REVISTA ESPAÑOLA DE COMUNICACIÓN EN SALUD
2025, v. 16, n.2, 7-21
https://doi.org/10.20318/recs.2025.9099

Originales

Design and pilot testing of an educational strategy based on behavioral and communication models within Mutual Aid Groups to improve the lifestyle of people living with type 2 diabetes in Mexico

Diseño y prueba piloto de una estrategia educativa basada en modelos conductuales y de comunicación dentro de Grupos de Ayuda Mutua para mejorar el estilo de vida de las personas que viven con diabetes tipo 2 en México

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Abstract

Introduction: Mutual Aid Groups (MAGs) are essential for the self-care of people living with type 2 diabetes (PLD) in Mexico; however, they have areas for improvement, especially regarding communication between healthcare providers and PLD. **Objective:** To design and pilot a Healthy Living Educational Strategy for PLD (HLED). **Methodology:** The HLED was implemented in two MAGs (urban - rural) in Cuernavaca, Morelos. It was structured based on Multimedia Training Methodology, grounded in the Theoretical Model of Communication for Development and the Participatory Communication Model, which promotes community participation in a climate of trust and two-way information flow. It included four monthly theoretical and practical workshops. Pre- and post-tests were conducted using a validated Instrument to Measure the Lifestyle of PLD, generating a lifestyle index (0–100; higher score: healthier life). Multiple regression models evaluated the impact. **Results:** Nineteen women and four men participated (age: 56.2 ± 10 years). Those who attended all workshops achieved 34.04 points more than those who attended only one (95% CI: 20.77, 47.31; p<0.01). **Conclusion**: HLED has the potential to improve PLD lifestyle in MAGs.

Keywords: Type 2 diabetes; Mutual Aid Groups; Mexico; diabetes education; lifestyle.

Resumen

Introducción: Los Grupos de Ayuda Mutua (GAM) son esenciales para el autocuidado de las personas que viven con diabetes tipo 2 (PVD) en México**;** sin embargo**,** presentan áreas de mejora, especialmente en la comunicación entre proveedores de salud y PVD. **Objetivo:** Diseñar y pilotear una Estrategia Educativa para una Vida Saludable dirigida a PVD (EVSD). **Metodología:** La HLED se implementó en dos GAM (urbano-rural), en Cuernavaca, Morelos. Se estructuró con base en la Metodología de Capacitación Multimedial, sustentada en el Modelo teórico de comunicación para el desarrollo y en el Modelo de comunicación participativa, que promueven la participación de la población en un clima de confianza, y el flujo de información de doble vía. Incluyó cuatro talleres teórico-prácticos mensuales. Se hicieron mediciones pre-post mediante el Instrumento validado para Medir el Estilo de Vida en PVD, generando un índice (0–100; mayor puntaje: vida más saludable). Modelos de regresión múltiple evaluaron el impacto. **Resultados:** Participaron 19 mujeres y 4 hombres (edad: 56.2 ± 10 años). Quienes asistieron a todos los talleres obtuvieron 34.04 puntos más que quienes asistieron a uno (IC 95%: 20.77, 47.31; p<0.01). **Conclusión:** La HLED tiene potencial para mejorar el estilo de vida de PVD en GAM.

Palabras clave: Diabetes tipo 2; Grupos de Ayuda Mutua; México; educación en diabetes; estilo de vida.

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Fecha de envío: 29/11/2024
Fecha de aceptación:10/08/2025

Introduction

An estimated 537 million people in the world live with diabetes (International Diabetes Federation, 2021). Despite the various public health initiatives and policies implemented in Mexico for nearly two decades (Barquera et al., 2018), the prevalence of diagnosed diabetes has reached 12.6% of the population (95% CI: 10.5,14.9), with only 36.1% of these individuals achieving adequate glycemic control. The rates of undiagnosed diabetes and prediabetes are 5.8% (95% CI: 4.4, 7.5) and 22.1% (95% CI: 19.6, 24.7), respectively (Basto-Abreu et al., 2023).

Notwithstanding, positive results have been obtained in the self-care practices (Rivera-Montiel, 2015) and glycemic control (Fernández et al., 2012) of people living with type 2 diabetes (PLD). Progress has been attributed to the launch of Diabetes Clubs or Mutual Aid Groups (MAGs) by the Mexican Health System. These peer-support interventions consist of organized groups of individuals who share a common health condition, such as diabetes, and come together to exchange experiences, information, and emotional support in a reciprocal, horizontal, and culturally relevant manner (García-Quintanilla et al., 2020). These groups operate under the Health Program for Adults and Older Adults pertaining to the Epidemiological Surveillance Center of the Ministry of Health (Lara et al., 2004).

MAGs kicked off in 1995 in primary care public health facilities (HFs) (Velázquez-Monroy et al., 2001) tasked with providing medical assistance to those with modest financial resources and no Social Security coverage (González-Block et al., 2020). The objective of MAGs consists in training PLD to practice self-care with the support of the health services and under medical supervision (Lerín, 2012). These efforts are grounded in two key principles: first, over 95% of diabetes care depends on the patients themselves, making continuous education on self-care essential (Jiménez-Chafey & Dávila, 2007); second, that peer-to-peer mutual support has been shown to improve metabolic control and help individuals develop self-management skills through the exchange of experiences and reinforcement of healthy behaviors (Pelegrina-Bonel et al., 2016).

