonsmoker	371 (86.3%)	12.9 ± 12.8	0.138
Current smoker	26 (6%)	13.3 ± 10.8	
Ex-smoker	33 (7.7%)	16.1 ± 11.8	
Hospital admission during illness			
Yes	103 (24%)	14.0 ± 12.4	0.216
No	327 (76%)	12.8 ± 12.7	
Need of oxygen therapy			
Yes	72 (16.7%)	17.4 ± 12.5	< 0.001^
No	358 (83.3%)	12.3 ± 12.4	
ICU admission			
Yes	20 (4.7%)	17.3 ± 12.3	0.066
No	410 (95.3%)	12.9 ± 12.6	

In COVID-19 cases, the duration of symptom remission seems to be longer compared to that observed in community-acquired bacterial pneumonia. Research has shown that 97% of symptoms in individuals with community pneumonia resolve, with dyspnea generally improving within an average of three weeks from symptom onset. However, the reasons for prolonged recovery in some individuals are still not fully understood. Factors that may contribute to this extended recovery include persistent viremia, unclear or weak immune responses, symptom recurrence, inflammatory reactions, and psychological factors such as post-traumatic stress disorder.

Additionally, severe COVID-19 infections often necessitate ICU care and can result in lasting complications post-recovery, including respiratory, musculoskeletal, mental, and psychiatric issues. These complications can greatly affect quality of life and contribute to a condition known as Post-Intensive Care Syndrome (PICS). Patients with PICS frequently experience a higher incidence of both mental and physical health problems, which tend to take longer to resolve. PICS

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can also lead to disability and ongoing distress. According to Murray and colleagues, about fifty percent of hospitalized COVID-19 patients may require continued treatment to enhance their long-term recovery outcomes.

Table 2 Post-COVID-19 symptom scores in patients based on their comorbidities.

	Yes	No	*P* value*
Diabetes mellitus	13.4 ± 11.8	13.1 ± 12.7	0.730
Hypertension	15.4 ± 12.9	12.7 ± 12.5	0.039^
Cardiac disease	13.8 ± 4.9	13.1 ± 12.7	0.276
Chronic pulmonary disease	20.5 ± 15.6	12.7 ± 12.3	0.012^
Renal disease	16.5 ± 11.9	13.1 ± 12.6	0.278
Psychiatric disease	22.0 ± 14.2	12.9 ± 12.5	0.068
Any chronic illness	15.8 ± 13.6	12.2 ± 12.1	0.004^

Anxiety and depression affected 35% of the patients included in this study. Both acute and chronic phases of COVID-19 have been consistently linked to significant mental health issues. The severe coronavirus infection is commonly associated with anxiety, depression, post-traumatic stress disorder, and insomnia. Among the first 153 COVID-19 patients in the UK, 30% experienced neurosis, impaired cognitive function, and other psychological health challenges. The emergence of psychotic symptoms has also been associated with corticosteroid treatment. In comparison to SARS, 5-44% of individuals reported experiencing various mental health issues one year later, including anxiety, depression, psychosis, and elevated levels of post-traumatic stress.

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Table-3 Laboratory and imaging results of COVID-19 patients upon admission.

Variables	Without diabetes	With diabetes	Total	Pearson's $\chi 2$	P value
Blood sugar level (n=734)					
< 4 mmol/L	1 (0.2%)	2 (1.4%)	3 (0.4%)	82.983	0.000
4-11 mmol/L	496 (84.4%)	72 (49.3%)	568 (77.4%)		
≥ 11.1 mmol/L	91 (15.5%)	72 (49.3%)	163 (22.2%)		
Serum uric acid (n=229)					
High	19 (19.6%)	10 (7.6%)	29 (12.7%)	7.294	0.007
Normal	78 (80.4%)	122 (92.4%)	200 (87.3%)		
Serum creatinine (n=219)					
High	5 (4.5%)	17 (15.9%)	22 (10%)	7.902	0.005
Normal	107 (95.5%)	90 (84.1%)	197 (90%)		
CRP (n=390)					
High	52 (19.2%)	53 (44.2%)	105 (26.9%)	32.03	0.000
Normal	218 (80.8%)	67 (55.8%)	285 (73.1%)		
Troponin (n=214)					
High	21 (15%)	32 (43.2%)	53 (24.8%)	20.725	0.000
Normal	119 (85%)	42 (56.8%)	161 (75.2%)		
Ferritin (n=361)					
High	141 (62.9%)	84 (61.3%)	225 (62.3%)	2.075	0.354
Low	3 (1.3%)	0 (0.0%)	3 (0.8%)		
Normal	80 (35.7%)	53 (38.7%)	133 (36.8%)		
D-Dimer (n=416)					
High	139 (47.3%)	79 (64.8%)	218 (52.4%)	10.557	0.001
Normal	155 (52.7%)	43 (35.2%)	198 (47.6%)		
SGPT (n=290)					
High	81 (45.3%)	49 (44.1%)	130 (44.8%)	0.034	0.854
Normal	98 (54.7%)	62 (55.9%)	160 (55.2%)		
CBC WBC TC (n=203)					
High	16 (11.8%)	20 (29.9%)	36 (17.7%)	10.425	0.005
Low	1 (0.7%)	0 (0.0%)	1 (0.5%)		
Normal	119 (87.5%)	47 (70.1%)	166 (81.8%)		
Lymphocyte (n=203)					
High	0.7%	3 (4.5%)	4 (2.0%)	3.258	0.196
Low	66 (48.5%)	31 (46.3%)	97 (47.8%)		
Normal	69 (50.7%)	33 (49.3%)	102 (50.2%)		

