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Community-Based School for the Control and Remission of Type 2 Diabetes

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Abstract

Recent research suggests that type 2 diabetes mellitus (T2DM) is potentially reversible, positioning non-pharmacological interventions as a central component of clinical treatment. Accordingly, the present study aimed to evaluate the effectiveness of a community-based school as an educational and community intervention strategy to achieve remission or metabolic control in patients with T2DM in a rural setting in Ecuador. A quasi-experimental pretest-posttest study without a control group was conducted with a sample of 24 patients with T2DM from a rural community in Manabí, Ecuador, who participated for 11 months in a community-based school structured around educational sessions and practical activities. Variables such as T2DM remission, metabolic control, and adherence to the program were assessed. Data were analyzed using descriptive and inferential statistics with the support of the Statistics Stats software. At the end of the intervention, 37.5% of participants achieved clinical remission of T2DM without the use of medication, and 58.33% reached metabolic control with treatment. Clinical complications persisted in 25.0% of the cases (95% CI: 12.0%–44.9%). These results suggest that a culturally adapted, comprehensive educational approach can effectively reverse or manage type 2 diabetes and does not depend on the participant's formal educational level to be effective.

Keywords: Diabetes Mellitus Type 2; remission; community health education.

Introduction

Diabetes Mellitus (DM) is a global public health problem, with the incidence of new cases, complications, and deaths increasing each year. In 2021, 537 million adults aged 20 to 79 were living with DM. This figure is projected to reach 643 million by 2030 and 783 million

by 2045. Annually, more than 6.7 million people die from causes related to diabetes, with approximately one death occurring every five seconds. Between 30% and 45% of people with diabetes—around 240 million individuals—remain undiagnosed (International Diabetes Federation, 2021).

Specifically, Type 2 Diabetes Mellitus (T2DM) is considered a metabolic and progressive disease, characterized by persistent hyperglycemia resulting from a combination of peripheral insulin resistance, progressive dysfunction of pancreatic β cells, and alterations in incretin hormone secretion (Novillo et al., 2025).

In recent years, several studies have suggested that T2DM may be potentially reversible, thereby challenging its traditional classification as a chronic disease. This emerging perspective opens the way toward a therapeutic model in which non-pharmacological interventions—such as intensive lifestyle modifications—cease to be merely complementary and instead assume a central role in clinical management. Such an approach requires a reassessment of the underlying pathophysiological mechanisms of the disease, as well as a re-evaluation of current medical recommendations, including prescription criteria for patients with T2DM who may achieve remission (Alvarado et al., 2017; Buse et al., 2009; Leal & Espinoza, 2019).

In general, T2DM does not occur in isolation but is accompanied by other diseases and/or risk factors, such as hypertension, obesity, insomnia, anxiety, depression, and family-related problems. Its natural history begins long before the prediabetes stage; however, diagnosis is often made once the disease is already established, sometimes with the presence of complications affecting multiple organs.

This highlights the importance of health education as a cornerstone in the prevention and treatment of Non-Communicable Chronic Diseases (NCDs), as it enables the organization of educational processes and positively influences the knowledge, practices, and habits of individuals and communities in relation to their health (Hernández-Sarmiento et al., 2020). Nevertheless, not all patients will be able to reverse the disease, as this depends on factors such as the accuracy of the diagnosis, the onset and duration of the disease, the presence of complications, individual patient characteristics, and the level of physician–patient engagement.

The role of health professionals is focused on preventing and controlling chronic diseases. However, prevention is not limited to avoiding disease onset and complications; it also includes offering the possibility of T2DM remission. According to Zavala-Calahorrano & Fernández (2018), in Ecuador, T2DM ranks as the second leading cause of death, surpassed only by ischemic heart disease.

Although the Ecuadorian Ministry of Public Health (MSP) has made progress in diabetes care through screening, treatment, and follow-up programs—such as the establishment of specialized diabetic foot units and the implementation of the HEARTS initiative for the prevention and control of cardiovascular diseases, which also incorporates diabetes and dyslipidemia management—there are no nationally structured programs equivalent to a community-based diabetes school. This model involves an organized, systematic, and

personalized intervention with defined objectives and duration, addressing the patient's medical, social, cultural, family, and spiritual dimensions, alongside continuous educational follow-up.

