

Impact of a RSSDI village adoption program on glycemic control in rural India: a community-based intervention study

Abstract

Background: The burden of type 2 diabetes mellitus (T2DM) is increasing in rural India, where limited access to screening, health education, and continuous care contributes to poor glycemic control. The Research Society for the Study of Diabetes in India (RSSDI) Village Adoption Program was designed as a structured, community-based intervention integrating regular screening, health education, counseling, and glucometer-supported self-monitoring. This pilot study assessed its impact on glycemic control in four rural villages in Uttar Pradesh.

Methods: A retrospective, quasi-experimental community study was conducted in Daniyalpur, Kewadi, Mubarakpur, and Safedabad between 2019 and 2023. Random Blood Sugar (RBS) values recorded during screening camps were analyzed at baseline (2019) and follow-up (2023). Annual means were derived from 12 months of data. Between-year comparisons were performed using Welch's t-test, and effect sizes were calculated using Cohen's d. Within-year (first 6 vs. next 6 months) analyses evaluated short-term intervention effects. Glycemic stability was assessed using coefficient of variation (CV).

Results: Overall mean RBS declined from 165.95 mg/dL (2019; n=201) to 150.10 mg/dL (2023; n=216), a non-significant reduction of 9.55% (p=0.1436). Significant improvements were observed in Mubarakpur (-27.11%, p=0.0030) and Kewadi (-24.85%, p=0.0015), with marked reductions in variability (CV 7.20% and 4.56% in 2023). Safedabad showed modest improvement, while Daniyalpur demonstrated elevated annual mean RBS in 2023 but significant within-year improvement after program resumption. Across villages, significant within-year reductions were observed in both 2019 and 2023.

Conclusion: The RSSDI Village Adoption Program demonstrates that a structured, community-based model can achieve rapid and clinically meaningful improvements in glycemic control in rural settings, with sustained benefits in engaged communities.

Keywords: Type 2 diabetes mellitus, rural health intervention, community-based screening, glycemic control, village adoption program

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Anuj Maheshwari,¹ Narsingh Verma,² Jalees Fatima,³ Ajoy Tewari,¹ Amit Gupta,⁴ Rakesh Parikh,⁵ Sanjay Agarwal,⁶ Sajid Ansari,⁷ Anubha Srivastava,⁸ Shivendra Sinha,⁹ Shubhashree Patil,¹⁰ Nishant Kanodia,¹ Nisha Maheshwari,¹¹ Sabiha Ansari,¹² Abhinav Verma,¹³ Pooja Kanodia,¹⁴ Vineeta Tewari,¹⁵ Shivam Verma,¹⁶ Sunil Gupta,¹⁷ Rajeev Chawla,¹⁸ Banshi Saboo,¹⁹ Aravinda Jagdeesha,²⁰ Singh NK,²¹ Anil Virmani,²² Shivangi Maheshwari,²³ Jay Tewari,² Vijay Vishwanathan²⁴

¹Department of Internal Medicine, Hind Institute of Medical Sciences, India

²Dean, Hind Institute of Medical Sciences, India

³Department of Internal Medicine, Era's Lucknow Medical College, India

⁴Department of Internal Medicine, Centre for Diabetes Care, India

⁵Department of Internal Medicine, Diabetes Clinic, India

⁶Department of Internal Medicine, Aegle Clinic, India

⁷Department of Cardiology, S.S Heart Care Centre, India

⁸Department of Internal Medicine, Moti Lal Nehru Medical College, India

⁹Department of Internal Medicine, Brij Diabetes Centre, India

¹⁰Department of General Medicine, Diabetes and Wellness Clinic, India

¹¹Department of Dermatology & Diabetic foot, Sri Harikamal Diabetes & Heart clinic, India

¹²Department of General Medicine, Primary Health Care Centre, India

¹³Department of Sport, Exercise and Health, University college of London (UCL), UK

¹⁴Department of Ophthalmology, Prasad Institute of Medical Sciences, India

¹⁵Department of Basic Science, Lucknow's Era Medical College, India

¹⁶Department of Physiology, Dr. Ram Manohar Lohia Institute of Medical Sciences, India

¹⁷Department of Internal Medicine, Sunil's Diabetes Care n' Research Centre, Pvt, Ltd, India

¹⁸Department of Internal Medicine, North Delhi Diabetes Centre, India

¹⁹Department of Internal Medicine, Diabetes Care & Hormone Clinic, India

²⁰Department of General Medicine, Dr Aravind's Diabetes Centre, India

²¹Department of General Medicine, Diabetes and Heart Centre, India

²²Department of General Medicine, Dr AK Virmani Clinic, India

²³Department of Pediatrics, IMS & SUM Hospitals, India

²⁴Department of Internal Medicine, M.V. Hospital for Diabetes & President of Prof. M.Viswanathan Diabetes Research Centre, India

