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ORIGINAL RESEARCH

Maintenance of Self-Care Activities During COVID-19 Lockdown in Patients with Type 2 Diabetes That Received a Comprehensive Care Program Training

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Introduction: In 2020, several countries established a global emergency state. Lockdowns restricted people's lifestyles and daily activities to prevent coronavirus spread. These measures hindered diabetes mellitus control and lifestyle changes. This study aims to evaluate if attending a multidisciplinary program before the pandemic helped maintain a good metabolic state, lifestyle modifications, and mental health in patients with diabetes mellitus during the COVID-19 lockdown.

Methods: Patients included in this study attended a multidisciplinary program, with <5 years of diagnosis of type 2 diabetes, without disabling complications, between 18–70 years old. The complete lockdown occurred from February 27, 2020, to May 31, 2020. The first patient (non-COVID) to return to the center for face-to-face consultation was in March 2021. Consultations in 2019 were face-to-face and changed to a virtual modality during 2020. We analyzed metabolic, lifestyle, mental health, and diabetes education parameters.

Results: A total of 133 patients with type 2 diabetes mellitus were included with complete information in visits before and during the lockdown. Metabolic parameters and self-care measures (nutrition plan, foot evaluation, and self-glucose monitoring) evaluated on our patients had no change during the lockdown. We found a significant increase in the time patients spent sitting during the day ($p<0.05$). Barriers to exercise increased during lockdown, being joint pain (3.8% to 12.0%, $p<0.01$) and lack of time to exercise (4.5% to 7.5%, $p=0.33$) being the most common. There was no significant difference in symptoms of anxiety and depression, quality of life, and empowerment.

Conclusion: A multidisciplinary diabetes mellitus program, including diabetes education for self-care activities, positively impacts patients, maintaining good outcomes despite lockdown difficulties.

Keywords: multidisciplinary care, lifestyle, self-care, mental health, type 2 diabetes, COVID-19 pandemics

Plain Language Summary

Since the beginning of the COVID-19 pandemic, lockdowns have restricted people's lifestyles and daily activities. Many patients changed their nutritional plan, stopped exercising, had difficulties obtaining drug treatment, and had regular consultations that were difficult to take place.

We work in a comprehensive care center for patients with type 2 diabetes. Our study aimed to evaluate if patients attending a multidisciplinary program before the pandemic helped maintain a good metabolic state, lifestyle modifications, and mental health during the COVID-19 lockdown.

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For this analysis, we included patients from our Center who had consultations in 2019 (which were face-to-face) and changed to a virtual modality during 2020. We analyzed metabolic, lifestyle, mental health, and diabetes education parameters.

We included 133 patients with type 2 diabetes mellitus with complete information in visits before and during the lockdown. We found no change during the lockdown in metabolic and self-care activities. There was a significant increase in the time patients spent sitting during the day since barriers to performing exercise increased during the lockdown. In mental health parameters, there was no significant difference in symptoms of anxiety and depression, quality of life, and empowerment.

Our results show that a multidisciplinary diabetes mellitus program, including diabetes education for self-care activities, positively impacts patients, causing better outcomes despite lockdown difficulties.

Introduction

Diabetes mellitus is a chronic metabolic condition with various consequences, including the sudden severe respiratory syndrome brought on by the most recent coronavirus. Patients with diabetes are considered as high-risk susceptibility to COVID-19 morbidity and mortality.[1,2]

During the COVID-19 pandemic, the lockdown was established to prevent contagions and diminish the disease morbimortality.[1] These caused several changes in people's lifestyles, modifying their diet, physical activity, sleep habits, alcohol consumption, and mental health.[1–4]

A multidisciplinary approach in patients with diabetes mellitus (independent from COVID-19 lockdowns) helps obtain several strategies to improve beliefs, adherence to therapy, and self-monitoring no matter the circumstances surrounding the patient. Therefore, metabolic control and quality of life improve.[5]

This study aims to evaluate if a multidisciplinary diabetes care program helps maintain a good metabolic, lifestyle, and mental health parameters in patients with a recent diagnosis of type 2 diabetes during the COVID-19 pandemic.