Communication between health staff and PLD is critical, as it often relies on unidirectional, expert-led models that overlook their linguistic, cultural, and experiential realities

Self-care in diabetes has been defined as the set of actions that PLD perform to treat, control and prevent advancement of illness. These include eating a healthy diet, engaging in physical exercise, abstaining from tobacco and alcohol, attending diabetes talks and adhering to pharmacological treatment (Caro-Bautista, 2015). The impact of these actions on the lifestyles of PLD can make the difference between health and disease (López-Carmona et al., 2004).

Nevertheless, although MAGs have proved a successful national strategy, areas of opportunity for improvement remain; addressing them would amplify their impact on the care and well-being of PLD. Among these, communication between health staff and PLD is a particularly critical issue, as several studies have documented that current interactions between healthcare personnel and patients often rely on unidirectional, expert-led models that fail to consider the linguistic, cultural, and experiential realities of PLD. This disconnect can lead to confusion, mistrust, and a lack of engagement, ultimately reducing adherence to treatment and limiting the effectiveness of educational efforts (Calpe Cristino et al., 2017; Lerin, 2017; López, 2016; Villanueva & Vargas-Parada, 2015).

Furthermore, it is necessary drawing on popular knowledge (Lerin, 2017; López, 2016) and standardizing the MAGs educational program and materials (Santamaría-Ochoa & Cid de León-Bujanos, 2012).

Accordingly, the objective of the present work was to design and pilot a Healthy Living Educational Strategy for PLD (HLED), as well as to assess its impact on the lifestyle of these individuals.

The HLED was developed using two proven methodologies effective in creating health promotion and education programs. First, the Intervention Mapping (IM) protocol has been recognized for generating culturally appropriate programs grounded in theories of human behavioral change across various health domains (Ahmadpour et al., 2020; Bakhuys Roozeboom et al., 2021; Bartholomew et al., 2016; Cherrington et al., 2011; Igwesi-Chidobe et al., 2020; Oosterom-Calo et al., 2015). IM acknowledges the critical role of theory in the various stages of planning health promotion and education programs, as theories provide valuable frameworks for understanding behaviors. Additionally, theories offer insights into strategies that can facilitate behavior change by effectively influencing individuals (Glanz et al., 2008). However, IM also recognizes the complexity of health-related behaviors, which often cannot be fully explained or addressed by a single theoretical approach. To address this challenge, IM integrates concepts and principles from multiple theoretical models, enabling a comprehensive and tailored approach to solving specific health problems (Brug et al., 2005).

Second, the Multimedia Training Methodology (MTM) has demonstrated its value in designing replicable and validated training programs (Amaya-Castellanos et al., 2019). The MTM is based on the Theoretical Model of Communication for Development and the Participatory Communication Model, which emphasize promoting cultural identity, democratic practices, and community participation. These elements foster a climate of trust, enabling two-way communication, commitment, and reciprocal collaboration in development projects (Vásquez, 2004). The MTM has been utilized by the Food and Agriculture Organization (FAO) to train farmers in agricultural projects (Calvelo, 1998). In Mexico, Amaya et al. (2018) applied the MTM to train vulnerable groups on food guidance.

Methods

Study design and population

We designed and piloted the HLED between January-August 2022. For its evaluation we used a pre-post-test design with a single group. Two MAGs were selected: one within an urban HFs (≥2,500 inhabitants) and the other within a rural (<2,500 inhabitants), both pertained to the Morelos State Health Services, 60 minutes far from Mexico City. We selected the sites for logistical convenience, in or near the municipality of Cuernavaca (the state capital).

Study included men and women who had been diagnosed with type 2 diabetes, were registered with the MAGs in their HFs and could complete the questionnaires and training activities in the study, regardless of their age, schooling or glycemic-control levels at the time of the intervention.

Instruments and variables

The independent variable was participating in the HLED workshops, categorized according to the number of sessions attended (one to four).

The main dependent variable was lifestyle, classified according to the self-care practices reported by participants. To assess this variable, we administered the Instrument to Measure the Lifestyle of People Living with Diabetes (IMEVID), which contained 25 closed-ended questions pertaining to the following domains: nutrition, physical activity, tobacco use, alcohol consumption, knowledge about diabetes, emotions and adherence to treatment (See Inline Supplementary Appendix 1). Previously developed and validated in the Mexican population (López-Carmona et al., 2004). We administered the IMEVID before (February 2022) and after implementing the intervention (July 2022) with support from the principal researcher. The IMEVID was analyzed following the method outlined by López-Carmona et al. (2004) who developed an index that assigns scores to each response: 0 for unhealthy practices, 2 for intermediate practices, and 4 for healthy practices. The total score was summed up to create an index ranging from 0 to 100, with higher scores indicating better health.

We also constructed secondary dependent variables to ascertain the metabolic control levels of participants. To this end, we obtained the following data from their clinical files in both HFs: fasting blood glucose concentration (mg/dl), body mass index, or BMI (kg/m2), and blood pressure (diastolic and systolic, mm/Hg).

