Original Report

DIABETES IN MAYAN POPULATIONS: MONITORING OF GLYCOSYLATED HEMOGLOBIN

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Background: Diabetes mellitus (DM) is a global health concern that has affected various populations worldwide. Among the various methods to monitor the progress and management of DM, glycosylated hemoglobin (HbA_{1c}) serves as a key marker for understanding long-term glucose control. The Mayan populations of Yucatan represent a unique demographic in which the prevalence and management of DM can be distinctively analyzed.

Method: In this study, HbA_{1c} levels were monitored over 12 months in 1722 patients with DM from 17 medical units of the Mexican Institute of Social Security in the southern region of Yucatan. Based on initial HbA_{1c} levels, patients were assigned to either standard or intensive treatment. Treatment efficacy was analyzed based on sex, age, and location.

Results: HbA_{1c} levels significantly decreased in patients receiving intensive treatment, from means (±SD) of 9.7±1.9% to 8.9±2.0% after 12 months (P=.001), with notable reductions in remote areas such as Akil and Huntochac (P<.05). Although slight reductions were observed among women and middle-aged individuals, these reductions were not statistically significant (P=.2 and P=.4, respectively). Despite the initial improvement, standard treatment was more effective for maintaining long-term glycemic stability, with lower variability and better adherence. However, a 10% increase in HbA_{1c} was observed in this group by the end of the study.

Conclusion: Monitoring of DM in Mayan populations revealed significant HbA_{1c} reductions with intensive treatment, especially in remote areas. Consequently, strategies to improve primary care and promote self-care in DM patients in the Mayan population must be implemented. *Ethn Dis.* 2025;35(2):65–72; doi:10.18865/EthnDis-2023-65

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INTRODUCTION

Diabetes mellitus (DM) is a disease that seriously affects the health sector. Its global prevalence has increased exponentially, making it a priority disease.[1] In Mexico, DM affects 9.7% of the population, with a particularly high impact in indigenous communities. In Yucatan, the incidence of DM increased from 5.4% to 10.7% between 2006 and 2018, representing an increase of ∼50%. In addition, mortality from DM has increased by 128% in the same period.[2,3] In the southern region of Yucatan, there is a high prevalence of DM (12.3%), and 90% of the population identifies as of Mayan ancestry.[4]

The increase in DM in the Mayan region is linked to globalization, which increases access to and consumption of processed foods.[5] In Mexico, the government has implemented measures against the DM epidemic, such as increasing taxes on bottled soft drinks and improving the patient monitoring process. However, these efforts are still insufficient.[6]

The primary goal for patients with DM is to maintain blood glucose levels within an optimal range. One tool used to diagnose and monitor DM is glycosylated hemoglobin (HbA_{1c}) levels, which have been proposed as an alternative screening test.[7] This test provides information on an individual's average blood glucose levels over the previous 2 to 3 months and the estimated half-life of red blood cells.[7]

An advantage of HbA_{1c} is that it can be measured at any time of the day, regardless of fasting duration. Samples remain stable and are unaffected by stress, allowing HbA_{1c} to be used as a decision-making variable in patient health management.[7,8] HbA_{1c} is commonly used in remote areas because of its versatility; in rural communities the blood obtained may take considerable time to reach a laboratory for analysis.[9] An HbA_{1c} value of 7% or higher indicates deterioration in patient health and is used to determine the treatment strategy.[10]

Community primary care, regardless of the form of organization of each regional health system, has an important role in medical intervention, both in prevention and in the glycemic monitoring of patients.[11] In Mexico, an increase in the quality of primary care has been a challenge for the health system, although there have been considerable advances and improvements in management of DM. However, it is still necessary to improve the performance of health services to achieve a level that meets international standards.[12]

Strategies contextualized to a region are necessary to improve primary care aimed at patients with DM. However, before implementing such strategies, it is necessary to understand the current state of DM in the Mayan population so their specific needs can be addressed effectively. At present, the extent of monitoring of patients with DM in the Mayan region south of Yucatan is not fully known, making it necessary to evaluate the status of DM in order to improve primary care and deploy awareness strategies and actions to promote the health of the Mayan population.[12] This study was conducted to address this gap by monitoring changes in HbA_{1c} levels over a 12-month period in patients diagnosed with DM among the Mayan populations of southern Yucatan.