Correspondence: Anuj Maheshwari, Department of Internal Medicine, Hind Institute of Medical Sciences, Ataria, Sitapur Uttar Pradesh, India

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Table 1 Activities planned in the villages

Activity	Frequency	Comments
1 Screening camp, open for all. Assessment of sugar, BP and consultation. Sessions on Yoga, diet and healthy lifestyle	Once every 3 months	This was conducted in all 4 villages
2 Distribution of the glucometer and training on self-management	Diagnosed with T2DM	In all villages
3 Monthly camps were conducted by the village coordinator. Assessment of BP, Sugar, and check on progress and adherence to medications	Once a month	Conducted by a dedicated coordinator
4 Medication education	Motivated to take medication	
5 Disbursement of instruments	Screening & follow-up camps	Glucometer, blood pressure (BP) apparatus
6 Disbursement of Consumables	Door-to-door monitoring	Glucose strips, battery
7 Yoga and meditation sessions	During monthly screening camps	To sensitise and teach



Figure 2 Glimpses of activity.

Due to the COVID-19 pandemic, program activities were significantly disrupted during 2020, 2021, and part of 2022. Daniyalpur was the most affected village, where monthly screening and consumable supply were suspended for an extended period. Regular screening and physician visits resumed in late 2022 and continued throughout 2023.

Participants

Inclusion criteria: Participants were adult residents of the four selected villages who participated voluntarily in community screening camps. No specific exclusion criteria was used. All individuals who underwent RBS measurement in the 2019 and 2023 screening drives were included in the respective cross-sectional analyses.

Intervention (Table 1)

Key components of the program included:

- I. **Community-based screening:** Health camps were organised to screen residents for diabetes and hypertension (via BP measurement).
- II. **Health education:** Educational sessions on non-communicable diseases (NCDs), their management, and prevention were provided to the community. Specific activities included yoga and meditation sessions.
- III. **Support for self-management:** The program included the distribution of glucometers and training for patients on their use for self-monitoring of blood glucose.

IV. **Follow-up:** The program aimed to ensure treatment adherence and provide ongoing monitoring through monthly visits by village coordinators

Monitoring of intervention fidelity

The lead doctor who adopted the village (village PI) oversaw all activities and also visited each village at least once every 3 months. All communication material was approved by UP RSSDI. All records of monthly visits by coordinators were reviewed by Village PI at the end of each month. UP RSSDI village adoption committee reviewed the progress every 6 months.

Data collection and variables

Data were extracted retrospectively from program records maintained during screening and follow-up camps. Variables included the village name, year of assessment (2019 or 2023), RBS level and BP level. The number of participants screened (N) was recorded for each village at each time point. To obtain a stable estimate of glycemic control at the community level, the average of 12 months of RBS measurements was used for each year of analysis.

Attrition and treatment of data: In a screening camp methodology it was not possible to track the same individual over time. We have treated the data as a series of cross sectional representative sample drawn from the same population. Efforts were made to maximise attendance through early announcement and engagement with community leaders. We are confident that the sample we have is consistent and reflects the village population

Primary outcomes

The primary outcome of this analysis was the change in mean RBS level (mg/dL) between the baseline assessment in 2019 and the follow-up assessment in 2023. An average value of 12 months of measurements was taken to ensure an accurate representation of the community.

Statistical analysis

Data analysis was performed retrospectively using Python (pandas, numpy, scipy libraries). The following statistical approaches were employed:

- I. **Descriptive Statistics:** Mean, standard deviation (SD), median, range, and coefficient of variation (CV) were calculated to characterise the distribution and variability of RBS levels for each village and year.
- II. **Year-to-Year Comparison (2019 vs 2023):** A Welch's independent-samples t-test was used to compare mean RBS

levels between 2019 and 2023 for each village and overall. Welch’s test was chosen because it does not assume equal variances, which is appropriate given the different levels of variability observed across villages and years. Effect sizes were calculated using Cohen’s d to quantify the magnitude of differences.

III. Intra-Year Analysis (Intervention Impact): To assess the immediate impact of the intervention components within each year, the 12 months of data were divided into two 6-month periods: Months 1-6 (initial period) and Months 7-12 (follow-up period). Welch’s t-test was used to compare mean RBS levels between these periods for each village and year.

IV. Temporal Trend Analysis: Simple linear regression was performed on the monthly mean RBS data for each village and year to identify the direction and statistical significance of trends in glycemic control over the 12-month period. The slope coefficient represents the monthly change in RBS (mg/dL per month), and the R² value indicates the proportion of variance explained by the linear trend.

V. Stability Analysis: The coefficient of variation (CV = SD/Mean × 100) was calculated as a measure of RBS stability. A lower CV indicates more consistent blood sugar levels, which is clinically desirable as it suggests better glycemic control and reduced risk of both hyperglycemic and hypoglycemic episodes.

