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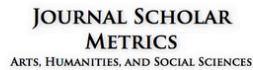
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Online Cognitive-Behavioral Intervention on Adherence and Quality of Life in Elderly Adults with Diabetes: Two cases study

Alejandro Pérez Ortiz*, Juan Manuel Mancilla Díaz, Ana Leticia Becerra Gálvez, Ana Luisa Mónica González-Celis Rangel, Rosalía Vázquez Arévalo

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ABSTRACT

During the COVID-19 pandemic, elderly adults with type 2 diabetes mellitus (T2DM) have experienced difficulties to adhere to their therapy (TA), a situation which not only has had an impact on their glycemic control, but on their quality of life (QoL) as well. Telepsychology has proved to be an effective alternative to treat health-related complications in patients with this disease, however, results of same are unknown among the Latin American population. The aim of this study was determining the effect of Online Cognitive-Behavioral Therapy on TA, overall QoL and specific QoL in two elderly adults with T2DM. The case of a 62-year-old woman and a 60-year-old man who was offered an intervention consisting of nine sessions offered through a video conference platform is presented. The procedure included: psychoeducation, self-control training techniques, behavior reinforcement, feedback and problem solving. The Objective Clinical Change (OCC) evidences an increase in TA behaviors, such as use of medications, following a healthy diet ($OCC \geq 0.20$) and monitoring capillary blood glucose in the medium term (four months). Likewise, improve specific QoL for T2DM patients ($OCC \leq -0.20$). It is concluded that telepsychology is a low-cost, safe, feasible and effective type of therapy to increase and maintain TA behaviors, as well as to improve the QoL of patients suffering T2DM. Even though, more research is needed to increase the effectiveness of this therapy modality. *Key words:* telepsychology, cognitive behavioral therapy, elderly adults, diabetes, adherence, quality of life.

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Novelty and Significance

What is already known about the topic?

- Cognitive Behavioral Therapy can be administered both face-to-face and online, both therapeutic modalities are effective for the attention of different psychological problems.
- There are few studies aimed at increasing and/or maintaining therapeutic adherence behaviors as well as improving the quality of life in older adults with diabetes mellitus.

What this paper adds?

- Online Cognitive Behavioral Therapy was shown to increase adherence behaviors (medication intake, adherence to a healthy diet and capillary glucose monitoring) and improve quality of life related to diabetes mellitus.
- Therapeutic adherence was evaluated as a product (reduction of biochemical parameters) and a process (maintenance of behaviors over time), two clinical components that will help to broaden the view in the evaluation of this multidimensional construct.

Diabetes mellitus (DM) is a chronic disease characterized by a series of different and complex biopsychosocial metabolic disorders which prevalence increases with age (International Diabetes Federation -IDF-, 2013). In 2019, the IFD estimated that more than 135.6 million people over 65 years of age have this disease, with the highest prevalence (19.2 million) in North America and The Caribbean. In Mexico 47.7% of

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people with diabetes are the elderly (Basto Abreu, López Olmedo, Rojas Martínez, Aguilar Salinas, Cruz Góngora, Rivera Dommarco, Shamah Levy, Romero Martínez, Barquera, Villalpando, & Barrientos Gutiérrez, 2021). This disease does not only result in physical decline caused by the metabolic disorders and side effects of its treatment, but also in a higher risk of experiencing mood disorders (e.g. stress, anxiety and depression) and a negative impact on the Quality of Life -QoL- (Boden, 2018; Robinson, Coons, Haensel, Vallis, & Yale, 2018).

Suffering from DM -specifically type 2- during old age, demands a different therapeutic approach compared to its treatment in other stages of life. This is due to the time since it is diagnosed, complications resulting from the disease, medical comorbidities (presence of chronic diseases, polypharmacy and frailty syndrome) and psychological (mood disorders and cognitive impairment), as well as the level of cognitive abilities and functional capacity in older adults (Sesti, Incalzi, Bonora, Consoli, Giaccari, Maggi, Paolisso, Purrello, Vendemiale, & Ferrara, 2018; Weinger, Beverly, & Smaldone, 2014). In view of the fact that elderly adults have a higher life expectancy, but also more health complications, the World Health Organization (WHO, 2015) emphasizes the importance of addressing the QoL needs of this age group.

The promotion of therapeutic adherence behaviors (TA; i.e. use of medications, a healthy diet, physical activity, capillary blood glucose monitoring and foot care) to improve glycemic control and QoL are considered as the therapeutic goals to work on with elderly adults with type 2 DM (T2DM; Gómez Huelgas, Gómez, Rodríguez, Formiga, Puig, Mediavilla, Miranda, & Ena, 2018; Kalin, Goncalves, John-Kalarickal, & Fonseca, 2017; Mogre, Johnson, Tzelepis, Shaw, & Paul, 2019). TA understood as one of the main behavioral problems in chronic patients, involves behaviors, which achievement standards correspond to the instructions provided by healthcare professionals, that result in control or improvement in clinical results and in the QoL (Lugo & Villegas, 2021).

