Importance of comprehensive education for patients with type 2 diabetes mellitus: nutrition, adherence to treatment and exercise in a remote community

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Abstract

Introduction: to date, there is no effective educational model for diabetes control. This program adds to the efforts made in Mexico in a remote community.

Objective: to analyze the impact of an educational-informative intervention that included adherence to treatment, exercise and nutrition for the control of type 2 diabetes mellitus (DM).

Methodology: a prospective, longitudinal, homodemic, single-center, census study was carried out in the Chachapa Puebla Health Center during a 4-month period from July to October 2022. The study population was 117 patients of which only 30 met the inclusion criteria.

Results: it was found that after the educational intervention strategy,

67% of patients improved their adherence to treatment, with a value of *p < 0.0001, The duration of physical activity changed from a mean of [78.5 ± 9.15 min] to a mean of [154.5 ± 6.06 min], the significance level established was *p < 0.0001. For the eating habits variable, an increase of [20.17± 0.98] to a mean of [23.76±0.60] was observed, with a value of *p <0.0001. Glycosylated hemoglobin changed from a mean of [8.25±0.40], to a mean of [7.32±0.30], with a value of *p<0.0001.

Resumen

Introducción: hasta el momento no existe un modelo educativo efectivo para el control de la diabetes. Este programa se suma a los esfuerzos realizados en México en una comunidad alejada.

Objetivo: analizar el impacto de una intervención formativa-informativa que incluyó el apego al tratamiento, el ejercicio y la alimentación para el control de la diabetes mellitus (DM) tipo 2.

Metodología: se desarrolló un trabajo censal prospectivo, longitudinal homodémico, unicéntrico, esta investigación se llevó a cabo en el Centro de Salud de Chachapa Puebla en un periodo de 4 meses de julio a octubre del 2022. La población en estudio fue de 117 pacientes de los cuales solo 30 cumplieron con los criterios de inclusión

Resultados: se encontró que después de la estrategia de intervención educativa, el 67% de los pacientes mejoraron su apego al tratamiento, con un valor de *p < 0.0001, La duración de la actividad física cambió de una media de [78.5 ± 9.15 min] a una media de [154.5 ± 6.06 min], el nivel de significancia establecido fue de *p < 0.0001. Para la variable de hábitos alimenticios se observó un aumento de [20.17± 0.98] a una media de [23.76±0.60], con un valor de *p <0.0001. La Hemoglobina glicosilada cambió de una media de [8.25 ± 0.40], a una media de [7.32 ± 0.30], con un valor de *p < 0.0001.

Introduction

The World Health Organization (WHO) considers diabetes mellitus (DM) to be a global threat epidemic (1). The International Diabetes Federation (IDF) estimated that by the year 2021 there were 537 million diabetics in the adult population between 20 and 79 years of age in the world. In this study, Mexico ranked 7th among the 10 countries with people suffering from diabetes, causing 6.7 million deaths (2).

On the other hand, the National Health and Nutrition Survey 2021 on COVID-19 (ENSANUT on COVID-19 2021 (acronym in Spanish)) (3) and

the National Institute of Statistics and Geography (INEGI by its acronym in Spanish) (4) reported that in Mexico by the year 2021 there were an estimated 13.4 million diabetics in the adult population. In the case of the state of Puebla, INEGI reported that by 2021 this disease had caused 10,461 deaths, being the third leading cause of death in the state.

According to information published in the IDF Diabetes Atlas (2), the global health expenditure due to diabetes was US$966 billion for adults aged 20 to 79 years in 2021, with respect to this estimate the figure is expected to increase to US$1.05 trillion by 2045. Of the seven IDF regions, region 2, comprising North America and the Caribbean, comprises a total health expenditure of 415 billion dollars (USD), which represents 42.9% of total diabetes-related expenditure for the year mentioned above, the expenditure per adult with diabetes is 8,209 USD so the impact of this total health expenditure in the world is 11. 5% and according to the ranking of the 10 countries or territories with the highest total health expenditure due to diabetes in adults aged 20 to 79 years, Mexico is positioned in the 8th place with 19.9 billion USD (2).

In terms of prevention, according to NOM-015-SSA2-2010, nutrition and physical activity should be promoted and emphasized, so they should be encouraged in their various forms: daily life, non-sedentary work, recreation and exercise, since they have a protective effect against diabetes (6).

On the other hand, the Mexican Official Standard NOM-043-SSA2-2005 (acronym in Spanish), which guides the Basic Health Services, Promotion and Education for Health in Food, refers that in the area of nutrition, useful information will be provided for the prevention of the disease, as well as the type of food that should be consumed, in what quantities and how to mix them with each other in case of diabetes mellitus (7).