VI. Clinical Classification: The proportion of months in which mean RBS fell below 126 mg/dL (normal fasting glucose) and 200 mg/dL (acceptable random glucose) was calculated to provide a clinically meaningful context for the findings.

Statistical significance was set at p < 0.05. Effect sizes were interpreted as follows: Cohen’s d of 0.2-0.5 (small), 0.5-0.8 (medium), and >0.8 (large).

Ethics

The study was approved by the Independent Ethics Committee (IEC) of Prof. M. Viswanathan Diabetes Research Centre (IEC/N-002/05/2025; approved on 15 May 2025).

Results

Overall, 201 subjects in 2019 and 216 subjects in 2023 were tracked during the program.

Table 2 Year-to-year comparison of RBS (2019 vs 2023)

Village	n (2019)	n (2023)	Mean 2019 (mg/dL)	SD 2019	Mean 2023 (mg/dL)	SD 2023	Change (mg/dL)	Change (%)	p-value	Cohen's d
Safedabad	60	60	169.15	64.68	154.04	65.22	-15.11	-8.93%	0.4389	-0.2326
Mubarakpur	47	47	176.26	62.31	128.49	58.06	-47.78	-27.11%	0.003	-0.7934
Kewadi	30	39	164.86	53.26	123.88	20.54	-40.97	-24.85%	0.0015	-1.0698
Daniyalpur	64	70	153.51	53.9	194	24.97	40.49	26.38%	0.2266	0.9784
OVERALL	201	216	165.95	46.25	150.1	57.27	-15.84	-9.55%	0.1436	-0.3044

Kewadi: Substantial improvement

Kewadi showed the second-largest improvement, with mean RBS declining from 164.86 mg/dL in 2019 to 123.88 mg/dL in 2023, a reduction of 40.97 mg/dL (-24.85%, t=4.1395, p=0.0015). This change represents a very large effect size (Cohen’s d = -1.07) and is highly statistically significant. The CV improved dramatically from 19.62% to 4.56%, indicating exceptional stability in 2023. Notably,

Year-to-year changes in RBS (2019 vs. 2023)

Overall findings

Across all four villages combined, mean RBS decreased from 165.95 mg/dL in 2019 to 150.10 mg/dL in 2023, representing a reduction of 15.84 mg/dL (-9.55%). However, this overall change was not statistically significant (t=1.4755, p=0.1436), indicating that, when villages are pooled, heterogeneous responses mask the program’s true effectiveness within individual villages. (Figure 3)

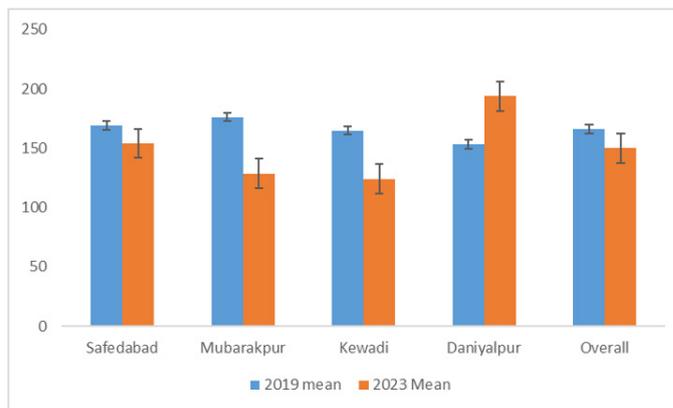


Figure 3 Mean RBS levels for all villages (2019 & 2023).

Village-specific outcomes

Mubarakpur: Marked success

Mubarakpur demonstrated the most impressive improvement among the four villages. Mean RBS decreased from 176.26 mg/dL in 2019 to 128.49 mg/dL in 2023, a reduction of 47.78 mg/dL (-27.11%, t=3.7027, p=0.0030). This change represents a large effect size (Cohen’s d = -0.79) and is highly statistically significant. The improvement was accompanied by a significant reduction in variability: the CV decreased from 23.71% to 7.20%, indicating that not only did average blood sugar improve, but it also became remarkably stable and predictable. In 2023, all 12 months had a mean RBS below 200 mg/dL, and 4 months fell below the 126 mg/dL threshold. (Table 2)

8 of 12 months in 2023 had a mean RBS below the normal threshold of 126 mg/dL, suggesting that the majority of the screened population achieved normal blood sugar levels. (Table 2)

Safedabad: Modest non-significant improvement

Safedabad showed a decrease in mean RBS from 169.15 mg/dL in 2019 to 154.04 mg/dL in 2023, a reduction of 15.11 mg/dL (-8.93%). However, this change was not statistically significant (t = 0.7939,