Material and Methods

Study Site

The study was conducted in the medical centers of the Mexican Institute of Social Security (IMSS) located in the southern region of Yucatan, Mexico.

Population and Medical Protocol

The study included 1722 individuals diagnosed with DM who were registered at the health care facilities of IMSS between March 2019 and December 2020. Among these individuals, 1279 were women, and 443 were men, with ages ranging from 21 to 90 years. Patients were selected according to the IMSS guidelines based on the Mexican Official Standard NOM-015-SSA2-2010 for the prevention, treatment, and control of DM.[13] Physicians identified potential participants during routine consultations, ensuring they met the inclusion criteria described in the IMSS Clinical Practice Guidelines.[14] Patients attended follow-up appointments for HbA_{1c} measurements at baseline, 6 months, and 12 months.

The responsible physicians determined the treatment approach based on each patient's HbA_{1c} levels, allocating them into standard glycemic control (HbA_{1c}<7%) or intensive control (HbA_{1c}≥7%) groups. The standard treatment group received 850 mg of metformin twice daily. The intensive treatment group received higher doses of medications, such as metformin up to 1,000 mg twice daily and glibenclamide up to 10 mg daily. Insulin therapy was initiated when physicians deemed it necessary. The importance of a healthy lifestyle was emphasized for all participants. Dietary recommendations were based on a diet high in fruits, vegetables, whole grains, and lean proteins and low in sodium and saturated fats. Participants were encouraged to engage in at least 30 minutes of moderate-intensity exercise daily, such as brisk walking or cycling.[14]

Informed consent was obtained from all participants prior to their inclusion in the study. All procedures were conducted in accordance with the ethical standards of the institutional ethics committee and the Declaration of Helsinki. The study strictly adhered to the standards and guidelines established by the IMSS, as described in NOM-015-SSA2-2010, ensuring appropriate patient recruitment, monitoring, and treatment protocols.

Statistical Analysis

Descriptive statistics were used to summarize variables such as sex, age, and type of treatment. The normality of the data distribution was assessed using the Shapiro-Wilk test with skewness and kurtosis analyses. For comparisons between dichotomous variables, the Mann-Whitney *U* test was applied. Temporal changes were analyzed using the Kruskal-Wallis test and Tukey's multiple comparison post hoc test. The effectiveness of the standard and intensive treatments was evaluated using Kaplan-Meier analysis to estimate the time required for patients to achieve and maintain optimal HbA_{1c} levels. A significance level of $P<.05$ and a 95% confidence interval were established for all statistical analyses.

Results

Analysis of HbA_{1c} Monitoring in Patients by Type of Treatment, Sex, and Age

The study included 1722 individuals with DM, with more women (74.2%, n=1279) than men (25.7%, n=443) and ages ranging from 21 to 90 years (mean=57.1±12.3 years). The overall initial mean HbA_{1c} was 8.6±2.3%, which decreased to 8.3±2.2%, although this reduction was not statistically significant (P=.4). Fewer patients received standard treatment (n=672) than received the intensive treatment (n=1009). Initial mean (±SD) HbA_{1c} levels were significantly lower in the standard treatment group (5.9±0.6%) than in the intensive treatment group (9.7±1.9%) (P=.001). At 6 months, mean HbA_{1c} levels were 6.5±1.6% for the standard group and 9.0±2.1% for the intensive group (P=.001). At 12 months, HbA_{1c} levels were 6.7±1.9% and 8.9±2.0%, respectively (P=.001) (Figure 1A).

Patients in the intensive treatment group experienced a significant reduction in HbA_{1c} levels over time (from 9.7±1.9% to 8.9±2.0% in 12 months; P=.001), whereas those in the standard treatment group had a slight increase (from 5.9±0.6% to 6.7±1.9%; P=.001) (Table 1). This result suggests that although both approaches improved glycemic control, intensive treatment had a higher reduction in HbA_{1c} levels over time.

