Multimedia education to support management of type 2 diabetes patients. A quasi-experimental study

La educación multimedia como apoyo en el manejo de pacientes con diabetes tipo 2. Estudio cuasi experimental

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Abstract

Objective: To evaluate the efficacy of education through a multimedia information system, in controlling patients with type 2 diabetes. **Methods:** Randomized open clinical trial. The intervention group was trained to consult an educative multimedia tool in the waiting room, which was developed according to the population characteristics and centered on monitoring indicators, information on type 2 diabetes and nutrition. Venous blood concentrations of glucose, glycated hemoglobin (HbA1c), triglycerides, total cholesterol, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol were measured. Paired t Student was used to assess the effect of the intervention. **Results:** 2,334 patients were included, 958 in the intervention group and 1,376 in the control group. In the intervention group, an increase in HDL-c values was observed (from 40.45 to 47.40 mg/dL; $p = 0.001$) as well as a descent on triglycerides values (from 227.78 to 210.38 mg/dL; $p = 0.001$). There was a reduction on triglycerides levels in the control group (from 232.64 to 210.84 mg/dL; $p = 0.016$). There was a significative increase in total cholesterol values in both groups. There were no changes in the mean values of glucose and HbA1c after the intervention. **Conclusion:** Implementation of a multimedia information system improves HDL-c and triglycerides in patients with diabetes. There is a need for a continuous reinforcement of the educative intervention by health professionals to improve glycemic and other indicators in metabolic control.

KEY WORDS: Multimedia. Type 2 diabetes. Prevention and control. Dyslipidemia. Cardiovascular risk factors.

Resumen

Objetivo: Evaluar la eficacia de la educación a través de un sistema de información multimedia en el control del paciente con diabetes tipo 2. **Método:** Ensayo clínico abierto aleatorizado. El grupo de intervención fue instruido para consultar una herramienta educativa multimedia en la sala de espera de los consultorios, misma que fue diseñada de acuerdo a las características de la población y centrada en automonitoreo de indicadores, información sobre diabetes tipo 2 y nutrición. Se midieron en sangre venosa las concentraciones de glucosa, hemoglobina glucosilada (HbA1c), triglicéridos, colesterol total, colesterol ligado a lipoproteínas de alta densidad (HDL-c) y colesterol ligado a lipoproteínas de baja densidad. Con la t de Student pareada se evaluó el efecto de la intervención. **Resultados:** Se incluyeron 2334 pacientes, 958 en el grupo de intervención y 1376 en el grupo control. Se observó en el grupo de intervención un incremento del HDL-c (de 40.45 a 47.40 mg/dl; $p = 0.001$) y una disminución de los triglicéridos (de 227.78 a 210.38 mg/dl; $p = 0.001$). En el grupo control disminuyeron los triglicéridos (de 232.64 a 210.84 mg/dl; $p = 0.016$). En ambos grupos se incrementó de forma significativa el colesterol total. No se observaron cambios en los valores de glucosa y HbA1c posterior a la intervención. **Conclusión:** La implementación de un

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Date of reception: 28-01-2018
Date of acceptance: 19-05-2018
DOI: 10.24875/CIRUE.M18000061

Cir Cir. 2018;86:354-360
Contents available at PubMed
www.cirugiyacirujanos.com

sistema de información multimedia mejora el HDL-c y los triglicéridos del paciente con diabetes. Se requiere un reforzamiento continuo de la intervención educativa por parte del profesional de la salud para incidir en el control glucémico y otros indicadores del control metabólico.

PALABRAS CLAVE: *Multimedia. Diabetes tipo 2. Prevención y control. Dislipidemia. Factores de riesgo cardiovascular.*

Introduction

Comprehensive treatment of type 2 diabetes includes a lifestyle modification, coupled with adherence to drug treatment and general measures of care, where education for self-management of the disease plays an important role^{1,2}. Education is a necessary element for the proper management of diabetes, and it is required that all patients receive education and support to promote self-management³.

A reduction of 0.88% in glycated hemoglobin (HbA1c) has been reported when education for diabetes self-management is implemented in adults, including individual, and group education, combination of modalities and education provided by remote means, such as online and telephone communication⁴. The purpose of diabetes education is to provide knowledge, develop skills and learning to make correct decisions for a healthy lifestyle, as well as to promote active participation with the health professional^{5,6}.