$p = 0.4389$), with a small effect size (Cohen’s $d = -0.23$). The CV decreased from 33.55% to 17.94%, suggesting improved stability. The village maintained 10-11 months per year with RBS below 200 mg/dL, indicating generally acceptable control but without the dramatic gains seen in Mubarakpur and Kewadi. (Table 2)

Daniyalpur: Paradoxical worsening with intra-year improvement

Daniyalpur presented a complex pattern. Mean RBS increased from 153.51 mg/dL in 2019 to 194.00 mg/dL in 2023, an increase of 40.49 mg/dL (+26.38%). This change was not statistically significant ($t = -1.2570$, $p = 0.2266$), but the large effect size (Cohen’s $d = 0.98$) suggests a clinically meaningful worsening. The CV increased substantially from 31.06% to 49.28%, indicating highly unstable blood sugar levels in 2023. However, the village maintained 8-9 months per year with RBS below 200 mg/dL. (Table 2)

Immediate impact of intervention: within-year analysis

A critical finding of this analysis is the demonstration of significant improvements in RBS levels within a single year, suggesting that the intervention components (education, screening, counselling, glucometer provision) produce measurable effects relatively quickly.

2019 Data: strong intervention impact

In 2019, all four villages showed improvements in the second half of the year compared to the first half, with the overall effect being highly significant ($t = 4.6434$, $p < 0.001$, Cohen’s $d = -1.37$). Mean RBS across all villages decreased from 192.07 mg/dL in Months 1-6 to 139.82 mg/dL in Months 7-12, a reduction of 52.26 mg/dL (-27.21%). (Figure 4)

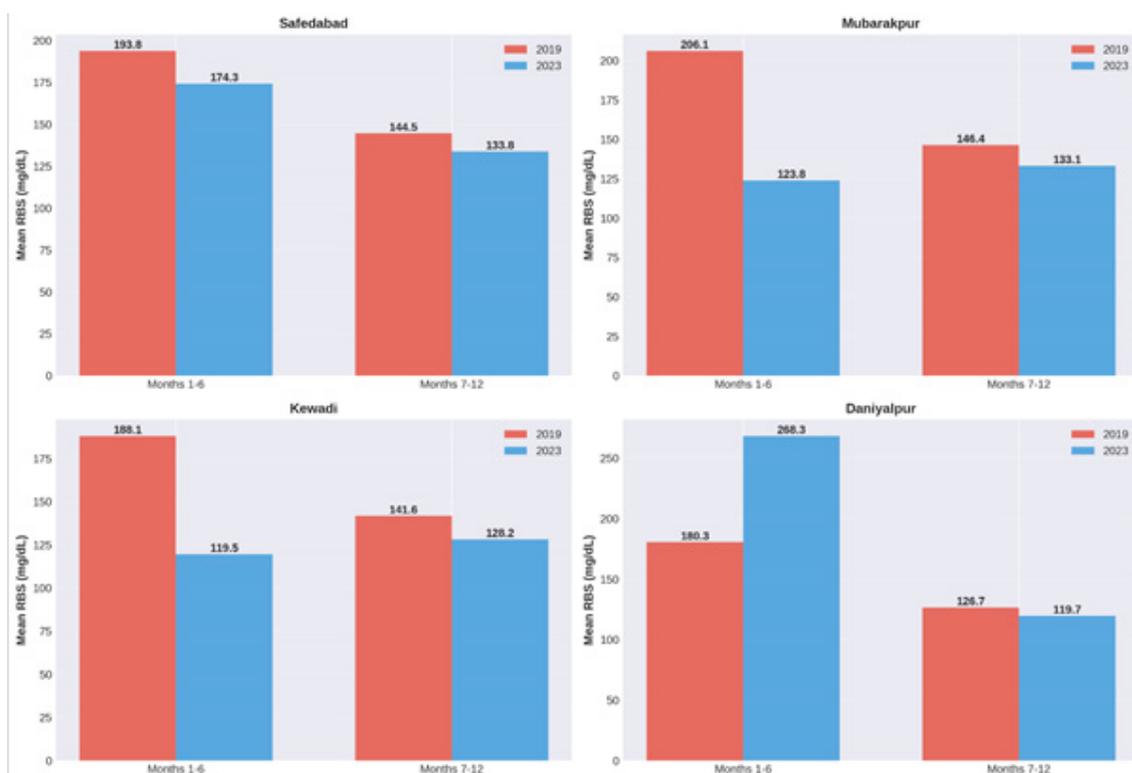


Figure 4 Intervention impact: First 6 months vs. Next 6 months.

