RESEARCH PAPER

The Role of a Virtual Diabetes Care Program in Managing Depression among Assiut University Students with Type1 Diabetes

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ABSTRACT
Objectives: Managing type 1 diabetes in young adults involves distinct difficulties, especially when associated with depression, which contributes to difficulty in achieving glycemic control. The study focused on evaluating the effects of a virtual diabetes care program on Depression. Methods: A total of one hundred and thirty-two students from Assiut University diagnosed with type 1 diabetes who met the eligibility requirements were randomly assigned to either the intervention or control group. The intervention group consisted of university students with type 1 diabetes who participated in the virtual diabetes care program. The control group included university students with type1 diabetes and provided routine, usual care at the students' clinic of Assiut University. Both groups were assessed for Depression (via online designed questionnaire) and HbA1c at baseline and after six months. Results: After six months, the mean score on the CES-D scale did not differ statistically significantly between the two groups. There was a significant rise in depression symptoms among male patients in the control group (P = 0.038) after 6 months, but the virtual diabetes care program participants showed a slight, insignificant decrease in depressive symptoms. Conclusion: The virtual group attendance and mobile app usage were associated with preliminary results of improvement in depression in males. Long-term exposure to the virtual diabetes care program should be investigated in young adults with T1DM, focusing on the reasons for the gender differences in response to the program.
Keywords: Type1 Diabetes, Young adults, Depression, Telemedicine, Virtual care
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INTRODUCTION

A growing number of people worldwide suffer from diabetes and depression, representing 10.5 and 5% of the world's population, respectively (1,2). Diabetes and depression have a reciprocal relationship in which each condition affects the development and course of the other (3).The likelihood of developing depressive symptoms is increased by several circumstances, including physiological stress brought on by ongoing uncontrolled diabetes, anxiety of long-term problems, and difficult self-management routines (4). On the other hand, diabetes self-care practices, including consistent medication compliance, a healthy diet, and exercise, might be impacted by depression (5,6).

Depression is more common in people with Type 1 diabetes than in the general population. About 14% of people with type 1 diabetes (T1D) have depression (7). Individuals with type 1 diabetes are two to three times more likely than the overall population to suffer from depression (6,8).

The majority of young adults go through several changes during this challenging developmental stage, such as adjustments to their lifestyle (such as their education, jobs, and housing arrangements), modifications to their health care, and changes in their relationships with friends, family, and intimate partners (9).

For people with type 1 diabetes, young adulthood is a crucial time of risk. Just 30% of late young people (ages 26–30) and 17% of early young adults (ages 18–25) with type 1 diabetes satisfy the current guidelines for glycemic management (i.e., HbA1c ≤7.0%) (10). Nevertheless, many are overlooked and do not receive the tools or

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assistance required to deal with the difficulties of college life (11).

It has been determined that some aspects of college life present obstacles or difficulties for this population in attaining effective diabetes self-management. These include academic obstacles like erratic schedules and routines, lack of time, and financial difficulties; social obstacles like peer pressure, alcoholism, smoking, drug abuse, dietary restrictions, eating disorders; and emotional and psychological obstacles like stress, inadequate or nonexistent social support, loss of parental involvement, denial and rebellion toward diabetes self-management, and feelings of anger, frustration, and sadness due to feeling cut off from peers (12).

In young adulthood, these difficulties may increase emotional distress and cause depressive symptoms (13,14). Although young adults find it difficult to share psychosocial concerns with their care providers due to a paucity of visits and a lack of a long-term relationship, they feel that such discussions are beneficial and should be included as part of diabetes care (13).

Therefore, they may benefit from shared medical appointments (SMAs). SMAs are clinical sessions where several patients receive clinical support, education, and counseling. SMAs can enhance outcomes, boost patient and provider satisfaction, and improve self-efficacy for diabetic self-management in addition to provide peer support and motivation (15).

Recently, many ways of care emerged to cope with the patients' needs and to overcome any obstacles or difficulties they face during their treatment journey. The development of virtual care technologies (including telehealth, MHealth, e-health, and telemedicine) is growing rapidly. A promising strategy to promote self-management and improve contact with healthcare clinicians is the use of telemedicine and smartphone applications in virtual diabetic clinics (16).

To the best of our knowledge, there isn't much research in this area, and none has been carried out in Egypt. The purpose of this study was to evaluate the effectiveness of a "virtual care program in managing depressive symptoms in young adults with type 1 diabetes and improving their HbA1c."