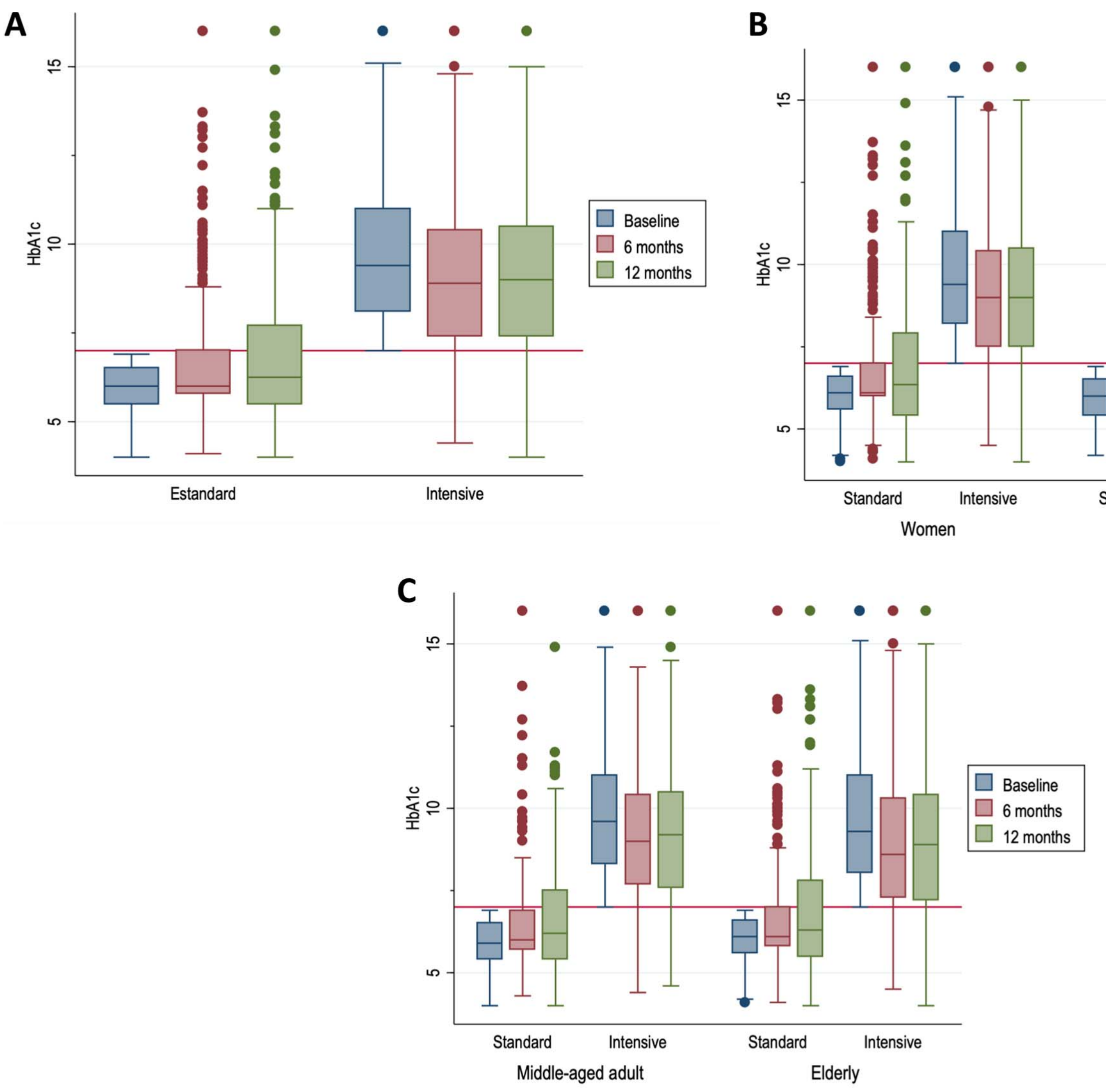

Figure 1. Comparison of HbA_{1c} levels in Mayan patients with DM by treatment, sex, and age; data were analyzed with Mann-Whitney *U* and Tukey's multiple comparisons (P<.05)

A paired analysis of HbA_{1c} levels between treatment groups revealed no significant difference between women (P=.3) and men (P=.1) (Figure 1B). Furthermore, no significant differences were observed between sexes within each treatment group throughout the study (P=.2 for standard and P=.4 for intensive).