In recent years, information and communication technologies (ICT) have shown a promising effect owing the ease they offer to spread knowledge on diabetes, prevent complications⁷ and reduce costs⁸, both in prevention and treatment^{9,10} and in education on the disease¹¹⁻¹³. ICTs have even achieved a positive effect on the emotional aspect of the patient with type 2 diabetes¹⁴.

Even so, the use of ICTs is controversial in terms of the long-term effect on disease control. However, a reduction in HbA1c has been reported after an intervention with ICT^{15,16}.

The purpose of this study was to assess the efficacy of education through a multimedia information system for glycemic and lipid profile control in patients with type 2 diabetes.

Method

A quasi-experimental 24-month follow-up study was conducted in an adult population diagnosed with type 2 diabetes in a family medicine unit (FMU) of the Mexican Institute of Social Security, in Mexico City, which has thirteen family medicine offices. Approval was obtained from of the Institute's research and

ethics committee. Patients who agreed to participate in the study signed the informed consent letter once they were explained the risks and benefits involved.

Patients diagnosed with diabetes by their attending physician, who knew how to read or write, who had no hearing problems or complications that prevented them from consulting the multimedia information system called DM2 Monitor were included (Fig. 1).

Seven offices (out of thirteen) were randomly chosen for the DM2 Monitor-exposure group and the remaining six offices in the unit continued with usual medical care (control group). In both groups, glucose, HbA1c, triglycerides, total cholesterol, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) concentrations were measured in venous blood after ten hours of fasting at the beginning and at the end of the study.

Characteristics of the maneuver

The DM2 Monitor design was user-centered, based on previously-identified population characteristics, such as gender, level of education and age. The platform was designed to be used through touchscreen monitors, with augmented typography and with a ticket printer to print the information of the graphs of the metabolic control indicator values sequence in time at their different visits, the list of food and the menu that was designed by the patient in the system.

The DM2 Monitor contents were based on the theory of self-management of chronic illness. In order to drive the patients into action in the care of the disease, video capsules and animated materials were created, in addition to the equivalent food exchange system simulator, by means of which the patients created their own personalized menus.

Patients were also encouraged to participate in the control of the disease and in decision making by identifying the results of their main control indicators (HbA1c, glucose, lipid profile) in a timeline, and reach an agreement with the doctor on the actions to be followed in the care of their disease. DM2 Monitor had audio devices for the reproduction of informative capsules. The patient could enter the system as many times as he/she considered relevant.

Figure 1. Description of DM2 Monitor contents.

DM2 Monitor description

DM2 Monitor was developed with three purposes: 1) to promote self-monitoring by each patient included in the study by showing him/her his/her biochemical data recorded at the FMU; 2) to provide the patient with information on type 2 diabetes, with visual and auditory means through materials animated with the Flash® technique being used for this purpose; and 3) to promote adherence to the diet with a module for the creation of a healthy menu, following the Mexican equivalent food exchange system¹⁷ (Fig. 2).

Seven computer kiosks (one for each intervention group office) with touch screen monitors, with audio devices and ticket printer were installed at the offices' waiting room, to consult the educational tool. The doctors of the exposed group offices were responsible for referring patients to the DM2 Monitor. Patients were instructed by two nursing professionals on the use of DM2 Monitor. Each patient was registered in the system.

Access to DM2 Monitor was maintained for a 24-month period and its use was free for previously registered patients, who were invited to go and check it at each appointment with their family doctor. During the study follow-up period, a nurse was in charge of

Figure 2. DM2 Monitor conceptual diagram.

inviting patients who had already been registered in order to encourage the use of the educational tool.

Data analysis

Patient baseline characteristics were analyzed by estimating central tendency and dispersion measures (mean and standard deviation) and proportions. To measure the effect of the intervention on metabolic control indicators (HbA1c, triglycerides, total cholesterol, fasting glucose, HDL-C and LDL-C), Student's t-test was used for independent samples at baseline and the paired t-test was used to compare the effect at the end of the intervention. Statistical analysis was performed with the SPSS software, ver. 22.

Results

Baseline data are shown in table 1. The sample comprised 2,334 patients, 958 in the intervention

group of and 1,376 in the control group. Average age was similar (61.5 ± 12.2 and 63.3 ± 13.3 years, respectively), with a higher proportion of women in both groups (64.9 and 63.9%). Average body mass index in both groups it was higher than 30 kg/m^2 ; therefore, it can be claimed that, on average, the study population of diabetic patients suffers from obesity.