As covariables prior to the pre-test measurement, we investigated the sociodemographic characteristics of participants through a general questionnaire exploring age (years), sex, educational level (highest degree obtained), marital status, and socioeconomic level. To determine the latter, we used the index formulated by the Mexican Association of Market Intelligence and Opinion Agencies (AMAI), based on a statistical model where Mexican households were classified into seven socioeconomic levels –from the highest to the lowest (A/B, C+, C, C-, D+, D and E) (AMAI, 2018). We also selected questions from the User section of the 2016 National Health and Nutrition Survey (Romero-Martínez et al., 2017). The items gathered general information on diabetes: time elapsed since initial diagnosis; frequency of attendance at control appointments per year; type of medication taken; actions undertaken to prevent complications; non-pharmacological treatment (nutritional plan, exercise program and alternative medicine such as homeopathy or herbalism); and presence of complications.

Procedure

Design of the educational strategy

We developed the HLED based on the 6 steps of Intervention Mapping (IM) protocol (Figure 1). Step 1, we integrated the work group with the following members: the research team, one medical leader from each HFs and one nurse from the rural HFs. Next, we constructed a logical model for type 2 diabetes based on a literature review and direct inquiry with PLD; four self-care topics were prioritized: (1) correct nutrition, (2) exercise, (3) medications and (4)

self-monitoring of capillary blood glucose. For this purpose, we used national (Diario oficial, 2010) and international (Davies et al., 2022) diabetes care guidelines.

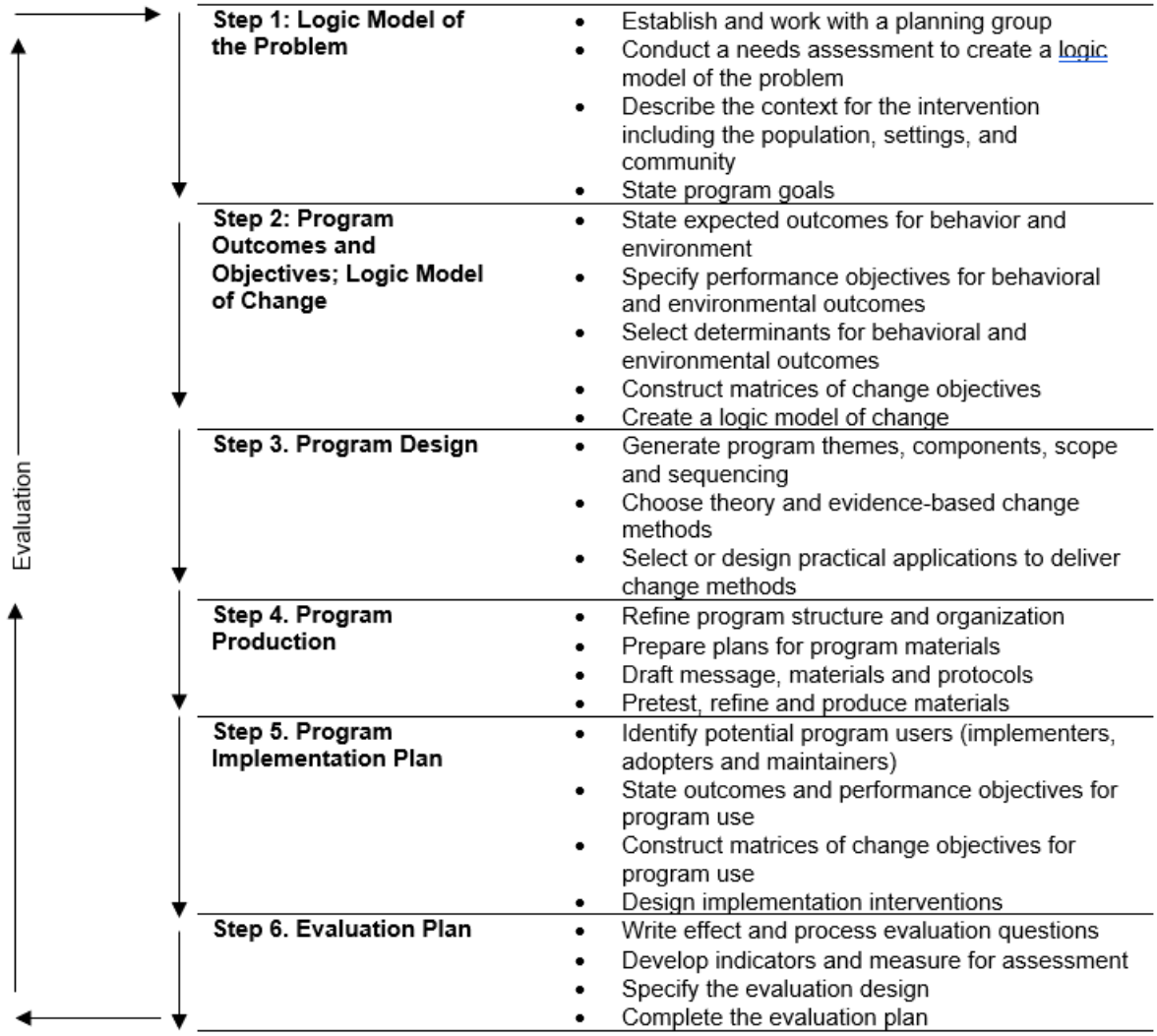

Figure 1. Steps of Intervention Mapping. Adapted from Jiménez-Aguilar, A., Rodríguez-Oliveros, M. G., Uribe-Carvajal, R., González-Unzaga, M. A., Escalante-Izeta, E. I., & Reyes-Morales, H. (2019). Design of an educational strategy based on intervention mapping for nutritional health promotion in childcare centers. Evaluation and Program Planning, 76, 101672.