Regarding adherence to treatment as prevention of type 2 diabetes mellitus, there is evidence that shows that the effect of adherence to treatment contributes to the improvement of clinical outcomes such as HbA1c levels and rapid glucose tests (8).

Furthermore, in terms of support programs for diabetic patients, a study was published in 2017 (9) indicating that the care of patients with diabetes in North America includes an educator and a physician. In this regard, the authors consider that such professionals are essential to maintain the necessary care and behaviors for self-management on an ongoing basis to achieve control of type 2 diabetes mellitus and prevent its complications.

For their part, Figueroa- Suárez et al. (10) in 2014, pointed out in their study in Mexican population, that the DiabetIMSS program should be consolidated in the different medical units since the patient's quality of life improves with this type of program. In this sense, Juárez- Ramírez et al., (11) in 2021, noted that the Mutual Aid Groups (GAM by its acronym in Spanish) help in Mexico in training for the control of diabetes, thus favoring adherence to treatment, although little is known about the results of this strategy (11).

Regarding the educational intervention, Canché-Aguilar et al.(12) determined the effect of an educational intervention based on lifestyle, degree of knowledge about diabetes and the level of HBA1c, using the IMEVID as an evaluation instrument; the data obtained showed the following: of 39 patients included, in the nutrition item before and after the educational intervention there was a significant difference for *$p<0.001$ with averages 22.49 ± 4.4 and 28.77 ± 3.6 respectively; in the item of physical activity before and after the educational intervention there was a significant difference with a value of *$p<0.001$ with averages of 5.46 ± 1.8 and 6.64 ± 1.8 respectively; in the item of adherence to treatment before and after the educational intervention there was a significant difference with a value of *$p<0.001$, with average values of 10.13 ± 3.2 and 12.90 ± 2.9 respectively, so they concluded that people living with diabetes, learn and understand its consequences, make changes in lifestyle and develop the ability to identify and seek help to solve problems arising from their disease.

In terms of targeted programs for patients with diabetes mellitus, Fundación Mídete (7) in 2016 indicates that nationally more than 80% of the population with diabetes mellitus received treatment for its control and only 25% maintained optimal control; the publication includes a list of the states with the mortality score attributed to diabetes mellitus, in which Puebla ranks fourth. The 2017-2018 institutional program of the state of Puebla shows that diabetes is the first cause of death in the population aged 20-59 years. One of the problems afflicting the Chachapa Puebla Health Center, which has 4, 237 inhabitants, of whom 117 suffer from type 2 diabetes mellitus, is that most are not controlled since they do not adhere to the indicated treatment, do not exercise, do not eat a diet in accordance with their condition and the number of people who have had glycosylated hemoglobin A1c fraction performed for monitoring hyperglycemia is unknown. For these reasons, it is important to carry out an educational program that includes nutrition, adherence to treatment and exercise in addition to the mea-

surement of HbA1c levels, aimed at patients with type 2 diabetes mellitus so that they can have adequate control of the disease and thus reduce the complications of the disease.

Unlike the United States, Mexico does not have a government program aimed at diabetic patients that takes into consideration diet, exercise, adherence to treatment and control monitoring in diabetic patients through the complementary test of glycosylated hemoglobin A1c fraction.

In this regard, the IDF in 2021 published the "Atlas 10th edition" which states that Mexico occupies the seventh place of people suffering from diabetes worldwide and in the North America and the Caribbean region is in 2nd place. The OECD reported in 2016 that Mexico is one of the countries where mortality caused by diabetes is growing at unsustainable rates. For its part, Fundación Mídete in 2016, revealed that nationally more than 80% of the population with diabetes mellitus received treatment for its control and only 25% maintained optimal control; the publication includes a list of the states with the mortality score attributed to diabetes mellitus, in which Puebla ranks 4th.

The 2017-2018 institutional program of the state of Puebla shows that diabetes is the first cause of death in the population aged 20-59 years. The problem afflicting the Chachapa Puebla Health Center, which has 4, 237 inhabitants of which 117 suffer from type 2 diabetes mellitus, is that most of them are not controlled since they do not adhere to the indicated treatment, do not exercise, do not eat a diet in accordance with their condition, and the number of people who have had glycosylated hemoglobin A1c fraction for monitoring hyperglycemia is unknown. For the reasons stated above, it is considered important to carry out an educational program that includes nutrition, adherence to treatment and exercise in addition to the measurement of HbA1c levels, aimed at patients with type 2 diabetes mellitus so that they can have adequate control of the disease and thus reduce its complications.