Analysis by age revealed that middle-aged people (21-50 years) had lower HbA_{1c} levels on standard treatment (6.2±0.8%) compared with intensive treatment (10.2±2.3%) at baseline (P=.001). Control was better at 6 months for middle-aged and elderly people (51-90 years) in the intensive group. In summary, age did not influence the effect of either treatment (P=.2) (Figure 1C).

Table 1. HbA_{1c} levels (mean±SD) of patients with diabetes by time treatment

Treatment	Baseline	6 months	12 months	P value
Standard	n = 485 5.9±0.6%	n = 497 6.5±1.6%	n = 520 6.7±1.9%	.001*
Intensive	n = 1237 9.7±1.9%	n = 1222 9.0±2.1%	n = 1161 8.9±2.0%	.001*

A Krustal-Wallis test was used to determine the significance of differences between HbA_{1c} treatments at baseline, 6 months, and 12 months.
*P<.05

Comparison of HbA_{1c} Levels of Mayan Populations Based on Distance From the Capital City

An analysis of the results among the 17 medical units in the southern region

Table 2. HbA_{1c} levels for patients with diabetes among Mayan populations treated at various medical units in the southern region of Yucatan from March 2019 to December 2020

Medical unit	Population	Age (years)	Mean (±SD) HbA_{1C} (%) Baseline	6 months	12 months	Change	Distance from Merida (km)	P value
Muna	220	57.7±11.5	7.5±2.0	7.2±1.8	8.1±2.1	+8	67	.04*
Sacalum	187	57.7±12.1	7.6±2.1	7.5±1.9	7.5±2.6	−1.32	70	.3
Mama	233	57.0±13.6	8.7±2.0	9.1±2.1	8.8±2.0	+1.14	73	.05
Tipikal	45	57.4±12.9	7.4±2.3	6.9±1.4	8.0±2.2	+8.11	85	.04*
Mayapán	70	56.2±13.4	9.2±2.2	7.6±1.7	7.9±1.8	−14.13	95	.001*
Akil	367	55.6±11.8	9.5±5.5	8.9±2.4	8.4±2.4	−11.57	106	.03*
UMM Akil	12	63.4±12.0	11.7±2.1	9.7±1.6	9.6±1.5	−17.94	106	.01*
Tixmehuac	150	59.6±13.5	9.1±1.8	9.1±2.3	9.0±2.4	−1.09	110	.4
Xul	42	59.0±13.8	8.9±2.4	7.8±1.5	8.0±2.0	−10.11	135	.03*
Dzi	64	59.4±12.5	7.9±1.8	7.6±1.5	7.7±1.7	−2.53	146	.1
Progresito	49	57.8±12.4	8.2±2.0	7.4±1.4	7.6±2.1	−7.31	146	.01*
Catmis	61	56.5±11.5	10.0±2.7	9.9±2.7	9.3±2.0	−7	160	.8
Huntochac	42	53.6±12.4	9.8±1.9	9.0±1.4	8.9±1.9	−9.18	170	.02*
UMM Huntochac	17	52.1±11.3	11.1±2.4	8.8±1.7	8.7±1.7	−21.62	170	.001*
Ichmul	78	56.6±12.8	8.2±1.9	8.1±1.7	8.0±1.6	−2.44	173	.3
Corral	25	57.0±11.3	9.2±2.1	8.2±1.6	8.3±1.8	−9.78	180	.04*
Becanchen	62	56.5±9.9	8.2±1.8	7.8±1.4	8.7±1.9	+6.1	182	.09
Total	1722	57.1±12.3	8.6±2.3	8.3±2.2	8.3±2.2	−6.02		.4