Troponin-1 levels were found to be significantly elevated in diabetic patients compared to those with COVID-19 who did not have diabetes (see Table 3). Similar results have been reported in Italy, where a substantial number of individuals with comorbidities, including diabetes mellitus, exhibited elevated heart troponin levels. High cardiac troponin sensitivity may be useful for identifying risk in older patients and for assessing the clinical characteristics of older adults with diabetes. However, due to the small size of this retrospective study focused on diabetes cases, selection bias may be a concern. Therefore, additional research is needed for a clearer understanding.

Furthermore, COVID-19 may not only exacerbate pre-existing diabetes but also trigger new cases of diabetes mellitus. In this study, a few new instances of diabetes (1.34%, n=10) were identified following COVID-19 infection. However, it remains unclear whether these cases pertain to Type 1 or Type 2 diabetes, as the role of ACE2 receptors in pancreatic beta cells needs further investigation, necessitating more comprehensive studies and larger cohorts.

One-fifth of the participants in this study received steroid treatment. The use of steroids in COVID-19 cases further disrupts glycemic control and raises insulin requirements. During the course of

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their illness, many patients required more than 40 units of insulin daily. Similar findings have been reported in other studies. Intensive insulin therapies, such as basal-bolus regimens and continuous intravenous insulin infusion, have proven both effective and potentially detrimental for hospitalized patients experiencing hyperglycemia. Our study indicates that among COVID-19 patients with diabetes, challenges such as reduced mobility and pain are common. There is a growing body of evidence linking vitamin D deficiency to increased morbidity and mortality in COVID-19 cases. Supplementation with vitamin D may help mitigate multi-organ damage associated with the virus. Clinical symptoms of chronic pain often include psychological distress combined with physical limitations, which can exacerbate the condition for individuals with diabetes.

Our key findings align with previous studies on SARS, MERS, and acute COVID-19, showing that post-illness periods are associated with depression, anxiety, fatigue, and post-traumatic stress disorder. In our cohort of diabetic COVID-19 patients, we observed that 24% experienced depression, 13% reported panic, 29% suffered from attention deficits, 22% exhibited memory loss, and 13% faced insomnia. Notably, insomnia, memory loss, anxiety, and depression were interconnected, suggesting that while a full manic state was unlikely, subthreshold symptoms were present.

Although our research did not include sufficient group comparisons or assessments of preexisting mental health conditions, there was a marked prevalence of anxiety, depression, and post-traumatic stress disorder among participants. Distinguishing the effects of the virus on the general population from the impact of the pandemic itself is challenging, as selection biases may contribute to high prevalence rates. Quality of life measurements in SARS cohorts were significantly lower than in control groups, with the effects on social functioning being more pronounced than those on mental health.

Nonetheless, the common symptoms observed could indicate potential selection bias unrelated to SARS-CoV-2 infection. As our findings were derived solely from cohort data without specialist validation, further psychiatric, clinical, and molecular research is needed to elucidate the mechanisms underlying the various disorders associated with COVID-19.

Conclusion

Our study found that eating disorders were prevalent among individuals with diabetes after one month of social distancing. Previous literature indicates that approximately 14% to 35% of diabetes patients test positive for eating disorders using the EAT-26, a figure that is significantly lower than what we observed in our cohort. A pilot study by Fernandez Aranda et al. reported that over 38% of patients developed eating issues after just two weeks of confinement. The authors noted that concerns about health and fitness could act as a triggering factor for eating disturbances in vulnerable individuals. It is important to point out that their research was conducted over a shorter duration compared to the lockdown measures assessed in our study.

The high prevalence of eating disorders in our population could negatively impact nutritional intake and, consequently, glycemic control, although we did not specifically evaluate this aspect. Additionally, our investigation highlighted a significant incidence of sleep problems among diabetic patients during this period. Only one previous study has examined sleep quality during the COVID-19 pandemic, reporting a prevalence of sleep issues at 18%. In our sample, factors contributing to poor sleep may be multifaceted, potentially including the presence of obstructive sleep apnea in individuals with higher BMI, instances of nighttime hypoglycemia, extended periods spent at home, reduced physical activity, and irregular sleep patterns.

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Moreover, the prevalence of insomnia during this time may reflect anxiety related to the heightened risk of COVID-19 among those living with diabetes.

This research revealed that, although there was no specific diagnostic purpose for patients with type 1 and type 2 diabetes, a significant proportion exhibited considerable psychological distress during the COVID-19 pandemic. The current situation has had a concerning impact on the mental health of individuals with diabetes. Our findings indicate that patients with both types of diabetes require access to support during and after this crisis. Future studies and initiatives should focus on the effects of mental health interventions for diabetes and seek to prevent deterioration in glycemic control during quarantine periods.

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