At the village level:

- I. Mubarakpur showed a significant improvement of 59.64 mg/dL (-28.94%, $p=0.0191$), with a large effect size (Cohen’s $d = -0.96$).
- II. Kewadi showed a significant improvement of 46.47 mg/dL (-24.71%, $p=0.0091$), with a large effect size (Cohen’s $d = -0.87$).
- III. Safedabad showed a non-significant improvement of 49.25 mg/dL (-25.42%, $p=0.1780$), though the effect size was large (Cohen’s $d = -0.76$).
- IV. Daniyalpur showed a non-significant improvement of 53.67 mg/dL (-29.76%, $p=0.0826$), with a large effect size (Cohen’s $d = -1.00$).

2023 Data: Sustained intervention impact

In 2023, the overall improvement from the first to the second half of the year remained significant ($t=2.7308$, $p=0.0116$, Cohen’s $d = -0.81$), though the magnitude was somewhat smaller than in 2019. Mean RBS decreased from 171.49 mg/dL in Months 1-6 to 128.71 mg/dL in Months 7-12, a reduction of 42.78 mg/dL (-24.94%). (Figure 4)

At the village level:

- I. Safedabad showed a significant improvement of 40.44 mg/dL (-23.20%, $p=0.0071$), with a very large effect size (Cohen’s $d = -2.15$).
- II. Daniyalpur showed a significant improvement of 148.67 mg/dL (-55.41%, $p=0.0113$), with a very large effect size (Cohen’s $d = -2.47$). This dramatic improvement suggests that the initial high

RBS values in Months 1-6 (mean 268.34 mg/dL) responded dramatically to the intervention.

III. Mubarakpur showed a non-significant increase of 9.28 mg/dL (+7.49%, $p=0.1057$), suggesting that the village had already achieved good control by the first half of the year and did not show further improvement.

IV. Kewadi showed a non-significant increase of 8.73 mg/dL (+7.30%, $p=0.0033$), similarly suggesting that good control had already been achieved early in the year.

The monthly trends in RBS across the 4 villages is given in Figure 5.