Objective

The objective of the present research was to analyze the impact of an educational and informative intervention that integrated adherence to treatment, exercise and diet on the control of type 2 diabetes mellitus through the change in glycated hemoglobin.

Material and methods

A prospective, longitudinal, analytical, homodemic and unicentric census study was developed. It was carried out in the Health Center of Chachapa, Puebla, in a period of 4 months from July to October 2022. The study universe was established as all patients diagnosed with type 2 diabetes mellitus in Chachapa. It was a non-random sample, by convenience. Of the 117 patients, only 30 patients with a diagnosis of type 2 diabetes mellitus participated in the study. The inclusion criteria were the following: people with a diagnosis of diabetes mellitus, patients who signed the informed consent form and patients with a diagnosis of diabetes mellitus between 30 and 60 years of age. Patients over 60 years of age were excluded, as well as those between 30 and 60 years of age who did not belong to the Chachapa Health Center, Puebla, and patients who did not attend the first HbA1c measurement.

1. HbA1c determination:

The sample was taken by venipuncture and processed according to the manufacturer NycoCard; HbA1C is a boronate affinity test. The reagents contain substances that rupture erythrocytes and produce a specific precipitation of hemoglobin, then a boric acid conjugate coupled to a blue dye binds to the cis-diol configurations of glycosylated hemoglobin. An aliquot of this reagent mixture is applied to the test plate and the free or conjugated total hemoglobin remains on the filter. The precipitate is titrated by blue (glycosylated hemoglobin) or red (total hemoglobin) color density on the NycoCard READER II and the reading obtained is proportional to the percentage of HbA1C in the sample.

Application of food questionnaire. The "healthy" answers suggested by the authors based on what is reported in the literature are as follows: 1 = e, 2 = e, 3 = b, 4 = b/c, 5 = a, 6 = a, 7 = a/b, 8 = d/e, 9 = At least 3 meal times per day, 10 = At least 3 meal times per day, 11 = a/b, 12 = a/b, 13 = a/b, 14 = a/b, 15 = a/b, 16 = a/b, 17 = a/b, 17 = a/b, 18 = d/e, 19 = a/b, 20 = a/b, 21 = d/e, 22 = d/e, 23 = b, 24 = b, 25. 1 = b, 25.2 = a/b, 25.3 = a, 25.4 = a, 25.5 = a/b, 25.6 = a, 25.7 = a/b, 25.8 = b, 25.9 = a, 25.10 = a, 25.11 = b, 25.12 = a, 26 = f/g, 27 = f/g, 28 = d, 29 = f, 30 = a, 31 = d/e.

For the purposes of this research, people with a score above 24 points on the questionnaire will be considered healthy and people with a score below 24 points will be considered unhealthy.

2. Program implementation:

The program was implemented according to the schedule of activities covering a 4-month period (July to October). The topics addressed were the following: what is diabetes, nutrition, exercise, self-monitoring, daily challenges, positive attitude, avoidance of complications, and medication. The Morinsky-Gree-Levine treatment adherence questionnaire was applied, and for exercise a questionnaire was established on the frequency and duration of exercise after the implementation of the program aimed at patients with type 2 diabetes.

3. Statistical analysis plan:

The corresponding paired qualitative variables were evaluated by McNemar's and Wilcoxon's statistical test with a value of *$p<0.05$. Paired quantitative variables are presented as the mean ± SEM and were evaluated through the paired Student's t-test with a value of *$p<0.05$. Prior to the application of the inferential tests, the normality of the data was determined through the Kolmogorov-Smirnoff test. Finally, the statistical package Graph Pad© ver. 8.0. was used to perform the statistical analysis and present the graphs.

4. Bioethics:

The present study adheres to the ethical and institutional norms, to the principles established in the Declaration of Helsinki and Tokyo; to the Regulations of the General Health Law on Health Research; as well as to the provisions of the Bioethics Committee and the Research Committee of the Centro de Estudios Superiores de Tepeaca. The privacy and confidentiality of the data obtained was maintained and the data of the patients who signed the informed consent form are presented.

Results

The study population consisted of 117 patients, of which only 30 met the inclusion criteria. The changes in each of the variables were statistically significant in each of the tests, reflecting that the educational program implemented was highly efficient, thus fulfilling the general objective of this research.