Step 2, we defined four behavioral outcomes along with their respective performance objectives (POs), identified their personal and external determinants and developed change-objective (CO) matrices (See Inline Supplementary Appendix 2). Step 3, we selected theoretical methods for working with the determinants: skill training, modeling and direct experience (Bartholomew et al., 2016). We prioritized constructs such as observational learning, behavioral capacity, self-efficacy, social cognitive skills through reinforcement of the Social Cognitive Theory (Bandura, 2005), perceived susceptibility, barriers and benefits, and cues to action under the Health Belief Model (Cabrera et al., 2001). Step 4, we established the structure of the training program based on Multimedia Training Methodology (MTM) that featured four complementary and indivisible elements known as the Multimedia Teaching Package (Amaya-Castellanos et al., 2019; Calvelo-Ríos, 1998): (1) a video or flipchart, (2) communication between facilitators and attendees, (3) a workbook and (4) practical work. Step 5, we identify the medical supervisors of each HCs as potential users of the HLED. We organized a meeting with them, who reviewed and provided feedback on our proposal. Similarly, the duration and frequency of the sessions were established. Additionally, the issue of absenteeism reported by medical supervisors was considered; therefore, in addition to in-person sessions, the use of digital media and platforms to share information with participants was also considered. Step 6, in this step, the plan was developed to evaluate both the implementation process and the impact of the program. Specific evaluation questions were defined to measure the achievement of objectives and effectiveness of each component of the program.

Implementation

We adjusted the intervention to match the frequency with which participants normally attended MAGs meetings. Accordingly, a total of four monthly theoretical-practical workshops were held, each with a duration of approximately 90-120 minutes. The structure is presented in Inline Supplementary Appendix 3.

Urban and rural MAGs shared identical workshop dynamics. First, the principal researcher (as the facilitator) framed the work of the session (duration: five minutes). Next, she introduced the main theme of the session using a video or flipchart to illustrate the key concepts of each topic. In session 1, participants talked about nutrition; in session 2, about exercise; in session 3, about medication; and in session 4, about glucose self-monitoring. The video/flipchart was presented according to a script previously formulated to ensure information fidelity (duration: 10 minutes). At the end, the researcher and participants discussed the contents of the video/flipchart (duration 30 to 40 minutes). Subsequently, attention was turned to the workbook, which reinforced the concepts addressed on the video/flipchart. This material offered basic recommendations and exercises for each topic; for instance, regarding nutrition, the participating PLD established their own schedules for mealtimes and formulated eating plans. Regarding exercise, they determined the most appropriate times for working out as well as the easiest types of exercise for their physical condition. Specific recommendations were made regarding medications, such as establishing a fixed schedule for taking them. For the last session, the workbook provided a section to record blood glucose concentrations at different times of the day (duration: 15-20 minutes). Afterwards, a guided practice was developed to assist participants in learning what had been addressed theoretically during the video/flipchart presentation. A game or simulation exercise was carried out for each topic (duration 30 to 50 minutes). In session 1, participants practiced creating a one-day menu based on healthy eating guidelines. Session 2 focused on designing a personalized exercise plan based on individual preferences and physical conditions. During session 3, the participants learned how to organize their medications and make a pill organizer. Finally, session 4 guided the participants through the process of creating a daily blood glucose log to support regular self-monitoring.

Additionally, considering the possibility of absence from in-person sessions, we created Facebook groups of participants and published the materials covered during in-person workshops. Likewise, videos and workbook exercises were distributed to participants via WhatsApp.

Process evaluation

To evaluate the implementation of the training model, the methodology proposed by Saunders et al. (2005) was employed, focusing on key components such as fidelity, delivered dose, received dose, and participant satisfaction. Fidelity was assessed by measuring adherence to the planned components of the model, ensuring compliance with scheduled activities and sessions. The delivered dose was evaluated as the percentage of sessions conducted relative to the total planned, quantifying the extent of implementation.

The received dose, or participants' level of exposure, was determined by tracking session attendance rates. Participant satisfaction was documented by evaluating each component of the model and assessing the perceived quality of the research's execution, as expressed by the participants.

Strategies to promote attendance and active participation were recorded, alongside barriers such as logistical challenges or resistance to behavioral change. Facilitating factors that contributed to successful implementation were also identified, providing a comprehensive understanding of the training model's initiation process. These data were collected from records and word documents.

Data analysis

We performed bivariate analyses to compare the variables of interest by area of residence (urban-rural) and by pre-post measurements. We used the chi-square test for categorical (McHugh, 2013) and Student's t-test for continuous variables (Mishra et al., 2019).