Materials and Methods

This is a program evaluation study. The Center of Comprehensive Care for the Patient with Diabetes (CAIPaDi) model was proposed to develop a patient-centered, multidisciplinary model. The program has been described elsewhere.[5,6] It is composed of nine structured interventions implemented by a multidisciplinary team. It consists of two phases. The first comprises an initial and three visits, one month apart. The second phase consists of annual evaluations to assess metabolic, mental health, lifestyle, and diabetes education goals. During each visit, patients are attended by nine different healthcare professionals: endocrinologists, diabetes educators, nutritionists, physical therapists, psychologists, psychiatrists, ophthalmologists/optometrists, and foot and dental care.

Before 2020, visits were held at the Center. Each intervention was 30-minutes long, following specific procedure manuals with a specific goal, a self-management strategy, and prespecified indicators. Blood tests and body measurements were obtained at arrival to modify interventions and treatments according to these results. Every visit has a particular objective to improve in a step-by-step assessment adjusted for each patient. The program's main objective is to prevent diabetes complications through training in long-term self-care activities.

For each visit, questionnaires are applied to complete the evaluation. These questionnaires include the Hospital Anxiety and Depression Scale (HADS),[7,8] Diabetes Empowerment Scale-Short Form [DES-SF],[9] Diabetes Quality of Life Measure [DQoL],[10,11] International Physical Activity Questionnaire (IPAQ),[12] and a 3-day food record to register calories consumed per day.[13]

Procedures

The study was carried out in Mexico. The complete lockdown occurred from February 27, 2020, to May 31, 2020. The confinement was gradually eliminated, starting with essential activities for economic reactivation. Since the Center is located in a hospital that served as a COVID Hospital, the first patient (non-COVID) to return to the Center for face-to-face consultation was in March 2021.

In 2020, due to the COVID-19 pandemic, the interventions for evaluating patients changed to a virtual model using online platforms or phone calls. We asked the patients to take blood tests in any laboratory of their convenience. The laboratory tests solicited were glucose, HbA1c (glycated hemoglobin), lipid profile, liver function

tests, creatinine, and albumin/creatinine ratio. All questionnaires were converted to a virtual format and were answered before the consultation. Healthcare professionals used these for a complete evaluation. We requested a three-day meal recall of two weekdays and one weekend day to quantify energy intake. We also asked patients to make a registry of their glucose monitoring, which was evaluated during virtual consultation. Depending on the characteristics of the patients, they were asked to monitor pre and 2h post meals if they were under insulin treatment, or at least once a day but in an escalating schedule (before breakfast, on a different day, monitoring before lunch, and another day monitoring before dinner). If patients were not under insulin treatment, we asked the patients to monitor their glucose twice a week. Also, patients were asked to send photos of their feet and usual shoes to evaluate foot care. The assessment of eye exams, dental care, and foot care was a semi-structured interview since it was impossible to examine the patients physically. In the foot care and endocrinology evaluations, the specialists asked about symptoms regarding neuropathy.

The Center contacted the patients by phone call or e-mail. If the patients agreed to attend their virtual appointment, they received an e-mail with all the instructions. They also received a link to answer the questionnaires. Questionnaires were answered using Google Forms. Laboratory tests, SMBG (Self-Monitoring of Blood Glucose), and photos were sent via e-mail to the Center so that healthcare professionals could evaluate them.

Participants

The CAIPaDi program attends patients with a recent diagnosis of type 2 diabetes mellitus, between 18 and 70 years old, without disabling complications, and non-smokers. For this analysis, we included patients who had complete information for annual evaluations in 2018 and 2019 (face-to-face evaluations) and 2020 (virtual evaluations).