As for its study in T2DM patients, it has been identified that TA decreases in patients who suffer from two or more chronic diseases (Jankowska Polanska, Swiaotoniowska Lonc, Karniej, Polanski, Tanski, & Grochans, 2021), if they perceive a poor state of health (Abraham, Sudhir, Philip, & Bantwal, 2015), if they do not establish an adequate medical doctor-patient relationship (Świątoniowska Lonc, Tański, Polański, Jankowska Polańska, & Mazur, 2021) and if they suffer from mood disorders (Orozco Beltrán, Mata Cases, Artola, Conthe, Mediavilla, & Miranda, 2016). On the other hand, social and family support (Świątoniowska Lonc *et alia*, 2021), disease education (Orozco Beltrán *et alia*, 2016) and a better emotional health (Marinho, Moram, Rodrigues, Leite, Salles, & Cardoso, 2018) benefit TA.

Regarding QoL, the WHO (1996) defines it as “an individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” (p. 385). This multidimensional construct integrates physical and psychological health, the degree of independence, social relationships, environmental factors and personal beliefs (Bautista Díaz, Reyes Jarquín, Bracqbien-Noygues, Rivera Guerrero, & Chávez, 2019). When studying patients with this disease, heterogeneous data have been found, considering that the QoL may be reduced due to the perceived stress to achieve glycemic control (Sudhir, 2014) or increase to the extent that more TA behaviors are performed and an appropriate glycemic control is achieved (Patel, Oza, Patel, Malhotra, & Patel, 2014; Pérez Ortiz, Becerra Gálvez, Mancilla Díaz, de la Hoz, Lugo González, & Cancino, in press). Despite contradictory opinions, it has been proved that people that suffer from

diabetes have a lower or poorer QoL (Aslan, Tekir, & Yildiz, 2021; Fuentes Merlos, Orozco Beltrán, Quesada, & Reina, 2021), and an even a lower quality of life has been reported in elderly adults who have suffered from this disease for a longer period of time since they were diagnosed. (Pamuk, Kaner, Koc, Toşur, Dasdelen, Aksun, & Pamuk, 2021; Ramos, Schwerz, Grou, Silva, Indiana, & Morato, 2017).

As already noted, it is a challenge both for patients as for healthcare professionals to achieve and maintain a series of TA behaviors. Aside from the multidisciplinary approach to address TA, psychology -and especially Cognitive Behavioral Therapy- enable the acquisition of such TA behaviors to control, avoid or delay complications of the disease and improve a patient's QoL (De Groot, Hill, & Wagner, 2016; Hunter, 2016).

In accordance with evidence provided by Cognitive Behavioral Therapy (CBT) in people with T2DM, systematic reviews and meta-analysis, it has been found that this type of face-to-face therapy has been very useful to reduce glycosylated hemoglobin (HbA1c), maintaining this effect in the short and medium term (González Burboa, Acevedo, Vera Calzaretta, Villaseca Silva, Müller Ortiz, Páez, Pedreros, Menéndez Asenjo, & Otero, 2019; Uchendu & Blake, 2016; Winkley, Upsher, Stahl, Pollard, Brennan, Heller, & Ismail, 2020); as well as to improve TA, QoL, psychological well-being and to reduce symptoms associated with mood disorders (González Cantero & Oropeza, 2016).

With the growth of information and communication technologies and the increase in prevalence of mental disorders, CBT started to be offered in different synchronous asynchronous and bimodal devices with internet access, (Alavi & Omrani, 2019; McCord, Bernhard, Walsh, Rosner, & Console, 2020). Until now, the results achieved with online CBT in patients with T2DM indicate that the therapy has been provided on line through applications for mobile phones and has been focused mostly on young and middle-aged adults from North America (USA and Canada), Europe (Finland, France, Italy, Norway and the United Kingdom) and Asia (Australia, China, Indonesia, Japan, the Netherlands, Sri Lanka and Taiwan); HbA1c is the main variable used, followed by use of medications, diet, self-care activities, physical activity, capillary blood glucose monitoring, self-efficacy in diabetes care, perception of disease, depression symptoms and stress, obtaining significant results for all of the aforementioned variables, except for the self-care activities and self-efficacy in diabetes care (Batch, Spratt, Blalock, Benditz, Weiss, Dolor, & Cho, 2021; El Gayar, Ofori, & Nawar, 2021; Huang, Lai, Chen, Lu, Li, Wang, & Su, 2016; Pal, Eastwood, Michie, Farmer, Barnard, Peacock, Wood, Edwards, & Murray, 2014; Pérez Ortiz, Becerra Gálvez, & Mancill Díaz, 2022).