1. Evaluation of adherence to treatment before and after the program aimed at patients with type 2 Diabetes Mellitus.

Treatment adherence of patients with a diagnosis of type II diabetes mellitus was assessed through McNemar's statistical test (see Table 1) which showed that for an n=30, 67% of patients improved their treatment adhe-

rence after the intervention, with a value at *p < 0.0001 bilaterally as shown in Table 1.

Table 1. Results of McNemar's statistical test for treatment adherence.

		AFTER		TOTAL (n, %)
		GOOD ADHERENCE (n, %)	BAD ADHERENCE (n, %)	
BEFORE	GOOD ADHERENCE	(3, 10)	(20,67)	(23, 77)
	BAD ADHERENCE	(1, 3)	(6, 20)	(7,23)
TOTAL		(4, 13)	(27,28)	(30,100)

* Own elaboration, n=30 before and after the study.

Exercise duration

To determine the duration of exercise of patients with a diagnosis of type II diabetes mellitus, it was evaluated through the paired T-Student statistical test, n=30; at the beginning of the study a mean of [78.5 ± 9.15 min] was obtained and after the intervention it increased to a mean of [154.5 ± 6.06 min], the significance level established was ****p < 0.0001, as shown in figures 1 and 2.
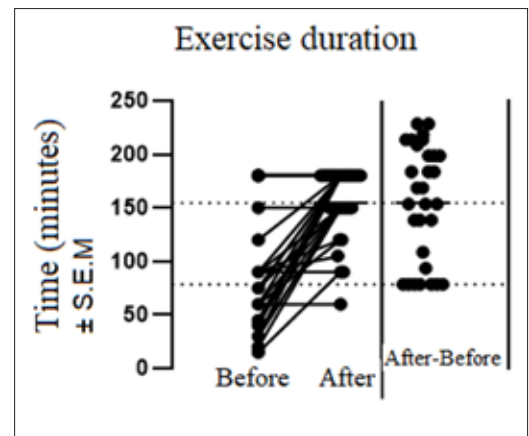
Figure 1

Results of the paired Student's t-test for exercise duration.
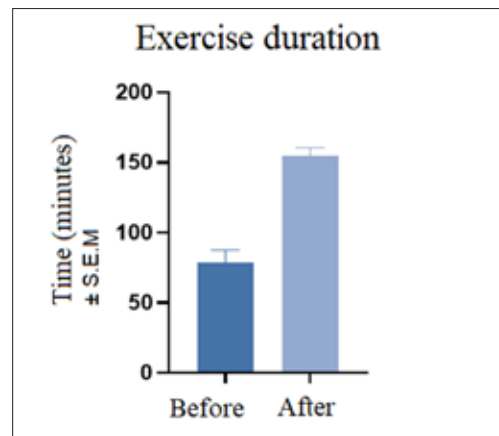
* Own elaboration. n=30 before and after the study.

Figure 2

Sample of the correspondence of each individual.

* Own elaboration. n=30 before and after the study.

The frequency of physical activity was determined through the survey and the planned physical activity, the coding was as follows: 1= once a week, 2= 3 times a week and 3= more than 3 times a week. The comparison was made through the Wilcoxon and Wilcox statistical test, for n=30, the established significance level was ****$p < 0.0001$, as shown in Figure 3.