We hypothesized that the strategy would improve the lifestyle of participants and constructed multiple linear regression models to examine this premise. In addition, we assessed the impact of the strategy on the final metabolic control measures (i.e., BMI, blood glucose and blood pressure). The models were adjusted for sociodemographic covariates, diabetes-related covariates, the initial lifestyle index and the metabolic control data collected at baseline. We kicked off with saturated models and eventually reached a reduced model containing only the variables that proved statistically significant ($p<0.05$) or contributed to explaining the variance in the outcomes of interest (R2 of the model). We assessed the assumptions of the linear regression models. Finally, we estimated the adjusted means of the final multiple linear regression models. Analyses were performed using the statistical program STATA version 13.0 (StataCorp, 2013).

In addition, for process evaluation, the data collected through records and word formats were entered into Excel sheets, which were then used for text analysis to identify factors that hindered or facilitated the activities, the interaction between participants and the researcher, and the use of teaching materials. These categories were previously established.

Ethical aspects

Our research protocol was approved by the Research Ethics Committee of the National Institute of Public Health of Mexico (CEI-0721H67) and by the Ethics Committee of the International Iberoamerican University (CR-124). Approval was obtained from the HFs health authorities. All participants provided oral informed consent and joined the study voluntarily.

Results

General characteristics of participants

28 individuals were invited to participate in the study from both HFs. 27 of them accepted, and among these, four were excluded from analysis for not having been diagnosed with diabetes but participated in the workshops. The average age of participants was 56.2 ± 10 years; 82.6% (n=19) were women; 56.5% resided in the rural area selected (n=13); 43.5% reported suffering from diabetes for less than five years; 78.3% took oral hypoglycemic agents to treat their condition, while just over 20% reported following an eating plan (n=5), exercising (n=5) and receiving an alternative treatment, e.g., homeopathy or herbal medicine (n=5). Regarding control practices during the year prior to the interview, 43.5% of participants had undergone an ophthalmological examination, while 17.4% of those residing in the rural area and none in the urban area reported taking one aspirin a day ($p= 0.05$). Twenty participants reported having had a foot examination; of these, 13 were rural and seven urban residents ($p=0.03$). With respect to complications, decreased vision was the most reported condition (65.2%), followed by burning, pain and loss of sensitivity in the soles of the feet (52.2%).

Implementation results

Fidelity

All four scheduled sessions were fully implemented (100%) in the two Mutual Aid Groups (MAGs) participating in the study. Each scheduled activity adhered strictly to the Multimedia Training Methodology (MTM) and was supported

by the Multimedia Pedagogical Package. The duration of each session ranged from 90 to 120 minutes, depending on participant interaction and the questions or concerns raised during the sessions. The materials developed for the intervention were utilized in their entirety, as originally planned. In workshop 4, however, a flipchart was used instead of the video in the rural MAG due to a power outage at the designated workshop venue.

Delivered and received dose

Adherence to the planned activities for each workshop was recorded at 100% in both MAGs. However, attendance varied across sessions and between groups. As shown in Table 1, the rural MAG had higher attendance in sessions 1 and 3, while the urban MAG showed greater participation in session 2. Despite variations in attendance, participants generally engaged actively and consistently, contributing through anecdotes, questions, and personal experiences. These contributions enriched the sessions and facilitated a better understanding of the topics discussed.

Table 1. Attendance at each workshop by urban-rural area.

	Mutual Aid Group			
Workshop Number	Urban (n total =10)		Rural (n total = 13)	
	n	%	n	%
1	5	50	11	85
2	6	60	4	31
3	4	40	12	92
4	5	50	6	46

Barriers and facilitator for the model implementarion

Four primary barriers to attendance were identified:
1. Work obligations, particularly in urban MAG.
2. Health-related issues, including personal or family health conditions such as diabetes-related symptoms (e.g., hypoglycemia or hyperglycemia), COVID-19, gastrointestinal illnesses, and even family bereavements.
3. Competing commitments, such as collecting monetary or in-kind support, attending medical appointments, or undergoing laboratory evaluations.
4. Difficulties in travelling, due to lack of money and mobility problems of the people themselves.
Conversely, several factors facilitated attendance, including:
1. Interest in the topics and activities.
2. Perceived physical and emotional benefits from attending the sessions.
3. Reminder calls made by the nurse in charge of the rural MAG to inform participants about upcoming meetings.
4. Follow-up appointments and additional support provided to participants.

Participant satisfaction

Participant feedback indicated that the topics covered—nutrition, exercise, medication management, and blood sugar self-monitoring—were well understood, and the information was perceived as timely, concise, and relevant. The activities were described as simple yet effective, helping participants better understand their condition and apply the knowledge in practice. Representative participant comments included:
• “The workshop was very simple, in the sense that it was very easy to understand. I think I learned the basics I need to control my condition here.” (Female participant, urban MAG)
• “The pillbox was very useful for organizing my medications.” (Male participant, rural MAG)

The HLED, lifestyle index and metabolic control measures

After conducting the workshops, 16 participants completed the post-test measurements: three from the urban area and 13 from the rural area. The seven participants who did not complete the study were urban residents: one emigrated abroad while the others withdrew for work-related reasons.