So far, no studies on online CBT addressing TA and / or QoL in elderly adults with T2DM have been reported in Latin America. Regarding Mexico, only one randomized controlled study using this type of therapy to reduce depression symptoms and substance abuse (Fu, Burger, Arjadi, & Bockting, 2020) has been found.

The COVID-19 health emergency resulted in a prolonged confinement or lockdown, limitations in health care access and difficulties for elderly adults with diabetes – considered as one of the most vulnerable social groups to infection- to perform TA behaviors, having a direct impact on their glycemic control and consequently on their QoL (Fisher, Polonsky, Asuni, Jolly, & Hessler, 2020; Sacre, Holmes Truscott, Salim, Anstey, Drummond, Huxley, Magliano, Van Wijngaarden, Zimmet, Speight, & Shaw, 2021; Sankar, Ahmed, Koshy, Jacob, & Sasidharan, 2020). This is how, remote care has been a feasible, safe and effective option during the COVID-19 pandemic to provide TA behaviors and ensure a good QoL of elderly adults with diabetes. The aim of this study was to determine the effect of online Cognitive-Behavioral Therapy on therapeutic

adherence and on the overall and specific quality of life in two elderly adults with type 2 diabetes mellitus.

METHOD

Cases Presentation

Participant 1. 62-year-old woman, married, retired and a homemaker, with a university education who worked as a teacher. She was diagnosed with T2DM two years ago and also suffers from high blood pressure and obesity. Considering her current state of diabetes, she takes 500 mg of Metformin three times a day and 2 mg of Glibenclamide for glycemic control and 50 mg of Losartan twice a day to lower her blood pressure. She reports measuring her capillary glucose at least twice a week. She has a laptop with internet access and the support of her family in case she has questions on how to browse the web or use videoconference platforms. She considers her knowledge of new information technologies is basic.

Participant 2. 60-year-old man, married, retired and a homemaker with a university education. He was diagnosed with T2DM six years ago and also suffers from high blood pressure and obesity. Considering his current state of diabetes, he takes 500 mg of Metformin once a day for glycemic control. He has a laptop with internet access and the support from his family in case he has questions on how to browse the web or use videoconference platforms. He reports that his knowledge of new information technologies is intermediate.

Instruments

Socio-demographic and Clinical Data Form. Expressly prepared questionnaire consisting of 12 questions to collect information on gender, age, education, marital status, occupation, comorbidities, number of years suffering from T2DM, device to connect and join the online intervention, level of knowledge of information technology and if the Participant has the support of a relative or friend to receive counseling or therapy when connected with the psychologist.

Therapeutic Adherence Scale (TAS-15, Soria, Vega, & Nava, 2009). Instrument created to assess TA behaviors in Mexican people that suffer from a chronic degenerative disease (e.g. diabetes, high blood pressure, osteoporosis, heart diseases, arthritis, high blood cholesterol, kidney diseases, atherosclerosis or cancer). Pérez Ortiz *et alia* (in press a) analyzed the psychometric properties of the scale in T2DM patients obtaining acceptable internal consistency indexes ($\alpha = 0.696$ [IC= 0.323 - 0.549] and $\Omega = 0.753$) and structure validity evidence with a good fit ($\chi^2(80) = 137.178$, $p = .000$; $\chi^2/df = 1.715$, $SRMR = 0.0653$; $RMSEA = 0.060$, [IC= 0.042 - 0.076]; $CFI = 0.870$; $AGFI = 0.880$; $TLI = 0.829$). It consisted of 15 questions which explain 42.42% of the variance and are distributed in a tri-factorial structure (control of medication and food intake, medical behavioral follow-up, and self-efficacy) with five Likert type scale answer options (0, 25, 50, 75 y 100)..

Diabetes 27 Quality of Life Instrument (DQoLI-27; Boyer & Earp, 1997). Adapted to the Mexican population by López Carmona and Rodríguez Moctezuma (2006), which assesses the specific QoL for patients with DM. Pérez Ortiz *et alia* (in press) obtained the psychometric properties in patients with T2DM achieving highly reliable internal consistency indexes ($\alpha = 0.988$ [IC= 0.985 - 0.990] and $\Omega = 0.988$), as well as evidence of the validity of the structure that indicate a good fit of the model ($\chi^2(303) = 667.558$, $p = .000$; $\chi^2/df = 2.203$, $SRMR = 0.0279$; $RMSEA = 0.078$, [IC= 0.070 - 0.086]; $CFI = 0.951$; $AGFI = 0.951$; $TLI = 0.943$). The instrument consisted of 27 questions which explain 85.05% of the variance and are distributed in five dimensions (Diabetes control, Anxiety-concern, Social impact, Sexual function, and Energy-mobility) with seven Likert type scale answer options (from Nothing affects me at all= 1 to Extremely affected= 7).