**Figure 3.** Results of Wilcoxon and Wilcox statistical test for exercise frequency.
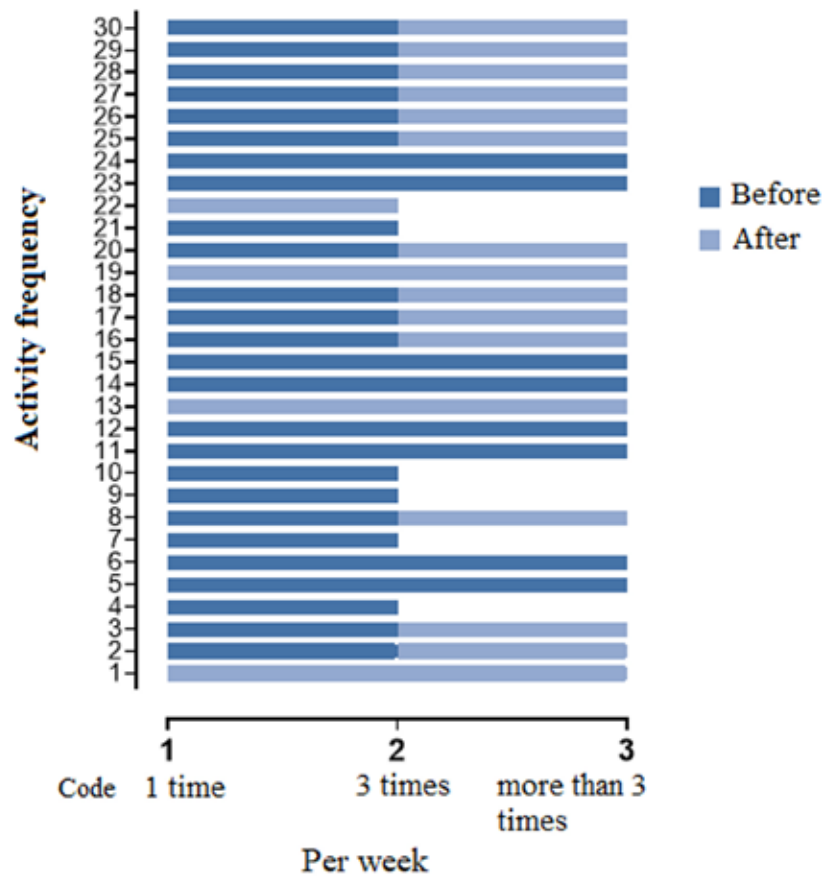
*Own elaboration. n=30. Frequency in the selection of answers (1, 2, 3) vs. the number of people before 1-4 people, 2-18 people, 3 - 8 people and after -0 people, 2 - 6 people, 3-24 people.

Determination of eating habits before and after the program f or people with type 2 diabetes mellitus.

To determine the eating habits of patients diagnosed with type II diabetes mellitus were evaluated through the Wilcoxon and Wilcox statistical test, n=30, at the beginning of the study a mean of [20.17± 0.98] was obtained, after the intervention increased to a mean of [23.76±0.60], The statistical analysis was established with a value of ****$p <0.0001$, as shown in Figure 4.

**Figure 4.** Results of the Wilcoxon and Wilcox statistical test for dietary habits.
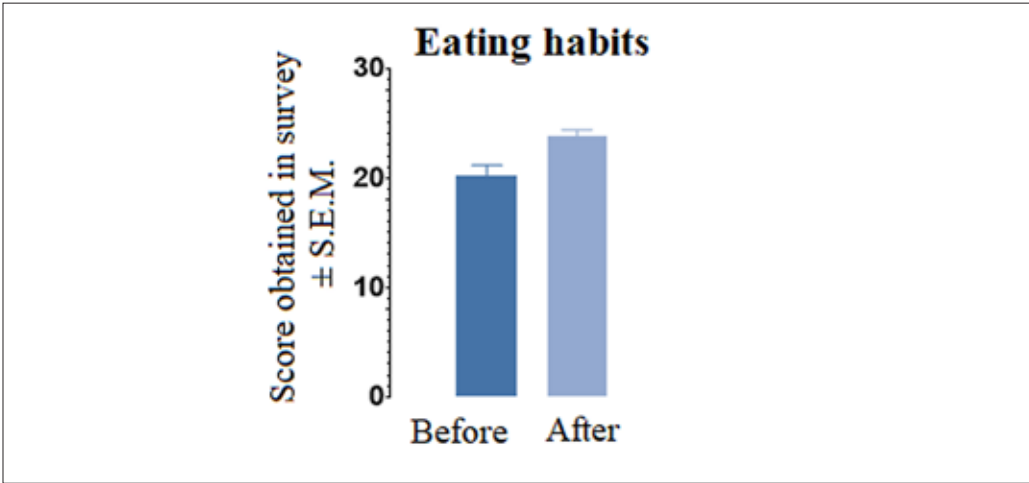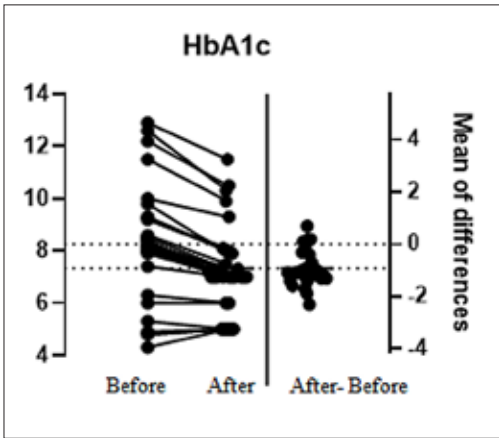

* Own elaboration. n=30.

Quantification of HbA1c before and after the program for people with type 2 Diabetes Mellitus.