Table 2 shows the comparison between pre-post measurements; in this you can notice a significant reduction in systolic and diastolic blood pressure and a higher lifestyle index at the post-test measurement.

Table 3 shows the variables that were significantly related to the final overall lifestyle index in the multiple linear regression model, which was statistically significant (F-test, p = 0.03), explaining 91% of the variance in the index (R^2 = 0.91). After adjusting for potential confounders, the participants who attended all four workshops scored an average of 34.04 points higher on the final overall lifestyle index, compared to those who attended only one workshop (p<0.01). Other variables positively associated with the index were being from rural areas (p<0.01) and having been diagnosed with diabetes for 5-15 years (p=0.01).

Conversely, there were variables negatively associated such as the age of participants (p=0.01). Suffering from diabetes for over 15 years (p=0.03). Taking oral hypoglycemic agents, and both taking hypoglycemic agents and insulin compared to those taking no medication whatsoever (p=0.03).

Table 2. Pre-post measurements over metabolic control and lifestyle index in people living with diabetes who participated in the study

	Pre-test		Post-test		Difference		
	X	S.D.	X	S.D.	X	S.D.	P* Value
Body mass index (kg/m2)	29.1	4.7	29.3	4.8	0.2	1.1	0.45
Systolic blood pressure (mm/Hg)	80.0	6.3	71.9	7.5	-8.1	10.5	0.01
Diastolic blood pressure (mm/Hg)	124.1	13.6	115.6	14.6	-8.4	15.2	0.04
Fasting blood glucose concentration (mg/dl)	194.8	90.2	200.1	82.6	5.4	55.7	0.71
Lifestyle index (points)	74.8	8.6	79.3	6.7	4.5	6.9	0.02

N=16 participants. *P value= Student's t-test

Table 3. Linear regression model to evaluate the relationship between the number of workshops attended and the final overall lifestyle index

Variables	Coefficient	P	95% CI
Number of workshops attended			
1 (reference)	1.00	-	-
2	3.53	0.25	(-4.46, 11.53)
3	7.62	0.09	(-2.04, 17.28)
4	34.04	<0.01	(20.77, 47.31)
Area			
Urban (reference)	1.00	-	-
Rural	37.27	<0.01	(22.12, 52.43)
Age (years)	-0.66	0.01	(-1.03, -0.29)
Time living with type 2 diabetes			
<5 years (reference)	1.00	-	-
5-15 years	10.35	0.01	(4.61, 16.09)
>15 years	-9.51	0.03	(-17.36, -1.67)
Type of medication			
None (reference)	1.00	-	-
Oral hypoglycemics only	-18.39	0.03	(-32.46, -4.33)
Hypoglycemics and insulin	-18.17	0.03	(-32.26, -4.07)
Insulin only	14.72	0.07	(-2.16, 31.59)
Initial Overall Lifestyle Index	-0.69	0.03	(-1.23, -0.16)
Intercept	146.01	<0.01	(94.62, 197.39)

N=16 participants. p = 0.03, R^2 = 0.91

Based on this model, Figure 2 shows the adjusted means of the final overall lifestyle index according to the number of workshops attended, with scores trending upward when more than one workshop was attended. A significant difference ($p<0.01$) was observed between attending one (75.0 points) vs. four (82.7 points) workshops.

Additionally, after adjusting for the AMAI index through a linear regression model, we observed that the participants who attended three workshops presented a significant difference (27 mg/dl on average) in fasting blood glucose between pre-post measurements vs. those who attended only one workshop ($p=0.03$) (Figure 3). No significant differences were observed for BMI or blood pressure between pre-post measurements after adjusting for potential confounders.