We used convenience sampling according to ease of access and the availability of people to be part of the sample during the pandemic. We included all patients who could be evaluated virtually in 2020. All included patients had finished the first phase of the program (visits 1 to 4) and at least one annual evaluation. The data obtained until December 2019 was from one annual evaluation. The following annual visit data was evaluated and corresponded to an evaluation after the lockdown (June to December 2020).

Statistical Analysis

We compared the information and reported the changes in patients between 2018 and 2019 (before lockdown) and then compared the changes from 2019 to 2020 when patients had virtual evaluations. According to the Kolmogorov–Smirnov test, results data are reported as means (+ SD) or medians and interquartile ranges (25–75) if they followed or did not have a normal distribution, respectively. Percentages were used for discrete values. The analysis included a *t*-test or Wilcoxon test for related samples, according to the distribution. McNemar and x^2 tests were used for analyzing data from categorical variables. Results are presented for metabolic changes, lifestyle interventions (nutritional plan and exercise), and mental health evaluations. A p-value <0.05 was considered statistically significant.

Results

The study included 133 patients with complete information from 2018, 2019, and 2020 (Figure 1). They were evaluated to compare their follow-up pre and during pandemic. Of these, 82 (61.7%) were women aged 52 ±12 years old and 2(1–5) years diagnosed with diabetes.

Metabolic parameters evaluated on our patients had no change. Triglycerides had a significant decrease at one year of follow-up (p=0.05). LDL (Low-Density Lipoprotein) cholesterol (p=0.05) levels and systolic blood pressure ($p<0.05$) presented a significant decrease after two years of follow-up (Table 1).

The changes in nutritional and physical activity parameters are shown in Table 2. Comparing 2018 with 2019, a decrease in calories consumed (p=0.02) and grams of fat consumed (p=0.03) was observed. Comparing 2019 with 2020, we found a significant increase in patients' time spent sitting during the day ($p<0.05$).

The patients were questioned about the barriers they presented to exercising and adhering to the eating plan.

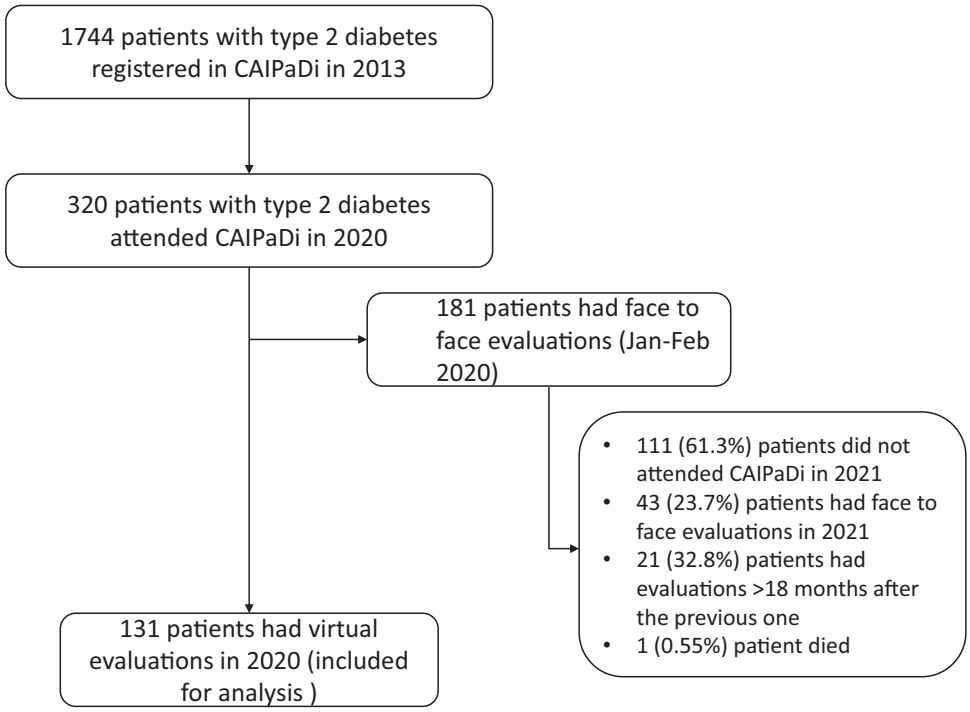

Figure 1 Flow chart of patients enrolled in the CAIPaDi program, and patients included for analysis with virtual and face-to-face evaluations.