To determine the quantification of HbA1c of patients with a diagnosis of type II diabetes mellitus was evaluated through the paired T-Student statistical test, for a n=30 at the beginning of the study a mean of [8.25 ± 0.40] was obtained, after the intervention it decreased to a mean of [7.32 ± 0.30], the significance level of *p < 0.0001, as shown in Figure 5 and 6.

Figure 5. Paired t-student test results for HbA1c.
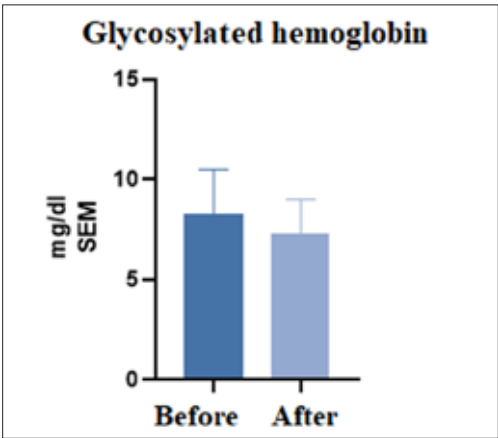
Figure 6. Correspondence of HbA1c for each individual.

* Own elaboration. n=30 before and after the study

Discussion

1. Adherence to treatment: Over the years there have been reports (12,13), from which evidence is obtained on educational intervention as a tool to achieve good adherence to treatment in patients diagnosed with diabetes mellitus. Other studies show evidence of the evaluation of adherence to treatment in which it is only emphasized that an "educational strategy" is considered for good therapeutic adherence (14), (15).

In the results of the present investigation, it was determined that, in order to achieve good adherence to treatment, the intervention of an educational program was fundamental, as stated by Juárez-Ramírez et al., (11). The continuous measurement of adherence with tests such as the Morisky and Green Levine tests by health professionals is effective in measuring the therapeutic adherence of patients with diabetes, as was stated by Limaylla et al., (8). In our research it was seen that both the educational program and the Morinsky and Green Levine test together made patients improve their self-management and self-knowledge of the disease. As a result, adherence to treatment was easier for them, as well as a decrease in HbA1c levels in people diagnosed with type 2 diabetes mellitus.

2. Physical activity habits: As a result of this research, it was observed that after the educational intervention there is an improvement in the frequency and duration of exercise before and after the educational intervention, similar to the results obtained by Canché-Aguilar et al. It is worth mentioning that there is a difference in the determination of physical activity since in this study the test included variables such as frequency and duration, in comparison with Canché-Aguilar et al. in which they used the IMEVID test.

The research concludes that physical exercise of 150 min per week is a fundamental factor for the reduction of HbA1c (16) and the control of diabetes (6). For these reasons, it is considered of utmost importance that at the time of treatment of patients with diabetes, they are recommended and trained on the importance of exercise for the control of this disease, since a change in the lifestyle of patients can improve their quality of life.

3. Eating habits: Diet is considered fundamental for the control of diabetes (6), for which there are studies that show that the high intake of rapidly absorbed CHO high in sucrose and low in fiber is associated as a risk factor in the increase of HbA1c in the elderly, there are no specific recommendations that have achieved optimal therapeutic and nutritional objectives,

therefore, it is essential that patients in treatment for diabetes seek advice from an expert in nutrition specialized in diabetes who, in collaboration with the medical team, will determine the treatment to meet the individual objectives of the patient (17).

The results showed that the determination of eating habits, before and after the educational intervention in patients with a diagnosis of diabetes mellitus, showed improvement after the intervention as did the results obtained by López Vaesken et al. (18) and Canché-Aguilar et al.

Healthy eating habits are elementary, since patients should know the different food groups, as well as the plate of good eating for "healthy" people and the variation of the plate of good eating for patients with diabetes mellitus, which is the "plate of good eating for diabetics" (19), and the optimal distribution of these to achieve a decrease in HbA1c, agreeing and highlighting the last point of Durán Agüero et al. (20) about the importance of the patient requesting information, at the same time that the physician provides information, and refers the patient to a nutritionist specialized in diabetes to determine, establish and comply with the individualized objectives for the patient, and achieving that they consume foods that provide a correct diet as mentioned in the NOM - 043 (7), remembering that food is part of lifestyle and to control diabetes, changing the lifestyle of the patient is fundamental as mentioned by Manguiamarchi (19) Yibi et al, 2018 (20).

4. Educational intervention: education for people diagnosed with diabetes was initiated in 1914 in developed countries and it has been evolving over the years, since it has been demonstrated that the need-benefit translates into the control of this disease (21).