METHODS:

Study Design:

This is a randomized controlled trial conducted in the students' clinic at Assiut University in Egypt.

Eligibility criteria for participants:

University students with type 1 diabetes aged 18-25 years who attend the students' clinic at Assiut University seeking medical treatment are included in the study. Patients were excluded if they had not visited the clinic in the year before enrollment.

Sample size:

G Power version 3.1.3 was used to calculate the sample size to detect a significant difference in depression in students with T1DM between the intervention and control groups, effect size 0.611*, α error 0.05, power 95%, allocation ratio 1:1, and the sample size was calculated to be 59 in each group with a total sample of 118.

We started with a sample of 132 students (66 in each group) due to the possibility of a dropout of participants during the study.

Randomization procedure:

Students fulfilling the inclusion criteria were randomly allocated by the study researchers into two groups, the experimental (intervention) group included university students with type1 diabetes who attended the virtual diabetes care program. The control group included university students with type1 diabetes and provided routine, usual care at the students' clinic of Assiut University.

Measures and procedures:

After obtaining informed online consent (Google form) from all participants of both groups, after explaining the steps of the study. Students were requested to complete the sociodemographic form, and the questionnaire (Google form) was sent to them at baseline and after six months via WhatsApp message. The data collection tool was a two-section questionnaire including:

The first section included the demographic data of the participants and questions about disease history.

Questions from the Center for Epidemiologic Studies Depression Scale (CES-D) were included in the second portion. The 20-item Depression Scale (CES-D) is used to assess depression symptoms in the general population. The total of all twenty items is the final score that is reported. A cutoff value of ≥16 indicates a high likelihood of depression. In earlier research on young people, the measure showed moderate validity ($r > 0.50$), moderate test-retest reliability (>0.50), and excellent internal consistency (Cronbach's $\alpha > 0.85$) (17).

- The HbA1c was also measured for all participants of both groups before and after the study.

The intervention program:

The intervention program was designed to include a combined sharing medical appointment (SMA), telemedicine, and an M-health intervention that lets young adults take part in a Zoom group telemedicine session with other young adults with T1D and an individual telemedicine appointment with a diabetic care specialist. They used a mobile app called 'Sokar' to record their daily blood glucose levels, the type of food in each meal, daily physical activity, and insulin time reminder.

Over the course of six months, participants in the intervention group performed online visits (via Zoom) every two months. Zoom conferencing software was used to conduct both group and individual telemedicine sessions during visits 1, 2, 3, and 4. Each session took an hour and included psychotherapeutic techniques, problem solving, goal setting, action planning, motivational consultation, care planning, self-help, carbohydrate counting, and dietary control. The topics that have been discussed were diabetes and depression, blood glucose self-monitoring using a mobile app, carbohydrate counting, adjusting insulin dose in different situations, chronic complications of diabetes, and how to prevent

their occurrence. The educational materials were sent to the patient via WhatsApp group. The control group did not participate in any virtual group visits, training sessions, or mobile apps; they only received normal in-person care at the clinic.

Statistical analysis:

SPSS version 25 was used for data entry and analysis. Descriptive statistics like mean, standard deviation, frequency, and percentage. The chi-square test and t-test (student & paired) were used to evaluate differences between the intervention and control groups, and ANOVA for normally distributed continues variable; non-parametric tests were used for non-continuous data.

RESULTS:

The study started with 132 students (66 students in both intervention and control groups). Only one hundred and eighteen (59 in each group) university students with type1 diabetes who continued and completed all the steps throughout the study were included in the statistical analysis.

The baseline variables (age, gender, faculty, family history of DM, regularity of treatment, and duration) did not significantly differ between the intervention and control groups, according to the data. (Table 1)

Results of outcome measures:

Depression:

Both the intervention and control groups exhibited increases in depression symptoms during the trial, as determined by the CES-D. Those in the control group reported a higher increase during the study period than those in the group receiving the program, with most of them having severe depression. Nevertheless, there was no statistically significant difference between the intervention group and the control group in terms of changes in depression symptoms after six months (P =0.19). (Table 2,3)

After six months, male patients in the control group reported a significant increase in depression symptoms (P = 0.038), but males who took part in the virtual diabetes care program showed a minor, insignificant decrease in depressive symptoms. Over the course of the trial, female patients in both groups showed an insignificant increase in CES-D scores. (Table 3)

Level of glycemic control:

There was a decrease in the number of students who had uncontrolled diabetes, and there was an increase in those who had controlled diabetes after six months in the intervention group. In the control group, there was an increase in the number of students who had uncontrolled diabetes, and there was a decrease in the number of those who were controlled after 6 months. (Figure 1, 2). However, after six months, there was no significant difference in the level of glycemic control between the intervention and control groups. (Table 4)

Table1: Baseline characteristics between the intervention and control groups. Assiut University, 2023

Variable		Intervention n (59)	Control n (59)	P-Value
Age	Mean ±SD	20.49 ± 1.30	20.61 ± 1.55	0.64
		n (%)	**n (%)**	
Gender	Male	28 (47.5)	26 (44.1)	0.86
	Female	31 (52.5)	33 (55.9)	
Faculty	Practical	27 (45.8)	15 (25.4)	0.94
	Theoretical	32 (54.2)	44 (74.6)	
Family history of DM	Yes	26 (44.1)	18 (30.5)	0.54
	No	33 (55.9)	41 (69.5)	
Regularity of treatment	Regular	41 (69.5)	44 (74.6)	0.09
	Irregular	18 (30.5)	15 (25.4)	
Duration	Mean ±SD	8.06±3.89	8.90± 3.56	0.22

Table 2: Comparing the Center for Epidemiologic Studies – Depression (CES-D) score and level of depression between the intervention and control groups at baseline assessment (pre) and after 6 months (post), Assiut University, 2023.

Variable	Intervention (Pre) n (%)		Control (Pre) n (%)	P-Value	Intervention (Post) n (%)	Control (Post) n (%)	P-Value
Center for Epidemiologic Studies – Depression Scale (CES-D)	**Mild**	18 (30.5)	15 (25.4)	0.076	19 (32.2)	17 (28.8)	0.10
	Moderate	15 (25.4)	19 (32.2)		11(18.6)	7 (11.9)	
	Severe	26 (44.1)	25 (42.4)		29 (49.2)	35 (59.3)	
	Mean ±SD	23.79±15.58	25.64±15.21	0.51	24.64±13.52	28.25±14.66	0.19

Table 3: Comparing the pre (At baseline assessment) and post (after 6 months) CES-D scores among the intervention and control groups by gender, Assiut University, 2023

Variable		At baseline assessment (pre)	After six months (post)	*P- value*
CES-D				
Intervention n (59)		23.79±15.58	24.64±13.52	0.55
	Female	24.19 ± 17.34	27.22 ± 13.72	0.29
	Male	23.35 ± 13.68	22.25 ± 13.04	0.60
Control n (59)		25.64±15.21	28.25±14.66	0.06
	Female	24.93 ± 15.04	26.30 ± 12.97	0.483
	Male	26.53 ± 15.68	30.73 ± 16.50	**0.038**

Table 4: Comparing the level of glycemic control between the intervention and control groups (At baseline assessment and after 6 months), Assiut University, 2023

Variable		Intervention (Pre) n (%)	Control (Pre) n (%)	P-Value	Intervention (Post) n (%)	Control (Post) n (%)	P-Value
Level of glycemic control (HbA1c)	**Controlled (HbA1C <7)**	4 (6.8)	9 (15.3)	0.49	13 (22)	3 (5.1)	0.63
	Uncontrolled (HbA1C >7)	55(93.2)	50 (84.7)		46 (78)	56 (94.9)	

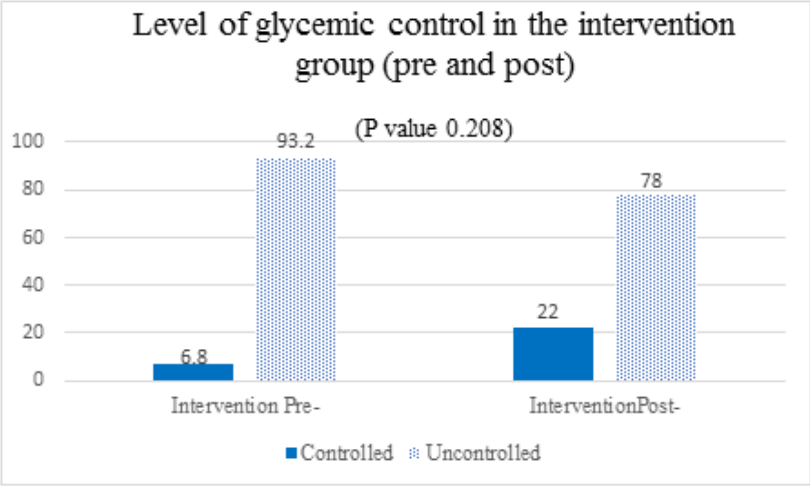

Figure (1): The pre (At baseline assessment) and post (after 6 months) level of glycemic control among the intervention group, Assiut University, 2023