Between 2018 and 2019, there were no differences in the reported barriers; 7.5% of the patients mentioned that lack of time is the main reason why they do not exercise, followed by 5.3% of patients who presented joint pain and 4.5% who did not exercise due to personal problems. Before the pandemic, five patients (3.8%) reported: "having no barrier" to exercise, which increased to

Table 1 Changes in Metabolic Parameters

	Pre Lockdown		Post Lockdown	p	p
	2018	2019	2020	2018–2019	2019–2020
Blood pressure (mmHg)					
Systolic	120 ± 11	120 ± 10	122 ± 13	0.96	0.11
Diastolic	74 ± 6.9	73 ± 5	73 ± 5.4	0.03	0.26
Triglycerides (mg/dL)	135 (100.5–181)	137 (110–191)	145 (104–183)	0.05	0.74
c-LDL (mg/dL)	104 ± 33	104 ± 29	98 ± 32	0.97	0.05
Glucose (mg/dL)	118 ± 32	122 ± 41	124 ± 39	0.20	0.68
HbA1c (%)	6.8 ± 1.3	6.9 ± 1.5	7.0 ± 1.5	0.60	0.32
Creatinine (mg/dL)	0.77 (0.64–0.9)	0.74 ± 0.16	0.78 ± 0.18	0.19	<0.05
Uric acid (mg/dL)	6.9 ± 1.5	5.5 ± 1.18	5.5 ± 1.2	0.40	0.62
ALT (mg/dL)	21 (15–31)	20 (15–30)	21 (16–30)	0.51	0.28
AST (mg/dL)	21 (17–26)	19 (17–24.7)	19 (16–24)	0.60	0.95
GGT (mg/dL)	24 (18–36.5)	23 (17–36)	22 (16–32.5)	0.80	0.92
ACR (g/mg)	10.23 (4.3–22)	10.7 (6.6–17.8)	8.7 (4–16)	0.41	0.74

Note: Glucose is fasting plasma glucose.
Abbreviations: c-LDL, low-density lipoprotein cholesterol; HbA1c, glycated hemoglobin; ALT, alanine transferase; AST, aspartate transferase; GGT, gamma-glutamyl transpeptidase; ACR, albumin/creatinine ratio.

Table 2 Changes in Nutrition and Physical Activity Parameters

	2018 (Pre Lockdown)	2019 (Pre Lockdown)	2020 (Post Lockdown)	p 2018–2019	p 2019–2020
Calories consumed (Kcal/day)	1402 ± 301	1345 ± 291	1394 ± 399	0.02	0.13
Carbohydrates (gr)	144 ± 43	141 ± 45	147 ± 49	0.49	0.19
Proteins (gr)	74 ± 17	69 ± 15	71 ± 20	<0.05	0.23
Fat (gr)	58 ± 13	55 ± 12	57 ± 20	0.03	0.22
BMI (kg/m2)	28.8 ± 4.5	28.8 ± 4.4	28.6 ± 4.4	0.88	0.10
Weight (Kg)	74.3 ± 14.6	74.3 ± 14.9	73.9 ± 14.7	0.86	0.16
Days of exercise/week	4 (0–5)	4 (0.5–5)	3 (0–5)	0.92	0.09
Minutes of exercise/week	150 (0–240)	135 (30–240)	120 (0–225)	0.46	0.16
Hours of television	2 (1–3)	2 (1–3)	2 (1–3)	0.67	0.71
Hours of sleep	7 (6–8)	7 (6–8)	7 (6–8)	0.94	0.80
Sitting time	4 (2–6)	4 (2–6)	4 (3–6)	0.98	<0.05
Steps/day	7000 (4897–10,000)*	6000 (4533–8290)**	6000 (3175–9080)***	0.16	0.50

Note: *n=58, **n=37, ***n=33.
Abbreviation: BMI, body mass index.