Table 2 shows the changes in metabolic control indicators at each one of the groups. In the group with DM2 Monitor, HDL-C was significantly increased (from 40.45 ± 10.03 to $47.40 \pm 11.76 \text{ mg/dL}$; $p = 0.001$) and a significant reduction was observed in triglycerides (from 227.78 ± 132.99 to $210.38 \pm 110.63 \text{ mg/dL}$; $p = 0.001$). In both groups, total cholesterol was significantly increased, but while in the control group this increase was significant for both HCL-C and LDL-C, in the intervention group only the increase in HDL-C was significant, while LDL-C remained at similar values.

Glucose and HbA1c remained without significant changes during follow-up in both groups.

Table 1. Baseline characteristics and metabolic control in the population with type 2 diabetes

	<i>DM2 Monitor group</i> (n = 958)	<i>Control group</i> (n = 1,376)
Age (years)	61.5 ± 12.2	63.3 ± 13.3
Gender		
Females	614 (64.9%)	879 (63.9%)
Males	344 (35.9%)	497 (36.1%)
Glucose (mg/dL)	164.65 ± 58.96	165.81 ± 60.17
HbA1c (%)	8.84 ± 2.07	8.94 ± 1.96
HDL-C (mg/dL)	40.45 ± 10.03	44.07 ± 7.78
LDL-C (mg/dL)	127.21 ± 34.16	123.88 ± 36.64
Triglycerides (mg/dL)	227.78 ± 132.99	232.64 ± 147.72
Total cholesterol (mg/dL)	198.61 ± 35.09	200.97 ± 36.62

Student's t-test, $p < 0.05$ for HDL-C and LDL-C. Data expressed as averages ± standard deviation. The comparisons were made with Student's t-test for paired samples.

HbA1c: glycated hemoglobin; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol.

Discussion

Type 2 diabetes is a disease that requires comprehensive treatment, where the changes the patient adopts by improving his/her lifestyle and care of the disease are substantial for an adequate management.

In the present study, an improvement was observed in HDL-C and triglycerides after 24 months of follow-up using an educational tool resorting to ICT. Similar data have been previously reported, although with a decrease in glucose and HbA1c values, with a multimedia educational tool and nutritional reinforcement¹⁵. Our results differ due the lack of an effect on HbA1c, which we consider might be due to reinforcement by a nutritionist in that study during follow-up with the educational tool. In this sense, it could be claimed that the use of ICT would have a greater benefit on metabolic control indicators if complemented with advice and reinforcement of the consultations made in the educational tool by the health professional. Nevertheless, other authors have not found benefit on HbA1c reduction, but they have found an increased perception of disease complications with a similar intervention to that of this study¹⁸.

It is important emphasizing that total cholesterol was increased in both groups. However, in the control group, the increase was in both LDL-C and HDL-C, whereas in the intervention group the increase was only favorable in HDL-C, while LDL-C remained stable. It is necessary for the medical professional to

make use of educational strategies and constant surveillance in order to promote pharmacological treatment adherence according to the guidelines, with the purpose to reduce cardiovascular risk factors¹⁹.

There is limited information in Mexico about multimedia information systems implementation for patients with type 2 diabetes. This type of intervention aimed at providing education using ICTs has been promoted by different consensuses on the treatment of diabetes as a new effective tool for providing education^{20,21}.

One relevant aspect of diabetes education lies in taking patient age and level of education into account, particularly because technology may not be a useful tool if these characteristics are not considered. There is evidence that subjects with low levels of education have had a greater increase in knowledge on diabetes after a multimedia education strategy; however, they learn less than those with higher levels of education²².

A greater impact on metabolic control has been reported with short exposure times and controlled environments, but educational intervention with the use of ICTs in an autonomous way has been also confirmed to have less impact than when there is active participation of the doctor, the nurse, the nutritionist or the diabetes educator²³⁻²⁵.

Strategies aimed at integrating digital information services should be designed based on a model of chronic illness care, in order to promote active participation of the patient in the care of the disease, in addition to systematic, monitored and motivational advice to the patient by the health professional²⁶.

The intervention was aimed at implementing a multimedia information system within a medical care setting in a clinical unit in a context that was the closest to real and everyday practice. Even when the use of the tool was promoted, one possible limitation is the lack of reinforcement on the use of the educational tool at each visit. We consider that autonomous administration without constant reinforcement by the health professional might have been the limitation for observing an HbA1c reduction. It is highly probable that the population with diabetes requires constant support from the healthcare professional, just as other authors have identified in similar populations^{15,27}.