The objective of this study is to evaluate the effectiveness of a community-based school as an educational and community intervention strategy to achieve remission or metabolic control in patients with type 2 diabetes mellitus in a rural context in Ecuador. Additionally, the study seeks to determine whether a comprehensive approach can overcome the limitations of conventional models centered on pharmacological treatment and contribute to the reduction of chronic complications and to the sustainability of the public health system in vulnerable populations.

Literature Review

At the international level, scientific evidence has consistently demonstrated that intensive lifestyle-based interventions can induce remission of type 2 diabetes mellitus (T2DM), particularly when implemented in the early stages of the disease. The Diabetes Remission Clinical Trial (DiRECT), conducted in the United Kingdom, showed that a structured strategy focused on significant weight loss through caloric restriction and behavioral support achieved T2DM remission in 46% of participants at one year, without the use of glucose-lowering medications—a proportion that remained substantial at two years (Lean et al., 2018; Lean et al., 2019). These findings contributed to redefining T2DM as a condition that is potentially reversible in appropriate clinical and community settings.

Complementarily, studies such as those of the Look AHEAD Research Group (2013) demonstrated that intensive lifestyle interventions based on continuous education, regular physical activity, and dietary habit modification lead to sustained improvements in glycemic control, body weight reduction, and decreased cardiovascular risk factors, even when complete remission is not consistently achieved. Likewise, research conducted in low- and middle-income countries has highlighted the value of culturally adapted, community-based health education programs as effective tools to improve therapeutic adherence, self-care, and metabolic outcomes in individuals with T2DM, regardless of their formal educational level (Hernández-Sarmiento et al., 2020; Pastakia et al., 2017).

In Latin America, multiple experiences have underscored the need for more comprehensive approaches that move beyond the biomedical model centered exclusively on pharmacotherapy. Studies carried out in rural and peri-urban contexts have shown that community diabetes schools—grounded in participatory education, continuous follow-up, and the strengthening of family and community support—contribute significantly to metabolic control and to the reduction of chronic complications (Acosta et al., 2023; Zavala-Calahorrano & Fernández, 2018). In this regard, the present study aligns with existing evidence and provides original data from the Ecuadorian context, where systematic evaluations of structured community-based interventions aimed at remission or comprehensive control of T2DM in rural populations remain scarce.

Research Method

Study Design

This study was conducted using a quasi-experimental pretest–posttest design without a control group, commonly employed in contexts where random assignment of participants is not feasible due to logistical or community-related reasons (Hernández-Sampieri et al., 2014). This design allowed for the evaluation of changes within the same group of subjects before and after the intervention, assuming that the observed variations may be related to the implementation of the program, although without attributing direct causality due to the absence of an external comparison group.

Additionally, the observational–descriptive approach of the study responded to the need to describe behaviors, adherence to interventions, and clinical evolution within community health programs (Hernández-Sampieri et al., 2014). Although the lack of a control group limited causal inference, this limitation was mitigated using multiple measurements and appropriate statistical analyses for intra-group time series, as recommended by Polit & Beck (2014) in the fields of nursing and public health.

The exploratory and pilot nature of the study justified the use of a small sample as a preliminary empirical basis for future, larger-scale research, consistent with the principles of community-based action research (Creswell & Creswell, 2018).

Population and Sample

The study sample consisted of 24 patients diagnosed with type 2 diabetes mellitus (T2DM) who were residents of the parish of Sixto Durán Ballén, located in the canton of 24 de Mayo, Manabí Province, Ecuador. Participants were selected through intentional non-probabilistic sampling, considering the intensive and participatory nature of the intervention.

The inclusion criteria comprised: (1) a confirmed medical diagnosis of T2DM; (2) permanent residence in the specified parish; (3) voluntary willingness and sustained commitment to actively participate in all activities of the community-based school; and (4) absence of severe diabetes-related complications that could limit participation. Patients presenting decompensated conditions or severe comorbidities that impeded active involvement in the program were excluded. The final sample size reflects both the level of commitment required and the comprehensive scope of the intervention.

Baseline characteristics of participants

Prior to the intervention, the following data were collected: sex, age, body mass index (BMI), time since T2DM diagnosis, family history, educational level, current pharmacological treatment, and presence of complications. This information was used to characterize the study population and explore potential associations.