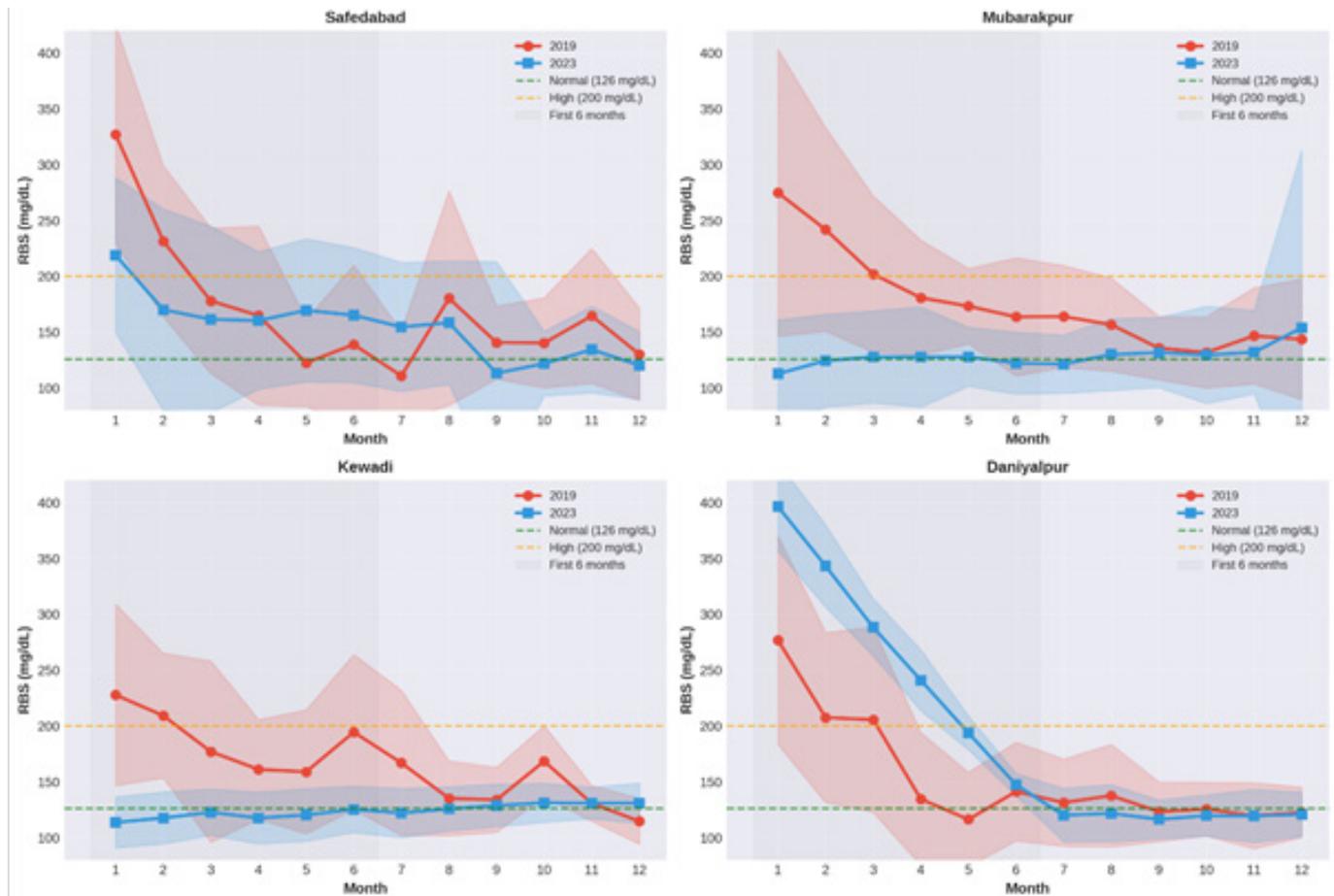


Figure 5 Monthly trends in mean random blood sugar (RBS) levels across four adopted villages in 2019 and 2023.

Stability analysis (coefficient of variation)

The CV provides a measure of RBS level consistency, with lower values indicating more stable control. Mubarakpur achieved the most dramatic improvement in stability, with CV decreasing from 23.71% in 2019 to 7.20% in 2023. This remarkable reduction indicates that not only did average blood glucose improve, but the variation around that average also decreased substantially, suggesting more consistent and predictable glycemic control. Kewadi similarly achieved excellent stability in 2023 (CV = 4.56%), the lowest among all villages, down

from 19.62% in 2019. The extremely low CV in 2023 indicates that the village achieved remarkably consistent blood sugar levels throughout the year. Safedabad improved its stability from 33.55% to 17.94%, indicating a meaningful improvement in consistency, though not to the level achieved by Mubarakpur and Kewadi. Daniyalpur experienced increased variability, with the CV rising from 31.06% to 49.28%. This high variability in 2023, despite the large intra-year improvement, reflects the extreme initial values (up to 396 mg/dL) that improved dramatically but left the village with highly unstable control. (Table 3)

Table 3 Village-specific trends and stability

Village	Year	n	Mean (mg/dL)	Median (mg/dL)	SD	CV (%)	Months <126 mg/dL (out of 12)	Months <200 mg/dL (out of 12)
Safedabad	2019	60	169.15	152.62	56.74	33.55	2	10
Safedabad	2023	60	154.04	159.4	27.63	17.94	3	11
Mubarakpur	2019	47	176.26	163.85	41.78	23.71	0	9
Mubarakpur	2023	47	128.49	127.87	9.25	7.2	4	12
Kewadi	2019	30	164.86	164.02	32.34	19.62	1	10
Kewadi	2023	39	123.88	124.01	5.65	4.56	8	12
Daniyalpur	2019	64	153.51	132.97	47.68	31.06	5	9
Daniyalpur	2023	70	194	134.56	95.6	49.28	6	8

Discussion

The data from this study provide compelling evidence for the effectiveness of the rural village diabetes intervention program, with important nuances regarding village-specific responses and the impact of the COVID-19 interruption.

Strong evidence of efficacy

The most striking finding is the consistent demonstration of significant within-year improvements across all villages in both 2019 and 2023. In 2019, the overall reduction of 52.26 mg/dL (-27.21%, $p < 0.001$) over six months, and in 2023, the reduction of 42.78 mg/dL (-24.94%, $p = 0.0116$), provide robust evidence that the intervention components—health education, monthly screening, personalized counselling, and glucometer provision, are effective in producing measurable improvements in glycemc control. These rapid gains mirror those of community health worker (CHW)-led trials in rural India, such as the Tamil Nadu lifestyle intervention, which achieved 20-30% risk reductions over 7 months through similar education and monitoring.¹⁰ The consistency of this pattern across multiple villages and two time periods suggests that these improvements are not due to chance or confounding factors, but rather reflect the genuine impact of the intervention. The large effect sizes (Cohen’s d ranging from -0.81 to -2.47) indicate that these are not merely statistically significant but also clinically meaningful changes.

Mubarakpur and Kewadi: sustained success

These two villages demonstrated sustained improvements from 2019 to 2023, with reductions of 27% and 25%, respectively. The achievement of very low CV (7.20% and 4.56%) indicates that these villages not only improved their average blood sugar but also achieved remarkable consistency in control. This suggests that the behavioural and lifestyle changes promoted by the intervention became embedded in the communities and were maintained despite the COVID-19 interruption -akin to long-term rural programs with glucometer training showing durable HbA1c stability.¹¹ The fact that Mubarakpur and Kewadi showed slight upward trends in 2023 (despite low absolute values) suggests that they had achieved a stable, well-controlled baseline by early in the year and maintained this throughout. This pattern is consistent with successful long-term behaviour change.