11 patients (8.2%) during the pandemic (p=0.18). Barriers that increased from 2019 to 2020 were joint pain (3.8% to 12.0%, p<0.01) and lack of time to exercise (4.5% to 7.5%, p=0.33). Barriers reported to a lesser extent were "I don't like exercising" (2.3% to 0.8%, p<0.01), "tiredness" (3.8% to 0.8%, p<0.01), and "personal problems" (6% to 6.8%, p<0.01).

Regarding the barriers to adherence to the meal plan, initially, 72 patients (54.1%) reported "not having any barrier" to following the indications of the nutrition team, 24.1% of the patients eat meals outside the home, and 10.5% of patients do not have time to prepare their meals. Before the pandemic, 58 patients (43.6%) reported having no nutritional barrier. This number changed to 67 patients (50.4%) in 2020 (p=0.09). The barrier "lack of time to prepare meals" changed from 22 patients (16.5%) to 16 patients (12.0%) (p=0.26). Before the pandemic, 30.1% of patients (n=40) referred to have as a barrier to adhering to a nutritional plan "all my meals are out of home", and 43.6% (n=58) reported

Table 3 Changes in Anxiety and Depression Scores, Quality of Life, and Empowerment

	2018 (Pre Lockdown)	2019 (Pre Lockdown)	2020 (Post Lockdown)	p 2018–2019	p 2019–2020
HAD anxiety, n (%)					
Mild	109 (82)	107 (80.5)	105 (78.9)	0.95	0.78
Moderate	15 (11.3)	18 (13.5)	20 (15.0)		
Severe	9 (6.8)	8 (6.0)	8 (6.0)		
HAD depression n (%)					
Mild	123 (92.5)	118 (88.7)	116 (87.2)	0.92	0.37
Moderate	7 (5.3)	9 (6.8)	14 (10.5)		
Severe	3 (2.3)	6 (4.5)	3 (2.2)		
Quality of life (DQoL)	71.4 ± 20.3	71.6 ± 18.7	71.7 ± 20	0.86	0.58
Empowerment	81.2 ± 14.9	81.9 ± 18.7	83.6 ± 14.1	0.90	0.68

Abbreviations: HAD, Hospital Anxiety and Depression Scale; DQoL, Diabetes Quality of Life Questionnaire.

no barriers. This changed favorably to 67 patients (50.4%) having no barrier and 23 patients (17.4%) referring to "all my meals are out of home", with a decrease means (p=0.34).

The area of mental health was evaluated through symptoms of anxiety and depression, quality of life, and empowerment (Table 3). Comparing 2018 with 2019 and 2019 with 2020, no statistically significant differences existed in any categories. However, the percentage of patients with moderate symptoms of depression (5.3% in 2018, 6.8% in 2019, and 10.5% in 2020) and moderate anxiety (11.3% in 2018, 13.5% in 2019, and 15% in 2020) increased.

Self-care measures have been constant in patients before and during the pandemic, so there were no statistical differences. The foot examination was performed in 87.2% of patients in 2018, 91% in 2019, and 91.7% in 2020. Self-glucose monitoring was reported by 90.2% of patients in 2018 and 88.7% in 2019 and 2020 (p=0.07). A non-significant increase in hypoglycemia was found from 18% in 2018 to 38.3% in 2019 (p=0.89) compared to 45.9% in 2020 (p=0.22). Hypoglycemia between 2018 and 2020 was non-significant (p=0.12).

The goals achieved by the patients were kept constant, so there was no statistical significance.