Brief Version of the Quality of Life Questionnaire of the World Health Organization (WHOQOL-BREF-16; WHO, 1996). Adapted to the Mexican population by González

Celis, Tron, and Chávez (2009), it assesses the QoL in Mexican adults. In patients with T2DM Pérez Ortiz et alia (in press a) obtained the psychometric properties achieving acceptable internal consistency indexes ($\alpha = 0.898$ [$IC = 0.879 - 0.919$] and $\Omega = 0.915$) and evidence of validity of structure that suggest that the fit of the model is satisfactory ($\chi^2(92) = 186.737$, $p = .000$; $\chi^2/df = 2.030$, $SRMR = 0.0469$; $RMSEA = 0.072$, ($CI = 0.057 - 0.087$); $CFI = 0.934$; $AGFI = 0.935$; $TLI = 0.914$). The scale consisted of 16 questions that explain 64.07% of the variance and are distributed in four dimensions (Physical health, Psychological health, Social relationships, and Environment) with five Likert type scale answer options (Not at all, A little, Moderately, Very much, and Completely).

Self-registration Form 1. Log where the Participant records his/her pre-prandial and post-prandial capillary blood glucose twice a week (one for each measurement). The day, type of measurement (pre or post-prandial) and the possible causes that led to hypo or hyperglycemia (must be reported in the observations section).

Self-registration Form 2. Log to record intake frequency of nine groups of foods (dairy products and derivatives, vegetables, fruit, cereals and root vegetables, animal products, pulses, oil and fats, sugar and sugary beverages), it is answered in the pre and post-test assessment and follow-ups. The Participant indicates the number of times he or she ate a type of food in the last week.

Intervention

The two Participants were part of another research project, which consisted of the application of a psychological battery that evaluated their level of health, adherence to treatment, and quality of life, which was shared in a GoogleForms® form in the months of September and November 2021 (Pérez Ortiz *et alia*, in press). After confirmation, and prior informed consent of both Participants, a group of messages was created on the WhatsApp® social network to share information related to the evaluations, use of self-registration and resolution of doubts.

The Participants had to send a photograph of the answered self-registration forms. The pre-test was conducted a week before the online intervention which consisted of nine group sessions divided in five thematic modules (I- Learning to live healthily: Diabetes Mellitus and Self-Care; II- Self-monitoring of capillary blood glucose; III- Use of Medication; IV- Diet and diabetes; V. Quality of life in old age), which were given through the Zoom videoconference platform, once a week for approximately an hour and a half. To promote TA behaviors using the Cognitive Behavioral Therapy, the intervention was designed considering suggestions in the systematic reviews conducted by González Cantero and Oropeza (2016) and Pérez Ortiz *et alia* (2022) in patients with T2DM. In the meantime, the cognitive behavioral techniques to improve the QoL and specific QoL for diabetic patients were taken from a non-systematic literature review. The general outline of the intervention can be observed in Table 1. A week after the nine sessions were completed, the battery of psychological tests (posttest) available on GoogleForms® and the self-registration forms were sent again. This was repeated after a month (follow-up 1) and two months later (follow-up 2) after having completed the study.

Ethical considerations

The Participants answered the battery of psychological tests after having read and signed their informed consent in which the aim and risk of the study were explained, as well as their rights by collaborating in an informed and voluntary manner in scientific research. This study was conducted in accordance with the guidelines to create research protocols set forth in the Code of Ethics for Psychologists and was approved by the Ethics Committee of the Psychology Masters' and Doctorate Program of the National Autonomous University of Mexico (UNAM): EP/PMDPSIC/0319/2021.

Table 1. Structure of Online Cognitive Behavioral Intervention.

Module (sessions)	Topics	Techniques
I. Learning to live healthily: Diabetes Mellitus and Self-Care (1-2)	Etiology and consequences of diabetes	Psychoeducation
	Diabetes myths and beliefs	
	What is self-care? Self-care behaviors	
II. Self-monitoring of capillary blood glucose (3)	What is capillary glucose self-monitoring?	Psychoeducation
	Training in capillary glucosa measurement	Behavior reinforcement and feedback
	Parameter interpretation	
III. Use of Medication (4)	Hypo and hyperglycemia, decision making in case of occurrence	Psychoeducation
	Benefits of daily use of medications for glycemic control	Behavior reinforcement and feedback
	Self-control training techniques	
IV. Diet and diabetes (5-6)	Dietary myths and beliefs about diabetes in old age	Psychoeducation
	Dish of the good food	Self-control training techniques
	Healthy eating in old age and when suffering from diabetes	Behavior reinforcement and feedback
	Self-control training techniques	Problem solving
	Problem solving training	
V. Quality of life in old age (7-8-9)	Myths and beliefs about old age	Psychoeducation
	Pleasant activities at home and in times of COVID-19	Behavior reinforcement and feedback
	Problem solving training	Problem solving