In this regard, our research focused on the creation of an educational program for the control of type 2 diabetes mellitus, determined by HbA1c levels. The program includes topics such as diabetes, nutrition, exercise, self-monitoring, daily challenges, positive attitude, and how to avoid complications and medication. The variables analyzed were adherence to treatment, exercise and nutrition, these were evaluated before and after the intervention showing an improvement in each of the tests, and when evaluating the effectiveness of the educational program, it is considered that this was effective because the decrease in HbA1c was achieved and the number of people who managed to control their disease also increased.

The results of this research show that an educational program that includes the determination of adherence to treatment, dietary habits, exer-

cise habits, HbA1c before and after the intervention helps the control of people living with type 2 diabetes mellitus, similar to the results obtained by Canche et al. (12), thus contributing to all efforts to characterize and unify knowledge in order to achieve a "standard" educational model for awareness, education and control of the disease, with the use of tests to determine control or lack of control, such as the HbA1c.

Conclusions

With the present investigation it can be concluded that adherence to treatment in patients diagnosed with type 2 diabetes mellitus improves at the end of the study. Based on the answers of the questionnaire focused on people with type 2 diabetes mellitus we conclude that there is an increase in the duration and frequency of exercise performed, the patients decided to walk or jog 150 min or more per week. The eating habits of patients with type 2 diabetes mellitus also improved; these changes are reflected in the quantification of HbA1c, so the educational intervention showed that the learning obtained was significant in patients, which is why it is considered that the educational program that was presented is highly effective in achieving control of type 2 diabetes mellitus.

Perspectives

Perform a diagnosis of the diabetic population based on sociodemographic indicators, biochemical indicators, type of treatment, basic knowledge of the disease, determination of disease control. Determine follow-up for 3, 6 or 12 months afterwards by using tools such as phone calls, text messages, or some other messaging platform. Conduct a study to correlate the variables described in this project with the level of knowledge about the disease through a multivariate statistical analysis.

References

1. Organización Mundial de la Salud.OMS. Informe anual sobre la diabetes mellitus resumen de orientación. [Online].; 2016 [cited 2018 noviembre 7. Available from: https://apps.who.int/iris/bitstream/handle/10665/254649/9789243565255-spa.pdf.

2. Federación Internacional de la Diabetes. IDF Diabetes Atlas. [Online].; 2022 [cited 2022 noviembre 5. Available from: https://diabetesatlas.org/.

3. ENSANUT. Encuesta Nacional de Salud y Nutrición 2021 sobre la COVID-19 resultados nacionales. [Online].; 2021 [cited 2022 noviembre 11. Available from: https://ensanut.insp.mx/encuestas/ensanutcontinua2021/doctos/informes/220804_Ensa21_digital_4ago.pdf.

4. Instituto Nacional de Estadística y Geografía (INEGI). Estadísticas de defunciones registradas 2021 (Preliminar). In Estadísticas de defunciones registradas 2021 (Preliminar); 2022; Mexico. p. 89.

5. Instituto Nacional de Estadistica y Geografia (INEGI). Defunciones generales. [Online].; 2022 [cited 2022 noviembre 7. Available from: https://www.inegi.org.mx/sistemas/olap/consulta/general_ver4/MDXQueryDatos.asp?#Regreso&c=11144.

6. OMS. Informe Mundial de la Diabetes. Mixto. Genova Suiza : Organización Mundial de la Salud.; 2016.

7. Fundación Mídete. Asumiendo el control de la diabetes. [Internet] 2016: [citado 2018 Jul 20]. Disponible en: http://oment.uanl.mx/wp-content/ uploads/2016/11/FMidete_Asumiendo-ControlDiabetes-2016.pdf

8. Secretaria de Finanzas y Administración.. Programa Institucional 2017-2018. [Online].; 2018 [cited 8 noviembre 2018. Available from: http://www.transparenciafiscal.pue.gob.mx/index.php?option=com_docman&task=cat_view&gid=270&limit=5&limitstart=5&order=name&dir=ASC&Itemid=63.

9. SEGOB. NORMA Oficial Mexicana NOM-015-SSA2-2010, Para la prevención, tratamiento y control de la diabetes mellitus. [Online].; 2010. [cited 2018. Noviembre 11. Available from: https://dof.gob.mx/nota_detalle.php?codigo=5168074&fecha=23/11/2010#gsc.tab=0.

10. Limaylla ML. Metodos indirectos de valoración del cumplimiento tereapéutico. Revistas de investigación UNMSM. 2016 agosto; 19.(2.): p. 95-101.