Results were analyzed using descriptive and inferential statistics. A Krustal-Wallis analysis was used to determine the significance of differences between baseline and 12-month HbA_{1c} levels.
*$P<.05$

of Yucatan revealed differences in the changes in HbA_{1c} levels among diabetic patients based on their geographical proximity to the capital (Merida). Table 2 shows a comparison of HbA_{1c} levels over the monitoring months for each medical unit. The results indicate that patients in medical units located farther from Merida (>100 km) experienced more substantial reductions in HbA_{1c} levels than did patients in units closer to the capital (≤100 km).

In patients in units situated at a greater distance from Merida, an average reduction of 7.87% in HbA_{1c} levels was recorded after 12 months. Patients in units such as UMM Huntochac and UMM Akil had notable decreases of 21.62% ($P=.001$) and 17.94% ($P=.01$), respectively. Additionally, patients in other units such as Akil, Corral, Huntochac, Progresito, and Xul also had significant reductions ($P<.05$) in HbA_{1c} levels. The patients in the majority of these units improved their glycemic control by the end of the monitoring period.

In contrast, in medical units closer to Merida, the average change in patient HbA_{1c} levels was minimal, with an overall increase of 0.36%. Some localities even had significant increases in HbA_{1c} levels, such as Tipikal (+8.11%, $P=.04$) and Muna (+8%, $P=.04$). Only in Mayapán, among the nearby units, the patients had a significant reduction (14.13%; $P=0.001$) in HbA_{1c} levels. The observed differences could partly be explained by the higher baseline HbA_{1c} levels in patients from the more distant units, which provided a greater margin for improvement. Patients in these units had higher initial HbA_{1c} levels, which might have facilitated greater reductions over time.

Effectiveness of Standard and Intensive Treatments

Patients were assigned to 1 of 2 treatment groups based on their baseline HbA_{1c} levels, according to previously described clinical guidelines. Both interventions included lifestyle modifications, such as a balanced diet and regular physical activity, supplemented with pharmacological therapy that could involve the use of metformin, glibenclamide, or insulin. In the intensive treatment group, physicians had the discretion to adjust pharmacological doses, and approximately 15% of the patients in this group required insulin therapy.

The Kaplan-Meier analysis revealed that although the intensive treatment group achieved a greater overall reduction in HbA_{1c} levels over the 12 months, the standard treatment was more effective in maintaining stable and sustained glycemic control over time. Specifically, the standard treatment group had lower variability in HbA_{1c} values, indicating more consistent and uniform glycemic control. Patients in this group managed to maintain HbA_{1c} levels closer to the therapeutic target of 6.5%, with