Data Analysis

Analyses were performed to determine the clinical significance, which aims to assess whether a subject scores towards normal values within the clinical area after undergoing an intervention (De Vicente Colomina, Santamaría, & González Ordi, 2020). The clinical significance analysis of Jacobson and Traux (1991; in Iraurgi, 2010) was used (C criteria). For the calculation of C , the mean and standard deviation of a functional and a dysfunctional group are required. These values were obtained through the results of the first project in which these two patients participated (Pérez Ortiz *et alia*, in press) for each of the scales (total score and per dimension) and for pre-prandial capillary glucose. It is considered that an individual reaches a functional level when:

Positive variable: $X_{\text{post-intervention}} > C$
 Negative variable: $X_{\text{post-intervención}} < C$

Where X is the score obtained in the post-test. TA and QoL were identified as the positive variables, whereas specific QoL for DM and pre-prandial glucose as the negative variables.

In addition to clinical significance, the objective clinical change (OCC) proposed by Cardiel (1994) was estimated through the following algebraic expression: $OCC = (\text{Post-test} - \text{Pre-test}) / \text{Pre-test}$. This parameter assesses if an individual's change in behavior was significant with regard to his/her own behavior. If the OCC is ≥ 0.20 this indicates a significance after the intervention. In the positive variables the OCC should be ≥ 0.20 and ≤ -0.20 in negative variables.

In order to analyze capillary glucose changes between the different assessment stages, the average of two pre-prandial capillary glucose measurements of each Participant was calculated. While for assessing the changes in intake of the nine food groups, the frequency for each group was estimated and compared. Finally, the total score obtained in each scale and its respective dimensions was contrasted. Said procedure was performed at each stage of the assessment.

RESULTS

The scores obtained in the psychometric scales, as well as the capillary glucose measurements of the Participants can be seen in Table 2.

In therapeutic adherence, Participant 1 obtained a clinical change in the Control on medication and food intake dimension in the post-test and the two follow-ups, and in the first follow-up of the Self-efficacy factor. Participant 2 did not show any clinical changes at any stage of the assessment. As for clinical significance, both Participants already exceeded cut-off point C of the total score of the TAS-15 scale and its dimensions since the pre-test assessment, with the exception of the Control on medication and food intake factor in Participant 2.

With regard to quality of life, no clinical changes were observed in any of the Participants in the total score of the scale and its respective dimensions, except for the Social Relationships factor in Participant 2 during the first follow-up, however, he did not show up to the second follow-up. Contrary to what had been expected, Participant 1 reported a decrease in the Physical Health, Social Relationships and Environment dimensions at the different stages of the assessment. The two Participants already exceeded cut-off point C of the total score of the WHOQOL-BREF-16 scale and its dimensions since the pre-test assessment, so there was no clinical significance.

Regarding diabetes-specific quality of life, a decrease in the total score of the DQoLI-27 scale is observed in four of its dimensions (Diabetes control, Anxiety-concern, Social impact and Energy-mobility) in Participant 1 between the post-test and the two follow-ups, in contrast, in the Sexual Function dimension, there was a clinical change in the first, but not in the second follow-up. On the other hand, Participant 2 showed an increase in the total score of the DQoLI-27 scale in the second follow-up in the Diabetes control dimension, despite the fact that a favorable clinical change was obtained

Table 2. Evaluation of the participants in four moments.