A decrease was observed in patients who reached the goal of HbA1c <7% from 71.4% in 2018 to 68.4% in 2019 and reaching 64.7% in 2020 (p=0.49), HbA1c below 8% was found in 86.5% in 2018, 82.7% in 2019 and 80.5% in 2020 (p=0.41), finally, glycemic lack of control with HbA1c> 9% presented an increase from 8.3% in 2018 to 9.8% in 2019 and subsequently decreased to 9% in 2020 (p=0.91).

The goal of blood pressure <13/80 mmHg was reached in 82.7% of patients in 2018, 91% in 2019, and decreased to 83.5% in 2020 (p=0.10). A slight increase was observed in patients with hypertensive uncontrolled> 140/90 mmHg from 5.3% in 2018 to 8.3% in 2020 (p=0.09).

The goal of c-LDL <100 mg/dL was reached by 51.1% of patients in 2018 and 2019 and increased favorably to 57.7% of patients (p=0.52). Cholesterol levels >130 mg/dL increased from 17.3% in 2018 to 20.3% in 2019 and decreased to 15% in 2020 (p=0.52).

Discussion

This study assessed the effect of a multidisciplinary diabetes program in patients with type 2 diabetes mellitus during the COVID-19 lockdown. By applying different questionnaires and following semi-structured interviews on digital platforms, this study evaluated patients' lifestyles and attachment to prescribed treatments. Metabolic and glycemic parameters remained under control.

The pandemic lockdown changed patients' lifestyles, including a more significant proportion working from home. This change significantly increased sitting time and decreased calorie expenditure. Similar results were presented by Ruiz et al during total home confinement.[4,14] Lockdown limited physical activities because gymnasiums were closed, and outdoor activities were limited and not recommended. Patients participating in our study suffered these limitations. Patients decreased the days per week of exercising. Nevertheless, it was not statistically significant. Conversely, other series have reported that their patients kept physically active during the pandemic because they prioritized these actions at home or spent their free time working out. The importance of lifestyle modifications to achieve metabolic control can be highlighted. Patients diagnosed with diabetes mellitus should learn how to prioritize these actions to change their lifestyles.[14–16]

Significant differences were not found in anxiety and depression. Moderate anxiety levels are slightly augmented because of constant preoccupation with adverse circumstances.

Balanced diet preservation was conserved. The environment in which a patient is involved has an essential role in food intake, affecting the quantity and quality of food selected: adverse situations, obesogenic surroundings, boredom, and anxiety. The results demonstrate that adequate diabetes mellitus training can teach patients to make good decisions.[14]

As part of the CAIPaDi program, patients had a prescribed individualized diet by a nutritionist. Follow-up during 2020 demonstrated good adherence to the nutritional plan. These results are consistent with other authors who showed that patients maintained their diet.[16] In contrast, Enriquez et al reported that Mexican patients were less likely to change their food consumption patterns and more adherence to diets during the pandemic.[17] Contrasting results are shown in a Spanish cohort studied by Ruiz et al, where augmented snacks and servings happened throughout the lockdown, acquiring unhealthy dietary habits attributed to stressful situations.[14] Analyzing the barriers of our patients, more than

half referred to having no barrier to adhering to the nutritional plan. This is expected since the CAIPaDi model helps overcome barriers to adherence. The main barrier before and during lockdown was "all my meals are out of the home." Although the percentage changed from 30% to 17%, this means that during the lockdown, many people continued working. These patients needed to go out to work and could not find places to eat (closed businesses), and it was difficult to find what to eat.

It is crucial that CAIPaDi patients present adequate glycemic and metabolic control. On the other hand, different studies have shown a worsening of metabolic control during the COVID-19 lockdown.[14] Some authors mention that an affected drug chain supply may not be a reason for uncontrolled glycemia.[16] Even though this study did not evaluate medicine shortage during the pandemic lockdown, it is assumed that patients were not affected, relying on controlled metabolic parameters.