Definition of variables

The study variables were defined as follows: (1) T2DM remission, defined as fasting plasma glucose (FPG) levels < 126 mg/dL in at least two consecutive measurements separated

by a 15-day interval, in the absence of hypoglycemic medication for a minimum period of three months. This definition was based on national clinical practice guidelines and adapted from the international consensus of the American Diabetes Association (2021). (2) Metabolic control, defined as FPG < 130 mg/dL and postprandial glucose < 180 mg/dL, with the use of oral hypoglycemic agents or insulin, and the absence of acute clinical symptoms during the preceding trimester. (3) Uncontrolled T2DM, defined as FPG ≥ 130 mg/dL or postprandial glucose ≥ 180 mg/dL, with or without pharmacological treatment, and/or the presence of persistent clinical symptoms. (4) Program adherence, defined as the percentage of attendance at educational sessions and participation in practical activities (physical exercise, health fairs, and family garden activities), measured through attendance records and direct observation. Adherence was classified as high (participation in 4–5 activities), moderate (2–3 activities), or low (0–1 activity).

Intervention procedure

The community-based school intervention was implemented in three sequential phases. (1) Initial assessment (January 2024): this phase included the review of clinical records, laboratory testing (fasting plasma glucose and postprandial glucose), psychological evaluation, assessment of current treatment, and semi-structured interviews addressing dietary practices and lifestyle habits. (2) Educational and practical intervention (February–November 2024): participants attended biweekly sessions during the first six months, followed by monthly sessions thereafter. The program combined theoretical components—covering nutrition, common myths related to diabetes, spirituality, pharmacological treatment, and specific self-care practices—with guided practical activities such as home gardening, structured physical exercise, and community health fairs. (3) Follow-up assessments (May–November 2024): this phase involved two fasting plasma glucose measurements at each follow-up point, administration of adherence questionnaires, repeated medical and psychological evaluations, and direct observation of participants' environments, including home gardens and dietary habits.

Statistical analysis

Data was initially processed using a Microsoft Excel spreadsheet and subsequently exported to the *Statistics Stats* software for analysis. Descriptive statistics and non-parametric inferential methods were applied, with an emphasis on the analysis of proportions, changes in categorical variables, and associations between relevant factors.

To evaluate pretest–posttest changes, the following analyses were conducted: **(1)** McNemar's test to compare clinical status before and after the intervention ("controlled" versus "uncontrolled"); **(2)** calculation of proportions and 95% confidence intervals (CI) for remission, metabolic control, persistence of complications, and medication-free status; and **(3)** Fisher's exact test to examine the association between educational level and final clinical condition. Study results were presented in tabular form and through bar and pie charts generated using the *Statistics Stats* software.

Results

Table 1 shows that most patients entered the program in a state of metabolic dysregulation (83.33%), despite being under oral pharmacological treatment or insulin therapy. Ninety-one-point sixty-six percent (91.66%) of patients were receiving pharmacological treatment; however, only four were metabolically controlled. No participant met remission criteria at baseline. In addition, six patients already presented clinical complications.

The intervention demonstrated a clear clinical impact, as nine patients (37.5%) achieved complete remission, while fourteen (58.33%) achieved metabolic control while continuing treatment. The number of participants not requiring medication increased from two to nine (a 350% increase). Insulin use increased from two to four patients, but only among those who required therapeutic adjustments to achieve metabolic control. The six patients who presented complications at baseline continued to do so; however, no new complications were reported.

Table 1. Comparison of Baseline and Final Clinical Status of Participants with T2DM

Category	Frequency (n = 24)		Percentage (%)	
	Before	After	Before	After
Medication use				
– None	2	9	8.33%	37.5%
– Oral	20	11	83.33%	45.8%
– Insulin (NPH)	2	4	8.33%	16.7%
Diagnostic status				
– Metabolic control	4	14	16.67%	58.33%
– Uncontrolled	20	1	83.33%	4.17%
– Remission	0	9	0.00%	37.5%
Complications				
– Yes	6	6	25.00%	25.00%
– No	18	18	75.00%	75.00%

Figure 1 examines the relationship between active participation and final clinical status. The analysis shows that participants with high levels of participation achieved remission or metabolic control, reinforcing the notion that greater involvement in program activities is associated with higher clinical success. In the high-participation group, 100% of patients achieved a favorable clinical outcome, with 41.2% reaching remission and the remainder achieving metabolic control; no cases of uncontrolled disease were observed.

In the moderate-participation group, although most participants achieved remission (33.3%) or metabolic control (50.0%), one patient remained clinically uncontrolled. Finally, the low-participation group (a single case) achieved metabolic control; however, the size of this subgroup is too small to establish a meaningful trend.