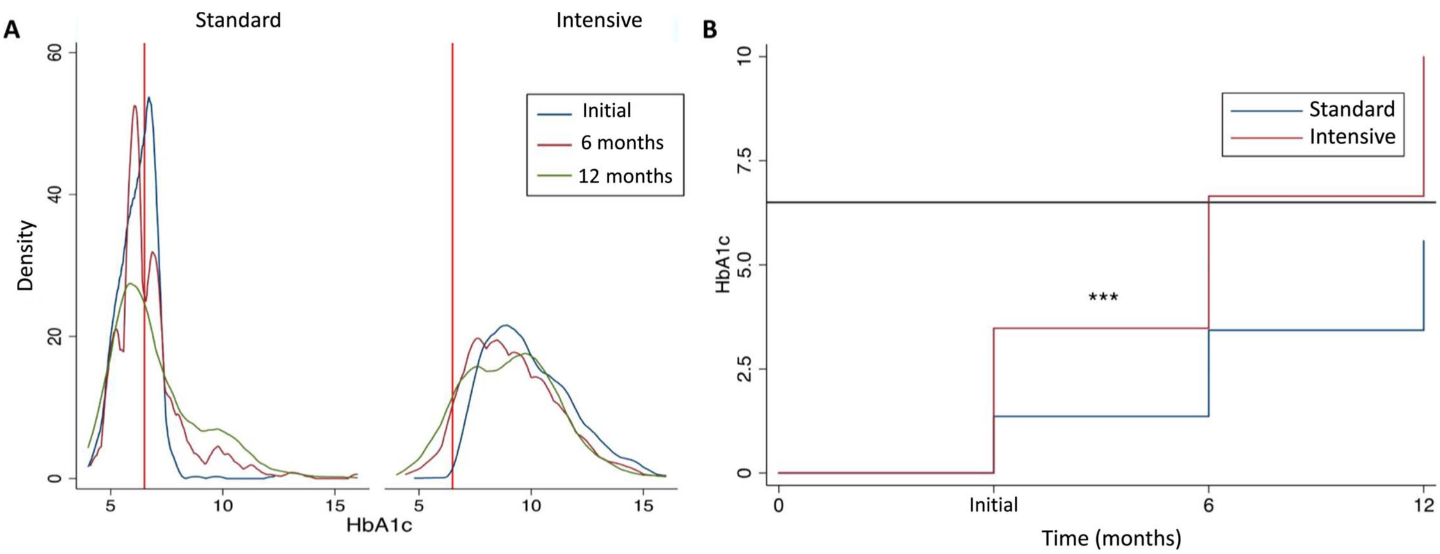

Figure 2. Effectiveness of treatments for HbA_{1c} control as determined by Kaplan-Meier analysis; data were analyzed with Shapiro-Wilks, skewness, and kurtosis tests (P<.05)

minimal variability, as evidenced by the distributions at baseline, 6 months, and 12 months (A=.000, K=.000 for all measurements) (Figure 2A).

In contrast, although the intensive treatment group achieved a more pronounced initial reduction in HbA_{1c} levels, it exhibited greater variability over time. This increased variability, with distributions at baseline (A=.000, K=.984), at 6 months (A=.000, K=.002), and 12 months (A=.000, K=.012), suggests instability in glycemic control. Furthermore, an early increase in HbA_{1c} levels (from 6 months onward) was found in this group (Figure 2B), indicating that some patients were unable to sustain the initial benefits of intensive therapy possibly due to inconsistent adherence to therapeutic and lifestyle recommendations or the complexity of managing an intensive regimen.

Discussion

This study was conducted to analyze changes in HbA_{1c} levels over a 12-month period in patients diagnosed with DM in Mayan populations from southern Yucatan, Mexico. The main findings revealed differences in glycemic control based on treatment type, sex, age, and the geographical location of patient's medical unit. The study period coincided with the onset of the COVID-19 pandemic, which likely impacted the participants' glycemic control. Although specific data on the impact of COVID-19 restrictions were not collected, it is plausible that national measures such as social distancing and lockdowns limited patients' access to medical care, availability of fresh foods, and opportunities for physical activity (all essential components in DM management).[15,16] Additionally, DM was a comorbidity that increased mortality risk in COVID-19 patients, being associated with a 15.8% increase in mortality. Combinations such as DM plus hypertension and DM plus obesity further elevated mortality rates to 54.1% and 36.8%, respectively.[16,17]

Initially, most patients (65.87%) were enrolled in the intensive treatment program due to high baseline HbA_{1c} levels (~10%). The intensive treatment group experienced a significant reduction in HbA_{1c} levels over 12 months (from 9.7% to 8.9%; P=.001), although not all patients achieved the recommended target HbA_{1c} below 7%. According to the Mexican Official Standard (NOM-015-SSA2-2010) for the prevention, treatment, and control of DM, an HbA_{1c} level below 7% is recommended to minimize the risk of complications and mortality.[13] The failure to achieve this target in the intensive treatment group highlighted various challenges in managing hyperglycemia in these populations.

However, the standard treatment group had superior long-term glycemic stability. The Kaplan-Meier analysis was used to evaluate the duration needed to reach and maintain target HbA_{1c} levels, allowing for a concise comparison of long-term glycemic control between the treatment groups.[18] The Kaplan-Meier results indicated that standard treatment was more effective than the intensive regimen for achieving sustained hyperglycemic control. Patients in the standard treatment group maintained a stable HbA_{1c} distribution throughout the study period, with reduced variability and levels consistently closer to the optimal target.