Several studies have demonstrated disturbances in mental health status. Anxiety, social distancing, and stress have increased during 2019, primarily because of COVID-19. Recent studies have described diabetes distress in which psychological health is affected in patients because of the lack of family support during the pandemic.[15] In this study, the percentage of patients diagnosed with depression in 2019 did not change compared to 2020. However, the rate of patients with moderate depression increased. According to the HADS, patients with "mild depression" in 2019 changed to "moderate depression" in 2020. Even though it was not statistically significant, this can be associated with mild carbohydrate, fat, and protein intake increases. Studies demonstrate that anxious patients tend to change to a less healthy food intake.[17]

The CAIPaDi model emphasizes self-care activities to prevent complications like hypoglycemia and foot ulcers. During the lockdown, implemented self-care measures encouraged in CAIPaDi Center were continued by patients. Follow-up of self-care activities demonstrates adherence to these measures. After the one-year lockdown, many patients kept checking their feet and monitoring glucose. Commitment to medical advice, self-monitoring, and therapy results in better outcomes.[18]

Among the strengths of the program is that patients received their programmed multidisciplinary appointments in a virtual model. The CAIPaDi model changed the interventions effectively to provide an interdisciplinary approach in different areas (medical treatment, lifestyle intervention, mental health, and diabetes education).

The principal limitation of the study was the number of patients lost on follow-up. The results may be biased to excellent metabolic and self-care activities since some patients who accepted their attention to be virtual were those with a better health conscience. Another possibility is that many patients were lost on follow-up since many did not want to go to a laboratory for blood tests.

Telemedicine is a strategy for diabetes care that will stay as an option together with face-to-face consultations. Healthcare professionals must embrace technology to improve the care of patients with chronic diseases. Considering this situation, patients and healthcare professionals must make necessary changes to maintain and enhance health delivery. A critical analysis of healthcare systems should optimize healthcare delivery for patients with diabetes. Creating innovative strategies for health education will become imperative for achieving and maintaining self-care activities and metabolic control goals.

Conclusion

According to the results, adopting a healthy lifestyle in diabetes mellitus is essential for achieving and maintaining metabolic control and decreasing health complications linked to inadequate glycemic control.

A multidisciplinary approach and education on patients with diabetes mellitus ingrained positive lifestyles and can improve patients' choices despite the difficulties faced.

Data Sharing Statement

Raw data were generated at the Center of Comprehensive Care for the Patient with Diabetes. Derived data supporting the findings of this study are available from the corresponding author [SHJ] on request and will be reviewed by the IRB Committee. De-identified individual participant data collected during the study will be shared with no end date. These data will be available to researchers who provide a proposal to achieve specific. Requesters

will need to sign a data access agreement and to confirm that data will only be used for the agreed purpose for which access was granted".

Ethics Approval and Informed Consent

The Institutional Ethics and Research Committees approved the comprehensive care protocol (INCMNSZ Research and Ethics Board - Reference 1198). It is also registered on ClinicalTrials.gov (NCT02836808). The procedures were conducted following the Declaration of Helsinki. All patients signed an informed consent form.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; they took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