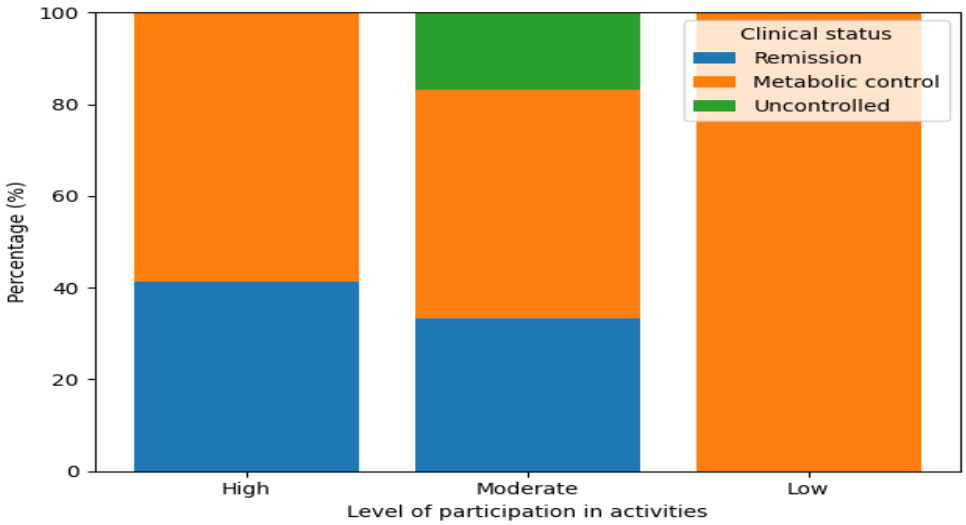

Figure 1. Relationship between participation in activities and final clinical status.

Note: X-axis: level of participation (High, Moderate, Low). Y-axis: percentage of patients according to final clinical status (remission, metabolic control, uncontrolled.

In Table 2, McNemar's test was applied to evaluate the change in clinical control of participants before and after the intervention. At baseline, only 4 of the 24 participants (16.67%) exhibited metabolic control, whereas at the end of the program 23 participants (95.83%) were clinically controlled (remission or pharmacological control). The test showed a statistically significant change in clinical status following the intervention ($b = 19$, $c = 0$; $p < 0.001$), supporting the effectiveness of the community-based school as an intervention strategy for the management of T2DM.

Table 2. McNemar's Test (n = 24)

	Post: Controlled	**Post: Uncontrolled**	**Total**
Pre: Controlled	4	0	4
Pre: Uncontrolled	19	1	20
Total	23	1	24
McNemar's test: p = 0.0000038			

Table 3 shows that, at the end of the program, 37.5% of participants achieved remission of type 2 diabetes mellitus (95% CI: 21.2%–57.3%), and 58.3% achieved metabolic control with pharmacological treatment (95% CI: 38.8%–75.5%). Only 4.2% remained clinically uncontrolled (95% CI: 0.7%–20.2%). In addition, 37.5% of participants discontinued the use of hypoglycemic medication (95% CI: 21.2%–57.3%). Clinical complications persisted in 25.0% of cases (95% CI: 12.0%–44.9%).

Table 3. Proportion Estimates and Confidence Intervals (n = 24)

Category	**Proportion (%)**	**95% CI Lower**	**95% CI Upper**
Remission	37.5%	21.2%	57.3%
Metabolic control (with medication)	58.3%	38.8%	75.5%
Uncontrolled metabolic status	4.2%	0.7%	20.2%
No medication	37.5%	21.2%	57.3%
Complications at follow-up	25.0%	12.0%	44.9%

Note: Proportions correspond to the number of participants presenting each clinical condition at the end of the intervention. The 95% confidence interval (95% CI) indicates the range within which the true population proportion is expected to lie with 95% certainty. Confidence intervals were calculated using the Wilson method, which provides greater accuracy for small samples.

In Table 4, Fisher's exact test was used to assess the association between educational level and remission. The obtained p-value (p = 0.00017) indicates a statistically significant association ($p < 0.05$). This finding reinforces the hypothesis that the community-based school, being culturally and methodologically adapted, does not depend on formal educational level to be effective.