Stability reflected a more consistent and predictable response to the therapeutic protocol, suggesting greater patient adherence. The differences in glycemic control between these groups could be partly explained by the complexity and difficulty of maintaining the intensive regimen over the long term, especially in rural areas where access to health care resources is limited. Additionally, the pandemic may have exacerbated these challenges by restricting access to medical care, the availability of fresh foods, and opportunities for physical activity.[15,16]

The sex-based analysis revealed that women, who were 74.2% of the study population, had a greater, though not statistically significant ($P>.05$), reduction in HbA_{1c} levels than did men. Women with DM often engage more in self-care practices, possibly due to cultural and historical roles emphasizing health maintenance and caregiving.[19-21] Their higher representation in the study may be linked to a predisposition to risk factors such as abdominal fat accumulation and hormonal changes that influence glucose metabolism.[22]

Regarding age, younger patients (21-50 years) achieved better glycemic control, particularly with the standard treatment ($P=.05$). DM in young people has increased by 30%, and cases are expected to quadruple in 40 years.[23] Early intervention after diagnosis is important to delay DM progression and improve quality of life.[24] Younger people with DM face a higher risk of mortality and vascular disease than do older people. Each additional year of age at diagnosis could reduce vascular disease mortality by 5%.[24] However, prevention and follow-up are challenging because of the paucity of clinical programs, inadequate health policies, and lack of information on effective interventions.[25] Primary care programs focused on the prevention and early monitoring of DM aim to avoid costly and detrimental complications for the patient. Self-care strategies and medical follow-up are necessary.[26]

A noteworthy finding was the disparity in HbA_{1c} reductions based on the geographical location of the medical units. Patients in units located more than 100 km away from Merida experienced more substantial reductions in HbA_{1c} levels compared with patients in units closer to the capital. Patients in units such as UMM Huntochac (−21.62%, $P=.001$) and UMM Akil (−17.94%, $P=.01$) had significant improvements, whereas those in units near Merida, such as Tipikal (+8.11%, $P=.04$) and Muna (+8%, $P=.04$), had increased HbA_{1c} levels. This contrast may be influenced by differences in baseline HbA_{1c} levels and access to industrialized foods. Patients in more distant units had higher initial HbA_{1c} values, allowing for greater potential reductions over time. Additionally, these regions may rely more on traditional diets and lifestyles, which could contribute to better glycemic control.

The southern region of Yucatan is predominantly rural and designated as a Priority Rural Attention Zone, characterized by high levels of marginalization and social deprivation and poverty rates exceeding 50%. The predominantly indigenous Mayan population faces major health problems, such as limited access to health care, low levels of education, and food insecurity.[27]

During the COVID-19 pandemic, 90% of the population in these communities was reported to be living between the poverty line and extreme poverty, hindering access to basic food supplies. According to the 2020 National Health and Nutrition Survey, the highest proportions of households experiencing moderate and severe food insecurity were found in rural areas (28.8%) and in the Yucatan Peninsula region (33.6%).[28] It is highly likely that food insecurity directly affected DM management by limiting the availability of nutritious foods necessary for glycemic control.

In recent decades, the Mayan population has faced significant challenges in the management and prevention of DM, primarily due to changes in dietary patterns driven by globalization and the increased consumption of industrialized products.[29,30] In rural areas of Yucatan, the market economy has been a factor in the gradual decline in traditional food production systems such as the milpa system, where dozens of traditional crops are raised together.[4,5] However, in more remote regions, people still maintain traditional lifestyles, with diets based on local crops and higher levels of physical activity related to agricultural work.[31] The contrast between these lifestyles may explain why communities closer to Merida such as Tipikal and Muna, which have easier access to the capital and more readily available industrialized products, have inferior glycemic control compared with more distant communities such as Akil and Huntochac, where traditional lifestyles prevail.