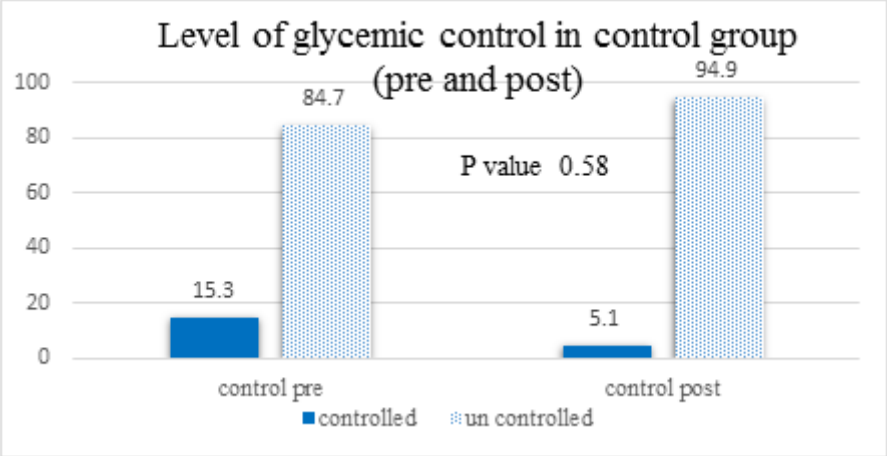

Figure (2): The pre (At baseline assessment) and post (after 6 months) level of glycemic control among the control group, Assiut University, 2023

DISCUSSION:

At the beginning of this study, young adults with T1DM in both intervention and control groups showed different levels of depression, with most of them having severe depression and maintaining these high levels throughout the study period. This can be explained by the findings of earlier research on the relationship between diabetes and depression, which found that people with diabetes are more susceptible to mental illnesses, particularly depression, because of the psychological stress caused by the disease, including immediate and long-term issues, daily insulin injections, routine blood glucose monitoring, physical complications, hospitalization, and diabetes-related restrictions (18). Consequently, those receiving treatment for diabetes who do not currently suffer from depression are more likely to do so in the future (19).

These findings were consistent with a study that evaluated the effects of a home telemedicine clinic model (CoYoT1 Clinic) on psychosocial outcomes in young adults with type 1 diabetes. The CoYoT1 group's change in depression symptoms over the course of the study period did not vary statistically from the control group (group × time P =0.07) (20).

Another study that examined how virtual group appointments (VGA) affected young adults with type 1 diabetes (T1D) in terms of self-reported health-related outcomes and depression revealed that these individuals had higher levels of depression at baseline and continued to do so throughout the study (21). These findings are not unexpected because, as previously indicated, young adults with T1D frequently experience a variety of psychosocial stresses.

After six months, male patients in the control group reported a significant increase in depression symptoms (P = 0.038), but males who took part in the virtual diabetes care program showed a minor, insignificant decrease in depressive symptoms. Over the course of the trial, female patients in both groups showed an insignificant increase in CES-D scores.

This was in agreement with the CoYoT1 clinic study, which revealed that whereas male patients in the control group reported a significant increase in depression symptoms (group × time P =.03) across the study period, male participants in CoYoT1 exhibited no changes in depressed symptoms from baseline. However, during the course of the trial, neither group's female CES-D scores changed significantly (20).

Sociocultural gender differences in coping with stressors may be one explanation behind the higher depressive symptom scores found and maintained in females compared to males, because it has been hypothesized that women are more inclined to ruminate, reduce physical activity, and eat more, while males are more likely to respond by acting aggressively and engaging in activities (22).

Additionally, females are more susceptible to depression and diabetes due to hormonal changes (23). Gender-based correlations between depression and diabetes may be influenced by both factors.

The majority of the intervention and control groups had uncontrolled glycemic control levels at baseline, and there was no significant difference between them. Despite the higher level of adherence and regularity of treatment reported in our study, most of the students have an uncontrolled level of diabetes, which may be explained by the results of a study, which found that seventy-two percent of doctors said that their typical patient does not take insulin as directed (25).

This was consistent with the data from the T1D Exchange clinic registry. According to it, glycemic control deteriorated in the 13–25 age group between 2012 and 2014, while all other age groups recorded either no change or an improvement. Peak hemoglobin A1c (HbA1c) levels occurred at age 19, with an average HbA1c of 9.2% (77 mmol/mol), and only 13% of young adults met the recommended HbA1c target of less than 7.0% (53 momL/mol)(26).