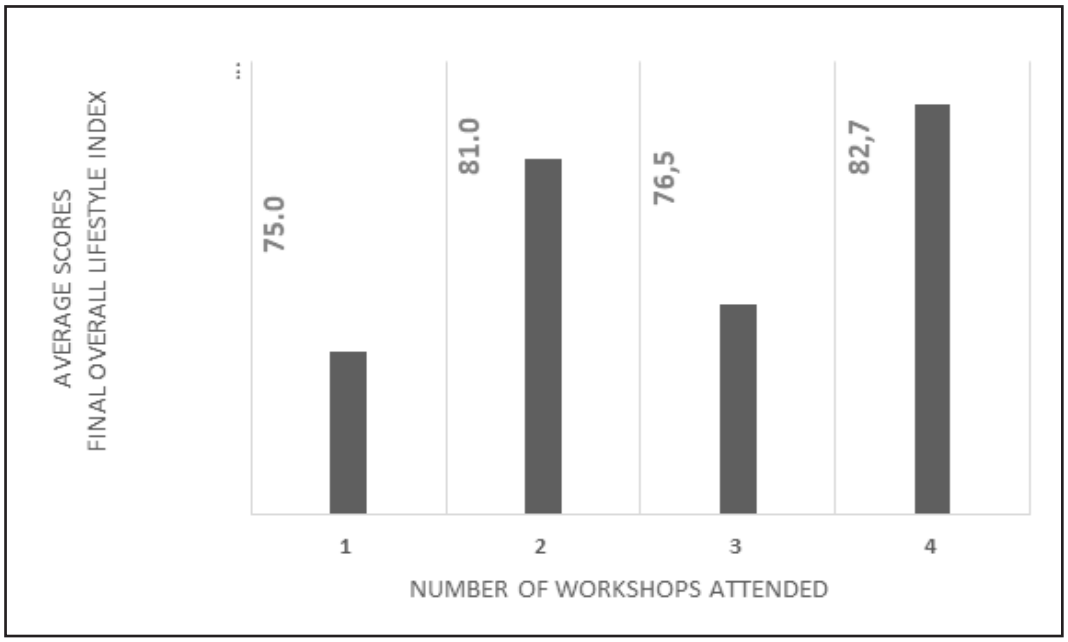

Figure 2. Means of final scores on the final overall lifestyle index adjusted by the regression factors of the linear model (Table 2), according to the number of workshops attended. *Statistically significant difference between workshops 1 and 4 ($p<0.01$).

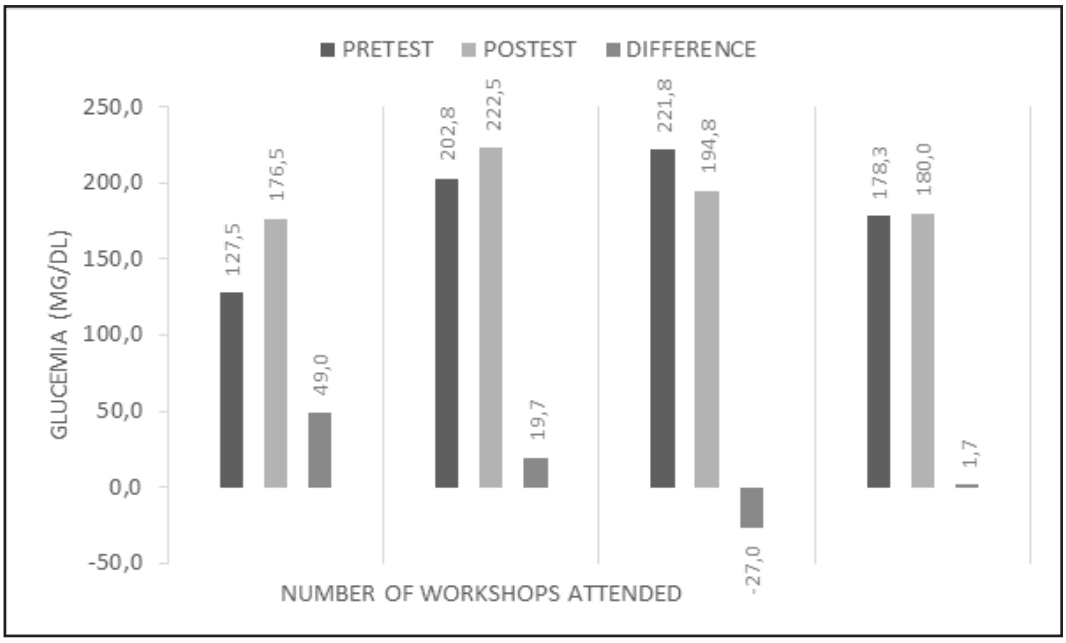

Figure 3. Adjusted means of fasting blood glucose levels: pre-test, post-test, and the difference between them according to the number of workshops attended. The mean values were adjusted for the AMAI index using a linear regression model. *Statistically significant difference between workshops 1 and 3 ($p=0.03$).

Discussion

Salient among our findings was that PLD who attended all four HLED workshops, registered higher average scores on the overall lifestyle index in the postest compared to those who attended a single workshop. This demonstrated not only the importance of attending every session, but also the relevance of the topics discussed. Furthermore, it underscored the effectiveness of the IM protocol as an effective methodology for developing programs based on behavioral change precepts, such as Social Cognitive Theory and the Health Belief Model. Both have successfully contributed to the development of programs for improving self-care among PLD (Ghoreishi et al., 2019; Shabibi et al., 2017).

In addition, using the Multimedia Training Methodology (MTM) process to structure the HLED facilitated replicating the workshops in urban and rural areas with favorable results. One strength of this methodology is that it allows communication in practically any social context without sacrificing fidelity (Amaya-Castellanos et al., 2019). The MTM has proven effective in addressing challenges such as illiteracy, poverty, and a lack of basic resources like electricity. Furthermore, it creates a platform for social and intercultural communication while fostering meaningful learning. The approach is rooted in the popular proverb: "If I hear it, I forget; if I see it, I remember; if I do it, I learn" (Amaya-Castellanos et al., 2019; Calvelo-Ríos, 1998).

The MTM integrates standardized communicative tools—such as videos, flipcharts, guided discussions, and workbooks—to address communication barriers

Notably, the MTM incorporates specific communicative components, such as instructional videos or flipcharts, guided group discussions, and printed workbooks that directly address the communication barriers and lack of previously identified standardization. The multichannel approach aligns with evidence suggesting that such strategies enhance cultural integration and facilitate content ownership in diverse communities (Williams & Swierad, 2019). Additionally, we observed that the use of video and digital materials helped provide distance guidance.