The high susceptibility of the Mayan population to insulin resistance combined with low adherence to dietary and pharmacological recommendations pose an added challenge to effective DM management in these communities.[32] However, in diabetic patients who ate a diet based on traditional Mayan crops had significantly reduced HbA_{1c} levels over 16 weeks, from 9.2% to 7.9% ($P=.01$), suggesting that these practices could be integrated into current treatment strategies.[33] Moreover, the implementation of peer support strategies has proven to be a promising and culturally appropriate intervention for managing DM in this population. Peer support enables patients to share experiences and exchange self-care advice, which led to a significant improvement in the quality of life for Mayan patients after 8 months, with a greater reduction in HbA_{1c} levels (−1.29%, $P=.001$) among those who participated in the program compared with those who did not (−0.98%).[34] Therefore, inclusion of family, social, and economic factors in the design of intervention strategies could improve DM control, especially in patients receiving intensive treatment.

The COVID-19 pandemic exacerbated psychological stress, increasing the prevalence of anxiety and depression worldwide. Although the present study did not directly evaluate psychological factors, social variables likely had a considerable impact on the emotional well-being of Mayan communities in southern Yucatan. Previous research conducted during the pandemic in these populations suggested that risk factors for anxiety included the predominant use of the Mayan language and older age, possibly due to communication barriers and limited access to mental health resources in their native language.[35] These barriers and the lack of culturally appropriate mental health services could have negatively affected treatment adherence, especially in the group subjected to intensive treatment, which requires more rigorous monitoring and frequent adjustments in therapy.

The present study has three main limitations that may affect the interpretation and generalizability of its findings. First, the absence of detailed individual data regarding social, economic, and psychological factors and comorbidity profiles could introduce biases when evaluating treatment effects. Second, although the COVID-19 pandemic disrupted access to health care, fresh food availability, and physical activity, these impacts were not directly measured, leaving uncertainty about their exact influence on the results. Third, the 12-month follow-up period limited our ability to determine the long-term sustainability of improvements in glycemic control. Future research should include comprehensive assessments covering socioeconomic, psychological, and clinical variables and should extend the follow-up period to better identify the barriers and facilitators of effective glycemic control.

Despite these limitations, the results of this study lay the groundwork for future interventions to focus on developing culturally appropriate strategies that address the specific needs of Mayan communities. Implementation of health education programs in the Mayan language, training of local health care personnel, and integration of traditional practices could improve the acceptance and effectiveness of interventions. Moreover, it is imperative to promote policies that address socioeconomic inequalities and enhance access to quality health care services. Collaboration between the government, health organizations, and local communities could help design and implement sustainable solutions that improve DM control and the quality of life of affected populations.

Conclusion

The monitoring of Maya populations in southern Yucatan revealed the current status of DM in this region. Although a slight reduction in HbA_{1c} levels was observed among women and younger individuals in response to treatment, it was not significant ($P>.05$). However, in communities farther from Merida, such as Akil and Huntochac, the reductions were more pronounced, possibly due to less access to processed foods and the preservation of traditional lifestyles. Intensive treatment achieved more significant initial reductions in HbA_{1c} levels, but the Kaplan-Meier analysis revealed that standard treatment was more effective for maintaining long-term glycemic stability with lower variability, indicating superior adherence and overall effectiveness. These findings highlight the need to strengthen primary care for DM patients, with self-care strategies tailored to the cultural and socioeconomic characteristics of these communities. Promotion of a diet based on local foods, healthy practices, and health education in the Maya language and community support could improve glycemic control and reduce associated complications in Maya populations of southern Yucatan. Therefore, it is necessary to develop and implement interventions that include health education in the Maya language, reinforce community support, and respect traditional practices in the management of DM.

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Conflict of Interest

No conflict of interest reported by authors.

Author Contributions

Research concept and design: Vázquez Encalada, Vázquez Gamboa, Segura Campos. Acquisition of data: Vázquez Encalada, Vázquez Gamboa, Segura Campos. Data analysis and interpretation: Martínez Rivera, Uuh Narvaez. Manuscript draft: Uuh Narvaez, Segura Campos. Supervision, Project administration: Segura Campos

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