Safedabad: Modest improvement

Safedabad showed a non-significant 9% improvement, suggesting that while the intervention had some positive effect, it was not as pronounced as in Mubarakpur and Kewadi. The improvement in stability (CV from 33.55% to 17.94%) suggests that some behavioural

change did occur, but the magnitude of improvement in absolute RBS levels was limited.

Daniyalpur: Paradoxical pattern

Daniyalpur presents the most complex picture. The village showed a concerning overall increase in mean RBS from 2019 to 2023, despite demonstrating dramatic within-year improvements. This paradox can be explained by examining the 2023 data more closely: the extremely high initial values in Months 1-6 (mean 268.34 mg/dL) improved dramatically to 119.66 mg/dL in Months 7-12, but the annual average (194.00 mg/dL) remained elevated compared to 2019 (153.51 mg/dL).

This pattern suggests several possible explanations:

New Cases or Worsening in Baseline Population: The village may have experienced an influx of individuals with newly diagnosed or poorly controlled diabetes, or the baseline population may have experienced worsening glycemc control during the COVID-19 gap.¹²

Reduced Program Adherence: The COVID-19 interruption may have disrupted the community’s engagement with the program, leading to loss of the behavioural changes achieved in 2019.¹³

The dramatic within-year improvement suggests that the intervention is effective when implemented, but the elevated baseline in early 2023 indicates that the gains from 2019 were not sustained.¹¹

The observed within-year RBS reductions (e.g., 52 mg/dL in 2019) align with RSSDI’s broader village adoption initiatives, where similar screening, education, and glucometer distribution in Barabanki villages (matching this study’s sites) improved diabetes control, as noted by government launches praising RSSDI UP efforts. Community-based interventions like this pilot mirror a Tamil Nadu study showing significant risk reduction via lifestyle education over 7 months, supporting rapid glycemc improvements in resource-poor rural settings.⁹

The fact that Mubarakpur and Kewadi maintained substantial improvements despite the program interruption suggests that the intervention produced durable behaviour changes. The individuals in these villages likely internalised the health education messages, continued to use the glucometers for self-monitoring, and maintained the dietary and physical activity modifications promoted by the program. However, the case of Daniyalpur suggests that without continued reinforcement, some communities may lose the behavioural gains achieved during active program implementation. The elevated baseline in early 2023 in Daniyalpur indicates that the village did not maintain the improvements from 2019 during the COVID-19 gap.

The significant within-year improvements observed in 2023 suggest that communities retained some memory of the intervention

and responded quickly when the program resumed. This is particularly evident in Daniyalpur, where the dramatic improvement in Months 7-12 indicates that the intervention components were still effective in producing behaviour change.

Mechanisms of intervention effectiveness

Education and awareness: The consistent within-year improvements suggest that health education messages about diet, physical activity, and diabetes management are effective in promoting behaviour change. The fact that improvements occur within 6 months indicates that these messages can be internalised and acted upon relatively quickly.¹⁰

Regular screening and monitoring: Monthly screening provides regular feedback on blood sugar levels and creates accountability. Providing glucometers for self-monitoring likely enhances this effect by enabling individuals to see the immediate consequences of their dietary and activity choices on their blood sugar levels.^{14,15}

Personalised counselling: The one-on-one counselling sessions likely provide tailored advice that is more effective than generic health education. Counselling can address individual barriers to behaviour change, provide emotional support, and help individuals develop personalised strategies for managing their diabetes.

Community engagement: The fact that improvements are consistent across multiple villages suggests that the intervention is effective in engaging communities and promoting collective behaviour change.^{9,16}

The differential responses across villages suggest that local factors, such as community readiness and engagement (Mubarakpur and Kewadi may have had higher baseline engagement with the intervention, leading to better uptake of the health education and counselling messages), local health infrastructure, socioeconomic factors, and population characteristics, influence the intervention's effectiveness. Possible factors include:

Clinical significance

From a clinical perspective, the improvements observed in Mubarakpur and Kewadi are highly significant. Mean RBS levels in the 120-130 mg/dL range, with very low variability, suggest that these villages have achieved good glycemic control at the population level. The fact that 8 of 12 months in Kewadi had a mean RBS below 126 mg/dL (normal glucose threshold) indicates that the majority of the screened population achieved normal blood sugar levels. These improvements are expected to reduce the risk of diabetes complications, including retinopathy, nephropathy, neuropathy, and cardiovascular disease, with consequent improvements in quality of life and life expectancy. However, the case of Daniyalpur serves as a cautionary note. The elevated baseline in 2023 and the high variability in blood sugar levels indicate that this village has not achieved the same level of control as Mubarakpur and Kewadi and may be at higher risk for complications.