Table 4. Fisher's Exact Test – Educational Level vs Remission (n = 24)

Educational level	**Remission**	**No remission**	**Total**
Low (no formal education)	9	3	12
Medium/High (primary/secondary)	0	12	12
Exact p-value (one-tailed): p = 0.00017			

Discussion

Since its inception, the World Health Organization (1948) has defined health not merely as the absence of disease, but as a state of complete physical, mental, social, and spiritual well-being. Under this holistic premise, the present study demonstrates that an integral approach—such as the one implemented through the community-based school for patients with T2DM—can be an effective tool for metabolic control and for achieving clinical remission in a significant proportion of patients.

The results reveal that 37.5% of participants achieved complete remission without pharmacological treatment, while 58.33% attained metabolic control with medication. These findings are consistent with previous studies such as DiRECT (Lean et al., 2018), which reported remission in 46% of patients following an intensive primary care intervention.

In contrast to traditional medical practice, which rarely considers remission as a therapeutic goal (Captieux et al., 2020), this study provides evidence from a rural community-based context, showing that T2DM is potentially reversible even without surgical intervention or emerging pharmacological agents such as GLP-1 analogues (Novillo et al., 2025; Shiguango et al., 2021). This reversal was achieved through an interdisciplinary educational model that was culturally adapted and sustained over time.

One of the most relevant findings is that the effectiveness of the community-based school did not depend on the participants' formal educational level, as demonstrated by Fisher's exact test ($p = 0.00017$). This result challenges traditional assumptions and aligns with studies such as that of Mateus et al. (2017), which emphasize the importance of language adaptation and culturally sensitive pedagogy in health programs.

The practical strategies implemented—such as family gardens—achieved a participation rate of 95.83% and had a strong impact on dietary habit modification, reinforcing

findings reported by Vinueza et al. (2016) and Jiménez-Corona et al. (2013) regarding the effectiveness of agro-educational environments in promoting healthy food consumption.

The nutritional component was central to the intervention: dietary intake was adjusted to a balanced macronutrient distribution (25% carbohydrates, 25% proteins, and 50% vegetables), with a significant reduction in sugars, refined flours, and sugar-sweetened beverages. This approach is supported by González-Rivas (2018), who reports that medical nutrition therapy can achieve HbA1c reductions of up to 2%.

In addition, the structured physical activity component contributed to weight loss and improved glycemic control. These outcomes are consistent with the positive effects reported in studies such as DiRECT and the work of Hidalgo et al. (2024), which highlight physical activity as a cornerstone in the treatment of T2DM.

Other innovative components included oral health care, diabetic foot management, and eye health, areas often neglected in conventional programs. The community-based school enabled these aspects to be addressed from a preventive perspective, with direct care and active participation, in line with national clinical practice guidelines and studies such as that of Sarabia et al. (2018).

Psychological and spiritual dimensions were also addressed and proved fundamental for sustaining long-term behavioral changes. Daily reading of spiritual texts promoted self-control, therapeutic adherence, and anxiety reduction, facilitating the achievement of therapeutic goals. This innovative dimension responds to the call by Hoyo et al. (2021) to incorporate spirituality into the modern definition of health.

Finally, the community-based school functioned as a space for social support and transformation of deeply rooted cultural myths, such as the belief that insulin causes blindness. Intercultural translation between medical knowledge and local worldview was essential for changing attitudes, increasing adherence, and fostering autonomy in self-care.

Despite the small sample size, the results are consistent with international and Latin American clinical studies, providing concrete evidence that T2DM remission is achievable through comprehensive educational interventions, without the need for high-cost technological or pharmacological resources.

Conclusion

The community-based school for patients with T2DM proved to be an effective and feasible strategy for achieving both remission and metabolic control in the majority of participants, without the need for new pharmacological agents or surgical interventions. The biopsychosocial, cultural, and spiritual approach applied throughout the intervention was a key factor in its therapeutic success. The inclusion of components such as family gardens, practical nutrition education, adapted physical activity, and spiritual strengthening facilitated sustainable lifestyle changes among participants.

Educational level was not a limiting factor for achieving remission, reinforcing the importance of adapting language, educational methodologies, and pedagogical strategies to the patient's sociocultural context. The community-based school model demonstrated strong potential as a replicable strategy, particularly in rural primary health care settings, promoting a person-centered approach that goes beyond disease-centered care.

Declaration of conflicting interest

The authors declare that there is no conflict of interest in this work.

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