One relevant aspect of this study is the management of patient clinical data at the FMU, with the purpose for the technological tool to include clinical and epidemiological surveillance and patient awareness utilities. With this utility, the presence of the doctor or

Table 2. Effect of the intervention on metabolic control indicators after 24 months of intervention

	DM2 monitor group (n = 958)				Grupo control (n = 1376)			
	Baseline	24 months	Mean difference	p	Baseline	24 months	Mean difference	95% CI
Glucose (mg/dL)	164.65 ± 58.96	165.99 ± 69.08	1.34	0.629	165.81 ± 60.17	162.72 ± 65.89	-3.09	-11.09-4.91
HbA1c (%)	8.84 ± 2.07	8.81 ± 1.95	-0.03	0.844	8.94 ± 1.96	8.86 ± 2.06	-0.08	-0.64-0.47
LDL-C (mg/dL)	127.21 ± 34.16	127.22 ± 38.73	0.01	0.998	123.88 ± 36.64	137.90 ± 43.86	14.02	-11.73-39.78
HDL-C (mg/dL)	40.45 ± 10.03	47.40 ± 11.76	6.95	0.001	44.07 ± 7.78	49.54 ± 13.71	5.46	-1.73-12.65
Triglycerides (mg/dL)	227.78 ± 132.99	210.38 ± 110.63	-17.40	0.001	232.64 ± 147.72	210.84 ± 117.72	-21.80	-4.16-39.44
Total cholesterol (mg/dL)	198.61 ± 35.09	204.45 ± 37.52	5.85	0.001	200.97 ± 36.62	207.56 ± 37.46	6.59	2.69-10.49

Data expressed as the mean ± standard deviation. Comparisons were made with Student's t-test for paired samples.

HbA1c: glycated hemoglobin; HDL-C: high-density lipoprotein cholesterol; 95% CI: 95% confidence interval; LDL-C: low-density lipoprotein cholesterol.

health professional in the doctor-educational tool-patient equation was sought. With the use of this strategy, reductions in HbA1c values of up to 0.8% have been observed¹⁶.

The use and evaluation of ICTs in the promotion of health in the type 2 diabetes patient are limited. It is important to continue assessing this type of initiatives, in order for care to be unified and to make use of technological tools to support the health professional, and to contribute to a better communication between the patient and the health professional^{28,29}.

The strategies for the use of ICTs must be further developed and investigated in Latin America, targeting populations that suffer from chronic diseases and vulnerable groups, considering communication strategies and new forms of digital literacy, as well as the use of social networks according to these populations. Moreover, health promotion and education initiatives through ICTs should be part of health policies, given that there is an urgency related to limited access to health, owing to access inequities due to different factors, in addition to epidemiological transitions overlap and insufficiency of both human and economic resources³⁰.

Initiatives through ICTs can be effective because they complete the circle of the doctor-patient care process. In addition, they contribute to real-time patient monitoring with treatment goals customization through clinical data management and follow-up with personalized advice^{31,32}.

It is important to consider that patients with diabetes who attend primary care FMUs still are at high risk of microvascular and macrovascular complications, since they present with obesity, metabolic lack of control and dyslipidemia. Comprehensive treatment is necessary in order to motivate patients to take care of their disease and achieve treatment goals³³.

One limitation of this work is the lack of a record of the number of visits to DM2 Monitor, given that free access to it was indicated. Future investigations should consider the use of access metrics and establishing an association with optimal exposure time or a performance indicator.

Finally, it is important to consider that this type of educational strategies using ITCs can promote the development of effective service models in order to improve the care of chronic illnesses, with positive results being obtained both in the improvement of metabolic control indicators and in knowledge and motivation of the patient with diabetes³⁴. However, their long-term effects have not been properly measured. Nevertheless, strategies as the one herein

presented contribute to improve control in the patient with type 2 diabetes.

Conclusion

It is important to continue assessing studies in patients with type 2 diabetes aimed at using ICTs to provide education in different modalities, which should be a complement to the guidance received from the medical and nutritional professional.

Implementation of a multimedia information system to provide diabetes education can improve the lipid profile in patients with type 2 diabetes. However, participation of the health professional is required, so that that the application of knowledge acquired through a technological tool is promoted in order to impact on metabolic control.

Funding

This study received funding granted by the Mexican Institute of Social Security, registration number 2006/1B/004 FIS/IMSS/PROT/143, in the 2006 call for Strategic Projects in Health and Technological Development.

Conflicts of interests

The authors declare that they have no conflicts of interest.

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