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References

1. Viswanathan V, Puvvula A, Jamthikar AD, et al. Bidirectional link between diabetes mellitus and coronavirus disease 2019 leading to cardiovascular disease: a narrative review. *World J Diabetes*. 2021;12:215–237. doi:10.4239/wjd.v12.i3.215
2. Kumar A, Khunti K. Assessment of risk, severity, mortality, glycemic control and antidiabetic agents in patients with diabetes and COVID-19: a narrative review. *Diabetes Res Clin Pract*. 2020;165:108266. doi:10.1016/j.diabres.2020.108266
3. Drucker D. Diabetes, obesity, metabolism, and SARS-CoV-2 infection: the end of the beginning. *Cell Metab*. 2021;33:479–498. doi:10.1016/j.cmet.2021.01.016
4. Tanji Y, Sawada S, Watanabe T, et al. Impact of COVID-19 pandemic on glycemic control among outpatients with type 2 diabetes in Japan: a hospital-based survey from a country without lockdown. *Diabetes Res Clin Pract*. 2021;176. doi:10.1016/j.diabres.2021.108840
5. Hernandez-Jimenez S, Garcia-Ulloa C, Mehta R, Aguilar-Salinas CA, Kershenobich-Stalnikowitz D. Innovative models for the empowerment of patients with type 2 diabetes: the CAIPaDi program. *Recent Pat Endocr Metab Immune Drug Discov*. 2014;8:202–209. doi:10.2174/1872214808999141110155515
6. Hernández-Jiménez S, García-Ulloa AC, Bello-Chavolla OY, Aguilar-Salinas CA, Kershenobich-Stalnikowitz D; Group of Study CAIPaDi. Long-term effectiveness of a type 2 diabetes comprehensive care program. The CAIPaDi model. *Diabetes Res Clin Pract*. 2019;151:128–137. doi:10.1016/j.diabres.2019.04.009
7. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. *Acta Psychiatr Scand*. 1983;67:361–370. doi:10.1111/j.1600-0447.1983.tb09716.x
8. López-Alvarenga JC, Vazquez-Velázquez V, Arcila-Martínez D, Sierra-Ovando AE, González-Barranco J, Salín-Pascual RJ. Accuracy and diagnostic utility of the Hospital Anxiety and Depression Scale (HAD) in a sample of Mexican obese subjects. *Rev Invest Clin*. 2002;54:403–409.
9. Anderson R, Fitzgerald J, Gruppen L, Funnel M, Oh MS. The diabetes empowerment scale-short form (DES-SF). *Diabetes Care*. 2003;26:1641–1643. doi:10.2337/diacare.26.5.1641-A
10. Jacobson AM, de Groot M, Samson JA. Quality of life in patients with Type I and Type II diabetes mellitus. *Diabetes Care*. 1994;17:167–274. doi:10.2337/diacare.17.4.267

11. Robles R, Cortazar J, Sanchez-Sosa J, Paez F, Nicolini H. Evaluation of quality of life in type 2 diabetes mellitus: psychometric properties of the Spanish version of the DQOL. *Psicothema*. 2003;15:247–252.
12. Hagstrom M, Oja P, Sjostrom M. The International Physical Activity Questionnaire (IPAQ): a study of concurrent and construct validity. *Public Health Nutr*. 2006;9:755–762. doi:10.1079/PHN2005898
13. López-Alvarenga JC, Sánchez RMB, Macías MN, Bolado-García VE, González BJ. Reproducibility and sensitivity of three types of dietary surveys. Approach for clinical-controlled studies. *Nutr Clin*. 2002;5:73–78.
14. Ruiz M, Knott C, Matilla D, et al. COVID-19 lockdown and changes of dietary pattern and physical activity habits in a cohort of patients with type 2 diabetes mellitus. *Nutrients*. 2020;12:2327. doi:10.3390/nu12082327
15. Nachinuthu S, Vijayalakshmi R, Viswanathan V, Viswanathan V. Coping with diabetes during the COVID-19 lockdown in India: results of an online pilot survey. *Diabetes Metabol Syndr*. 2020;14:579–582. doi:10.1016/j.dsx.2020.04.053
16. Ghosh A, Arora B, Gupta R, Anoop S, Misra A. Effects of nationwide lockdown during COVID-19 epidemic on lifestyle and other medical issues of patients with type 2 diabetes in north India. *Diabetes Metab Syndr*. 2020;14:917–920. doi:10.1016/j.dsx.2020.05.044
17. Enriquez O, Martins MCT, Pereira TSS, et al. Diet and lifestyle changes during the COVID-19 pandemic in Ibero-American countries: Argentina, Brazil, Mexico, Peru and Spain. *Front Nutr*. 2021;8:671004. doi:10.3389/fnut.2021.671004
18. Wu X, Luo S, Zheng X, et al. Glycemic control in children and teenagers with type 1 diabetes around lockdown for COVID-19: a continuous glucose monitoring-based observational study. *J Diabetes Investig*. 2021;12:1708–1717. doi:10.1111/jdi.13519