	Instrument/dimension	Pretest	Postest	Follow-up 1	Follow-up 2	OCC Pre-Pos	OCC Pre-F1	OCC Pre-F2	C
Participant 1	WHOQOL-BREF-16 Total	63	72	69	66	0.14	-0.10	0.05	22.60
	Physical health	14	17	17	17	0.21*	0.21*	0.21*	21.35
	Psychological health	20	20	19	17	0	-0.05	-0.15	12.77
	Social relationships	29	35	33	32	0.21*	0.14	0.10	20.03
	Environment	113	51	38	56	-0.55*	-0.66*	-0.50*	67.94
	TAS-15Total	39	16	13	17	-0.59*	-0.67*	-0.56*	18.12
	Control of medication and food intake	15	6	5	6	-0.60*	-0.67*	-0.60*	13.91
	Medical behavioral follow-up	27	12	8	12	-0.56*	-0.70*	-0.56*	11.38
	Self-efficacy	6	6	3	6	0	-0.50*	0	8
	DQoLI-27 Total	26	11	9	15	-0.58*	-0.65*	-0.42*	8.5
	Diabetes control	58	46	58	48	-0.19	0	-0.17	39.43
	Anxiety-concern	11	9	11	8	-0.18	0	-0.27*	6.72
	Social impact	12	11	12	10	-0.10	0	-0.17	8.85
	Sexual function	13	11	12	10	0	-0.08	-0.23*	5.79
	Energy-mobility	22	15	23	20	-0.29*	0.05	-0.09	15.75
	Preprandial glucose	108.50	115.50	112.5	112	0.06	0.04	0.03	124.77
	Participant 2	WHOQOL-BREF-16 Total	73	74	74	67	0.02	0.02	-0.08
Physical health		19	19	19	19	0	0	0	21.35
Psychological health		20	20	20	19	0	0	0	12.77
Social relationships		34	35	35	29	0.03	0.03	-0.15	20.03
Environment		70	71	61	99	0.01	-0.13	0.41*	67.94
TAS-15Total		19	18	14	27	-0.05	-0.26*	0.42*	18.12
Control of medication and food intake		5	6	7	10	0.17	0.40	1*	13.91
Medical behavioral follow-up		8	8	8	14	0	0	0.75*	11.38
Self-efficacy		14	13	12	13	-0.07	-0.14	-0.07	8
DQoLI-27 Total		24	26	20	35	0.08	-0.17	0.46*	8.5
Diabetes control		57	55	53	58	-0.04	-0.07	0.02	39.43
Anxiety-concern		8	8	8	7	0	0	-0.13	6.72
Social impact		12	11	11	11	-0.08	-0.08	-0.08	8.85
Sexual function		8	10	9	9	0.25*	0.13	0.13	5.79
Energy-mobility		29	26	25	31	-0.10	-0.14	0.07	15.75
Preprandial glucose		140	133	128.5	132.5	-0.05	-0.08	-0.05	124.77

Notes: Significant objective clinical change (OCC; values from ≤ 0.20 to ≥ 2.0); * = indicates where a target clinical change was achieved.

in the first follow-up, said change was lost in the second follow-up. The score in the Anxiety-concern dimension increased in all of the stages of the assessment, situation that occurred in the second follow-up of the Social impact and Energy-mobility factors. Regarding clinical significance, the total scores obtained with the DQoLI-27 scale and its dimensions, indicate that Participant 1 exceeded cut-off point *C* in all of them, except for the Energy-mobility factor. As for Participant 2, he exceeded cut-off point *C* in the total score of the scale only in the first follow-up and in some of the stages of the assessment of the Diabetes control, Anxiety-concern and Social impact factors.

As for preprandial capillary glucose, none of the Participants showed a clinical change in preprandial capillary glucose in the different stages of the assessment. Regarding clinical significance, Participant 1 had already exceeded cut-off point *C* since the pre-test assessment and this continued throughout the post-test and follow-ups; on the other hand, Participant 2 was not able to exceed cut-off point *C* in the different assessments.

Figure 1 shows Participant 1's pre-prandial and post-prandial capillary glucose in the pre-test assessment, the nine sessions of the intervention, the post-test and the two follow-ups, and as it can be seen the pre-prandial glucose parameters ranged between 99 and 125 mg/dL, compared to the post-prandial parameters which ranged between 104 and 145 mg/dL. In general, despite the observed capillary glucose instability, the measurements were always within the controlled parameters, pre-prandial 70 to 130 mg/dL and post-prandial below 180 mg/dL.

In Figure 2, the same parameters are shown for Participant 2, who had a pre-prandial glucose between 100 and 157mg/dL and a post-prandial glucose between 103 and 170 mg/dL. A higher instability can be seen in the case of this Participant, aside from the fact that all of his pre-prandial glucose measurements exceeded the control

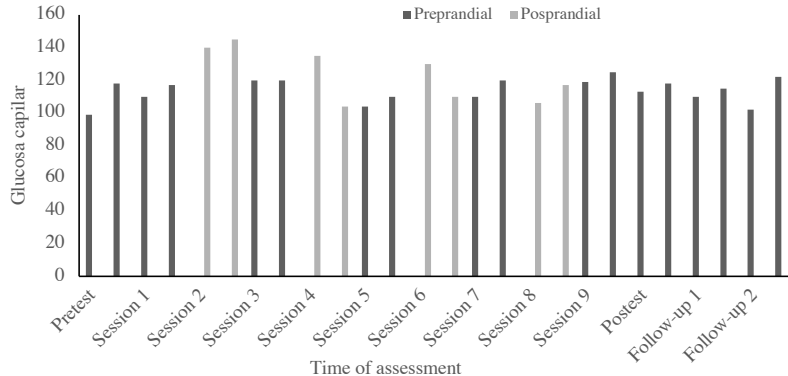


Figure 1. Preprandial and postprandial capillary glucose of Participant 1.

parameter.

Lastly, in food groups (Diet) both Participants showed a clinical change (positive or negative) in the nine food groups and throughout the evaluation times. Participant 1 achieved and maintained the clinical change in five food groups (vegetables, fruits, cereals and tubers, legumes, and oils and fats) during the post-test evaluation and the two follow-ups. This situation also arose in Participant 2 in all the food groups during the post-test and the two follow-ups, except for dairy products and derivatives and Legumes, as can be seen in Table 3.