11. Arnold Dominguez Y, Cabrera - Rode E. What will be the best strategy for screening of impaired glucose metabolism in the primary health care? Revista Cubana de Endocrinología. 2017 mayo - agosto; 28(2).

12. ADA. 6. Glycemic Targets: Standards of Medical Care in Diabetes-2021. Diabetes Care. 2021 enero; 44(1): p. S73-S84.

13. Seguí Díaz M. Actualización 2015 del algoritmo ADA/ EASD del tratamiento de la hiperglucemia. [Online].; 2015 [cited 2022 noviembre 11. Available from: http://www.redgdps.org/gestor/upload/file/UPDATE%202015/Update%20en%20diabetes%206-1-2-2015%20.pdf.

14. ADA. Diabetes Self-management Education and Support in Type 2 Diabetes: a Joint Position Statement of the American Diabetes Associationof Diabetes Educators, and the Academy of Nutrition and Dietetics. Diabetes Care. 2015 enero; 38.

15. Figueroa -Suárez M, Cruz - Toledo J, Otriz Aguirre A, Lagunez -Espinoza A, Jimenez -Luna J, Rodriguez - Moctezuma. Estilo de vida y control metabólico en diabeticos del programa DiabetIMSS. Gaceta Médica de México. 2014.

16. Juárez -Ramírez C, Treviño- Siller S, Ruelas - González. MG, Théodore F, Pelcastre- Villafuerte BE. Los Grupos de Ayuda Mutua como posible estrategia de apoyo emocional para personas indígenas que padecen diabetes. Salud Pública Mex [Internet]. 2020 diembre 22; 63(1): p. 12-20.

17. Canché- Aguilar DL, Zapata - Vázquez RE, Rubio - Zapata HA, Cámara - Vallejos RM. Efecto de una intervención educativa sobre el estilo de vida, el control glucemico y el conocimiento de la enfermedad, en personas con diabetes mellitus tipo 2, Bokobá Yucatán. Revista Biomédica. 2019 enero; 30(1).

18. Yibby Forero A, Hernández JA, Milena Rodríguez S, Jairo Romero J, Emely Morales G, Ángel Ramírez G. La alimentación para pacientes con diabetes mellitus tipo 2 en tres hospitales publicos de Cundinamarca, Colombia. Biomedica. 2018; 38(3).

19. Manguiamarchi P, Caniuqueo A, Ramirez - Campillo R, Cárdenaz P, Morales S, Cano - Montoya J, et al. Ejercicio intermitente y consejería nutricional mejoran control glicémico y calidad de vida en pacientes con diabetes mellitus tipo 2. Revista Medica de Chile. 2017.

20. Durán Agüero S, Fernández Godoy E, Carrasco Piña E. Nutrients and its association with glycosilated hemoglobin in patients with diabetes type 2. SciElo. 2016 febrero; 33(1).

21. H S, Chen G, C Z, Chen Y, Lui Y, He Y, et al. Effect of pharmaceutical care on clinical outcomes. Patient Preference and Adherence. 2017 mayo; 11: p. 897- 903.

22. Sosa Garcia BC, Gómez Martínez V, Madin Juárez B, García Reza C, Angeles Avila G. La adherencia terapéutica; Medición de enfermeria en personas con diabetes mellitus tipo 2. Medicina: esforço comum da promoção da saúde e. 2021;: p. 121-127.

23. Ninabanda-Mullo AK, Fierro- Vasco SG, Pacheco-Toro SI, Quintana- Domínguez TE. Education as a strategy to improve adherence in patients with diabetes mellitus. Polo del Conocimiento. 2022 septiembre 6; 7(9): p. 738-749.

24. López Vaesken A, Rodríguez Tercero A, Velázquez Comelli P. Conocimientos de diabetes y alimentación y control glucémico en pacientes diabéticos de un hospital de Asusnción. Rev. cienc. slud. 2021 junio; 3(1): p. 45-55.

25. Hernandez- Alcocer J, Cabrera-Araujo ZM, Torrres- Escalante J, Hernández- Escalante V, Marín- Cárdenas AD, Tuz- chi L, et al. Disminución de hemoglobina glicada A1c (HbA1c) posterior a una intervención nutricional con la herramienta intercultrual "plato del bien comer Maya para personas con Diabetes". Ciencia y Humanismo en la salud 2021. 2021 enero- abril ; 8(1): p. 1-6.

26. Hevia EP. Educación en diabetes. Revista médica de clínica Los Condes. 2016 marzo; 27(2).