Although we adapted the periodicity of the HLED workshops to be consistent with the usual frequency and dynamics of the MAGs sessions, we observed difficulties during this study such as limited attendance. The principal barriers to attendance emerged from the information provided by participants: (a) work obligations, frequently observed in the urban area; (b) their own health condition or that of a family member, either associated with diabetes or related to COVID-19 and other diseases; (c) commitments that interfered with the workshop schedules, such as collecting government support in cash or in kind, or attending medical appointments/laboratory tests; and finally, (d) difficulties in travelling to the HFs, whether because of lack of money or mobility problems; the latter were mainly an issue for older adults or patients who had already experienced complications from diabetes.

In addition to the above factors, the adjusted analyses showed that age, length of time living with diabetes and the initial lifestyle index were inversely associated with the final overall lifestyle index; factors that have been documented as an important impediment to self-care in other experiences (Azami et al., 2018; Goderis et al., 2009; Juárez-Ramírez et al., 2020; Romero-Baquedano et al., 2010; Villalobos et al., 2019).

The linear regression model showed that taking oral hypoglycemic agents alone or in combination with insulin was negatively associated with the final overall lifestyle index, compared with people who did not take medications. This may stem from the difficulty of taking medications over time. According to a recent meta-analysis, the cost of treatment represents an important deterrent for self-care practices (Piragine et al., 2023). Other mechanisms may also have contributed to this phenomenon. For instance, medication complexity and regimen burden, particularly when self-management support is limited, can decrease adherence and diminish motivation for lifestyle, changes (Murwanashyaka et al., 2022). Psychosocial factors, such as negative beliefs about medications or unmet social needs, have been linked to lower adherence among younger adults with diabetes, which in turn is associated with worse outcomes and less engagement in self-care activities (Weinstock et al., 2023). In light of these findings, future research should assess the affordability and availability of medications as well as regimen complexity, patient beliefs, and social support structures to better understand how these factors jointly influence self-care practices and lifestyle indices in PLD.

Analyses of metabolic control in PLD found a significant decrease in the fasting blood glucose levels of participants who attended three as opposed to one workshop. This difference was independent of the AMAI socioeconomic

index, once again underscoring the relevance of attendance and the topics discussed (Barreira et al., 2018; Gillen et al., 2021). Although not statistically significant, both diastolic and stystolic blood-pressure levels trended down towards the end of the study. This suggests the need to continue evaluating the impact of the intervention on this outcome, and to develop educational content aimed at improving/maintaining healthy blood-pressure levels.

The observed results must be assessed considering the strengths and limitations of our study. Given its design, it was impossible to ensure that the change in the lifestyle index resulted exclusively from the intervention (Manterola & Otzen, 2015). PLD attending MAGs as traditionally conducted have achieved positive health outcomes such as enhancing glycemic control as well lowering blood pressure and body weight, compared to the population that does not attend these kinds of groups (Rivera-Montiel, 2015). Nonetheless, when we began implementing the educational strategy, the MAGs selected had suspended their sessions because of the COVID-19 pandemic. This allowed us to conduct educational workshops free of the influence of traditional MAG activities. In addition, we adjusted the linear models for attendance at control appointments, but this variable proved statistically insignificant.

An important limitation of this study was the small final sample size (n=16), largely due to participant attrition at an urban site. Follow-up losses were unrelated to the variables of interest and were mainly due to participants' work obligations. Nonetheless, the results of the present study should be interpreted with caution. These findings should be considered exploratory and not generalizable. Future studies with larger and more stable samples are needed to confirm these preliminary trends and strengthen the evidence base.

Conclusion

Although the strategy and its implementation still face several challenges, its results have relevance as an innovation for primary care because to our knowledge, this is the first time that the IM and MTM have been used to structure a health strategy such as the HLED to be implemented within the context of the MAGs, showing its potential to strengthen the work of MAGs, improving communication between facilitators and participants and standardizing the program and materials for self-care in diabetes in Mexico. Furthermore, the use of accessible technologies such as Facebook and WhatsApp has enabled a user-centered design approach, which has been shown to enhance the acceptability, cultural relevance, and impact of health education interventions (Chen et al., 2023). However, it is important to bear in mind that the accessibility of the Internet and digital devices is not homogeneous in Mexico and therefore calls for further assessment.

Based on the above, our research team is considering introducing the following adjustments to the strategy before moving forward:

(1) Adapting the workshops to make them either 100% virtual or a combination of online and in-person sessions;
(2) Organizing a training scheme so that PLD themselves become promoters of self-care among their peers;
(3) Integrating other relevant topics such as the management of hypertension; and
(4) Utilizing an experimental design and integrating the Implementation Science approach (Bauer & Kirchner, 2020) with larger samples for future research.

The present study documents a positive relationship between the HLED and a higher average score on the overall lifestyle index for PLD who attended all the scheduled workshops. Likewise, favorable results were observed for fasting blood glucose, and a positive trend was seen for blood-pressure levels, meriting further evaluation.

Author contributions

The authors equally participated in the preparation of the manuscript and approved the final version presented.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Data Availability Statement

The data presented in this study are available upon request from the corresponding author.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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