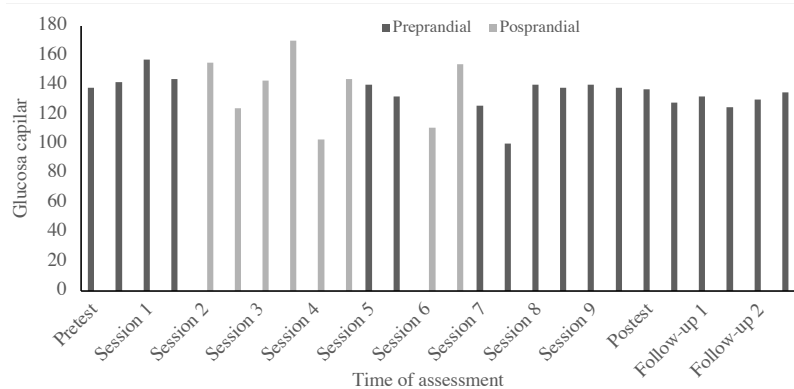


Figure 2. Preprandial and postprandial capillary glucose of Participant 2.

Table 3. Objective clinical change in dietary intake of nine food groups at three assessment times.

	Food group	Pretest	Posttest	Follow-up 1	Follow-up 2	OCC Pre-Pos	OCC Pre-F1	OCC Pre-F2
Participant 1	Dairy products and derivatives	4	3	4	5	-0.25*	0	0.25*
	Vegetables	9	12	12	18	0.33*	0.33*	1*
	Fruit	8	4	6	6	-0.50*	-0.25*	-0.25*
	Cereals and root vegetables	12	15	19	16	0.25*	0.58*	0.33*
	Meat	13	17	12	12	0.31*	-0.08	-0.08
	Leguminous	1	3	3	4	2*	2*	3*
	Oil and fats	15	12	9	9	-0.20*	-0.40*	-0.40*
	Sugars	2	2	4	5	0	1	1.50*
	Sweetened beverages	0	1	0	1	0	0	0
	Dairy products and derivatives	1	2	1	2	1*	0	1
Participant 2	Vegetables	6	8	8	13	0.33	0.33*	1.17*
	Fruit	2	5	6	8	1.50*	2*	3*
	Cereals and root vegetables	16	11	11	10	-0.31*	-0.31*	-0.38*
	Meat	22	8	9	9	-0.64*	-0.59*	-0.59*
	Leguminous	2	2	1	2	0	-0.50*	0
	Oil and fats	14	4	4	7	-0.71*	-0.71*	-0.50*
	Sugars	5	3	2	2	-0.40*	-0.60*	-0.60*
	Sweetened beverages	6	3	3	4	-0.50*	-0.50*	-0.33*

Notes: Significant objective clinical change (OCC; values from ≤ 0.20 to ≥ 2.0); *= indicates where a target clinical change was achieved.

DISCUSSION

The aim of this study was to determine the effect of Online Cognitive Behavioral Therapy on therapeutic adherence, diabetes overall and specific quality of life in two elderly adults with T2DM. First of all, an aspect that must be highlighted in this study are the identified factors that prevented an elderly adult with T2DM from having access to an online psychological counselling service, namely: not having a device to measure capillary glucose, no internet access and/or an electronic device, lack of interest, not knowing how to use information and communication technologies and a lack of support from a relative or acquaintance to help him/her connect. Although it was not an aim of the study and the frequency of each limitation is not representative of this group of patients, this data suggest that the implementation of Telepsychology for the care of a chronic disease in the older population in a developing country like Mexico, is limited -up to now- to people with financial means, knowledge of the new information technologies, family and/or social support and an interest to improve their

biopsychosocial health. Despite this situation, future professionals must continue with the creation of alternatives so that online therapy becomes a feasible, effective and safe option of psychological support for people that live in distant communities, have difficulties to move or when due to a health condition, a face-to-face interaction is unsafe, such as during the COVID-19 pandemic (Alavi & Omrani, 2019; Fu *et alia*, 2020; McCord *et alia*, 2020).

Nevertheless, regarding the results achieved in TA, the online CBT proved to be effective to increase the performance of two behaviors (use of medications and following a healthy diet) and maintain capillary blood glucose monitoring for more than four months. Our results match what was reported by Batch *et alia* (2021), who in a sample of 48 people with T2DM and through a cell phone application with a cognitive behavioral approach, were able to increase use of medications. Regarding following a healthy diet, this also matches what was found by Pérez Ortiz *et alia* (2022) in their systematic review, who found a study conducted in Australia that improved adherence to a healthy diet. Opposite to this research, in our study diet was assessed with a psychometric scale and a self-registration form. In contrast to the studies found by Pérez Ortiz *et alia* (2022) in which capillary blood glucose was only assessed as a product (glucose lowering), in this protocol it was assessed comprehensively, in other words, using a product and a process (performance of behavior over time; Lugo & Villegas, 2021), so it can be concluded that this behavior was integrated to the patients' behavioral repertoire to control their T2DM (De Groot *et alia*, 2016; Hunter, 2016; Mogre *et alia*, 2019).