Deteriorating glycemic control in young people with type 1 diabetes is probably caused by many variables,

including inadequate self-management, lack of parental supervision and family support, psychosocial issues, poor treatment adherence, and an ineffective transition from pediatric to adult care (27).

Diabetes and depression have a reciprocal interaction in which each condition affects the development and course of the other (3). Poor glycemic control can result from depression's impact on diabetic self-care practices, such as consistent medication adherence, a healthy diet, and physical activity (5,6) leading to poor glycemic control. Studies on depression and diabetes concluded that diabetic patients who are more depressed have higher HbA1c levels (28).

Anhedonia, or the absence of pleasure or joy, is a characteristic feature of depression, which has been linked to poor glycemic control and mortality (29). In a large study of more than 5000 participants with diabetes, it was shown that poor glycemic control was associated with anhedonia, which is a major depressive symptom (30), suggesting that anhedonia is an important factor that should be assessed and focused on while managing depression.

In addition, the academic performance and the examination in the college is an established stressor for university students, which cause raise in their blood glucose level, which is essential to supply extra energy to vital organs (31), making it more difficult to control their glucose levels.

There was also no significant difference between the intervention and control groups regarding the level of glycemic control after 6 months. There was an increase in the percentage of students in the intervention group who had controlled diabetes. While it decreased in the control group, the difference was insignificant in both groups.

These findings may be related to the study duration and frequency of the sessions. The virtual diabetes care program of our study was designed as a low-dose (every 2month session), short-duration, clinically integrated intervention; thus, it may need longer duration and more frequency of the sessions for the effects to appear and for HbA1c to improve. This can be explained by the results of a study, which found no glycemic improvement in the teleconsultation appointments group due to the low frequency of appointments over the study duration (32).

Additionally, a different study discovered that the greatest effect of video-shared medical appointments (SMA) on HbA1c was observed during four weekly sessions up until month three. Then, a bi-monthly booster session, after which the patients' HbA1c values began to improve once more (33).

In addition to the exam stress factor, which was mentioned before, was directly responsible for increased level of blood glucose from the basal level made it more difficult for them to reach their glycemic targets in this period (31).

These findings were similar to a study that examined how teleconsultation affected clinical outcomes and glycemic control for individuals with type 1 diabetes (T1D) and discovered that HbA1c levels did not significantly change throughout the course of the trial (34).

Glycemic control did not significantly improve at the 6-month follow-up in another trial that used Vista Dialog, a virtual care platform that enabled real-time contact between patients and healthcare providers (35).

However, a study using a Virtual Diabetes Clinic (VDC) that stratified individuals based on baseline A1C levels of <9.0, 8.0 to 9.0, and 7.0 to >8.0% did not support these findings. According to the study, A1C significantly dropped by 2.3 ± 1.9, 0.7 ± 1.0, and 0.2 ± 0.8%, respectively (all P >0.001), indicating a clear correlation between improved clinical outcomes and glycemic control for diabetes patients and involvement in the "Virtual Diabetes Clinic." (36).

Another trial that employed teleconsultations with a smartphone app demonstrated a significant improvement in HbA1c in patients with poorly managed type 1 diabetes (37).

Similarly, the study of (38) discovered that telecare in conjunction with shared care might considerably lower HbA1c levels in diabetes patients with inadequate glycemic control. However, the participants in this study were individuals with varying life circumstances and age groupings, which could produce varied outcomes.

Limitations of the study:

Some Students had difficulties with internet access, internet connection issues, and the proper time of the session. Most of them live away from their homes all the time with a poor internet connection. This was anticipated by repeating the session another time (mostly on weekends). Also, the sessions were recorded, uploaded, and sent to them to overcome this problem.

CONCLUSION:

This study concluded that the virtual group attendance and mobile app usage in the diabetic virtual care program were associated with preliminary results of improvements in depressive symptoms in males when compared with the significant deterioration in the control group.

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STATEMENTS AND DECLARATIONS:

Ethical considerations:

The study protocol was approved by the scientific committee of the Family Medicine Department, Faculty of Medicine, Cairo University in June 2020. Ethical approval was obtained from the Research & Ethical Committee in Cairo University, March 2021 (code: MD-77-2021).

Consent to participate:

An online consent was obtained from every patient before filling in the questionnaires. They were reassured about the strict confidentiality of any obtained information, and that the study results would be used only for the purpose of research.

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