Contrary to expectations, a clinical change and significance in patients' QoL was not achieved and Participant 1's QoL was impaired at certain stages of the assessment. The hypothesis is that perhaps both patients experienced difficulties during the COVID-19 pandemic in the WHOQOL-BREF scale dimensions, in addition, this event could have prevented the patients to perform TA behaviors to allow glycemic control and improve their QoL, as reported by Fisher *et alia* (2020), Sacre *et alia* (2021), and Sankar *et alia* (2020). Such a scenario could explain that the intervention did not allow both Participants improve their TA, QoL and lower their capillary blood glucose. According to systematic reviews and meta-analysis (Batch *et alia*, 2021; El Gayar *et alia*, 2021; Huang *et alia*, 2016; Pal *et alia*, 2014; Pérez Ortiz *et alia*, 2022), so far no online CBT-based interventions to improve the QoL of this type of patients have been published, reason why it has become an area of opportunity that needs to be remedied with the creation of psychological care programs, as pointed out by the WHO (2015), by prioritizing the elderly's QoL as one of the public health priorities of all countries.

Concerning diabetes-specific quality of life, the intervention reduced the impact in Participant 1 from suffering from this Condition 1 in the total score of the DQoLI-27 and in all of its dimensions, maintaining its effect in the two follow-ups. Whereas in the case of Participant 2, the clinical change and significance were only achieved in the Anxiety-concern factor in the first follow-up, subsequently in the second follow-up his overall QoL deteriorated in four of five dimensions. As discussed above, during the pandemic elderly adults and those that suffer from chronic diseases such as obesity, DM and/or high blood pressure are more vulnerable and at a higher risk of becoming infected. In this case, being elderly people suffering from the three mentioned Conditions, as well as their belief system concerning the pandemic and their illness could have negatively affected their QoL and diabetes-specific QoL, since both address their perception of their biopsychosocial state of health and in the second case in particular, how DM affects QoL (Fisher *et alia*, 2020; Sacre *et alia*, 2021; Sankar *et alia*, 2020).

Recent studies in Mexican patients with T2DM point out that, the greater the impact of DM on QoL, a lower overall QoL (Pérez Ortiz *et alia*, in press). In this regard, this would help explain what happened to patient 2 whose deterioration perception increased in his T2DM-specific QoL and consequently reduced his overall QoL. Possibly this is the first study using online CBT that considered overall QoL as well as T2DM-specific QoL in elderly adults, achieving a clinical change and significance in the latter; continue with studies that integrate this psychological variable will help improve overall QoL in this age group.

Hereunder, there is a description of the limitations of this study, as well as recommendations for their control in future research. For example, it is clear that a limited number of Participants undermines the external validity as it is insufficient to generalize the achieved findings; however, being an exploratory study to some extent and possibly one of the first studies in Latin America of this kind, the results of the use of Telepsychology to improve TA behaviors and diabetes-specific QoL are encouraging. In this scenario, the promotion of this type of psychological services among the study population, ensuring free access for Participants of any gender, age and social status can be improved. Likewise, in case of having the sufficient budget, provide the necessary materials to monitor capillary blood glucose for free. Also, the design may be changed for a quasi-experimental design which allows comparing the results obtained in the psychological variables between a group under treatment and one on a waiting list, in such a way that analyses with statistical tests are performed and the size of the effect is measured. Alternatively, a $N=1$ design, although this type of design does not intend to generalize data, as it is a little-explored topic it can be used to analyze the effects in the variables studied over time. Finally the use of the WHOQOL-BREF instrument was based on the fact that its psychometric properties were analyzed in elderly adults in a previous study, showed a good fit, however, it could not have been sensitive enough to assess QoL in the elderly, due to which the WHOQOL-OLD could be used in future studies considering that it is designed to assess this psychological construct in older population.

Online CBT is a low-cost, safe, feasible and effective type of intervention to increase TA behaviors such as, use of medications, following a healthy diet and monitoring capillary blood glucose in the medium term (four months). Furthermore, it improves T2DM-specific QoL. It can be implemented in elderly adults with T2DM of both sexes with medical comorbidities such as high blood pressure and obesity. Considering the systematic reviews and meta-analysis in the last five years, possibly this is the first study conducted in Latin America in elderly patients with T2DM. Continuing with more studies will be useful to identify therapeutic components that promote TA, glycemic control and QoL in this group of patients.

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