Challenges, limitations and areas for improvement

Outcomes varied substantially across villages, suggesting that a one-size-fits-all approach may be inadequate, as Safedabad and Daniyalpur showed weaker improvements than Mubarakpur and Kewadi. In Daniyalpur, the elevated 2023 baseline despite prior gains suggests that intervention effects were not sustained during the COVID-19 interruption, highlighting concerns about long-term durability and the need for strategies to maintain engagement during program gaps. The absence of data on intervention fidelity

and individual adherence limits understanding of differential village responses, while reliance on aggregated village-level data restricts identification of individual predictors of benefit. Additionally, the impact of COVID-19 was inferred rather than directly assessed, as no longitudinal data were available for 2020-2022, limiting deeper insights into the effects of program disruption.

Comparison with other community-based interventions

The findings of this study are consistent with a growing body of literature demonstrating the effectiveness of community-based interventions for diabetes management in low- and middle-income countries (LMICs). A systematic review by Lutfian et al. (2025) found that community-based interventions (CBIs) are an effective strategy for reducing HbA1c levels among patients with T2DM in developing countries.¹⁷ Similarly, a review by Gyawali et al. (2019) concluded that a community-based approach can be effective in the prevention and control of Type 2 diabetes in LMICs.¹⁸

Our program shares core components with other successful interventions, such as the use of community health workers (or village coordinators in our case) for education and follow-up.¹⁹ The integration of health education, screening, and linkage to care is a widely recognized best practice.¹⁶ A large-scale program in China also demonstrated the feasibility of a comprehensive community-based intervention, achieving significant improvements in blood pressure and glucose control.²⁰

However, our study also adds to the literature by highlighting the significant challenge of program heterogeneity and the impact of external shocks like the COVID-19 pandemic. While many studies report positive overall effects, the village-specific differences we observed underscore the importance of context. Furthermore, the use of peer support and mobile health (mHealth) are emerging as powerful tools to enhance engagement and sustainability in other programs and these could be valuable additions to the RSSDI model in the future.^{21,22}

Challenges to implementation quality, scalability, and sustainability

Several challenges must be addressed to improve the implementation quality, scalability, and long-term sustainability of the RSSDI Village Adoption Program.

- I. **Implementation quality & fidelity:** The heterogeneity in outcomes suggests potential variations in the fidelity of intervention delivery. Without standardized checklists, process metrics, or periodic audits, it is difficult to ascertain whether all coordinators delivered the intervention with the same intensity and quality. This lack of fidelity monitoring is a key limitation and a critical area for improvement.
- II. **Attrition:** While this study analyzed cross-sectional data, the underlying programmatic effort is longitudinal. The reasons for participants not attending follow-up camps were not systematically tracked, making it difficult to assess or mitigate attrition bias. Future iterations must incorporate strategies to track and engage participants to minimize dropout.
- III. **Scalability:** Scaling up the program will require a move from a convenience-based selection of villages to a more systematic approach. It will also require a robust and scalable training system for village coordinators and a sustainable supply chain for consumables like glucometer strips.

IV. **Long-term sustainability:** The program's current reliance on the goodwill of RSSDI members and potential ad-hoc funding is a major threat to its long-term sustainability. A clear plan for integration with the public health system and diversification of funding sources is needed. Empowering local communities to take ownership of the program is the ultimate goal for sustainability.

Key insights for program improvement

Village-specific tailoring

- I. Conduct comprehensive baseline assessments to identify local barriers, health literacy, and available resources.
- II. Engage communities through participatory planning to ensure cultural relevance and ownership.
- III. Use adaptive implementation with regular monitoring and village-specific modifications.

Sustainability and maintenance:

- I. Introduce periodic booster sessions to reinforce behaviour change.
- II. Strengthen community health worker engagement for ongoing support.
- III. Establish peer support groups to sustain motivation and shared learning.
- IV. Develop contingency plans to maintain continuity during emergencies.

Intensive support for underperforming villages

- I. Provide enhanced and more frequent counselling focused on individual barriers.
- II. Ensure appropriate medication review, access, and affordability.
- III. Offer structured dietary guidance and community-based nutrition support.
- IV. Implement culturally appropriate, community-level physical activity programs.

Monitoring and evaluation

Collect individual-level data for more detailed outcome analysis.

- I. Monitor intervention fidelity, adherence, and community engagement.
- II. Incorporate qualitative research to explore barriers and facilitators.
- III. Include comparison villages, where feasible, for more rigorous evaluation.

Conclusion

This evaluation of the rural diabetes intervention program in Uttar Pradesh demonstrates that a community-based model integrating health education, regular screening, personalized counseling, and glucometer-supported self-monitoring can achieve significant improvements in glycemic control within a short timeframe. Sustained gains in Mubarakpur and Kewadi despite COVID-19 disruptions indicate durable behavior change, while the relapse observed in Daniyalpur underscores the need for continued reinforcement to

maintain benefits. Variations across villages highlight the importance of culturally tailored, context-specific strategies and intensified support for underperforming areas. Overall, the findings provide a strong foundation for strengthening, sustaining, and scaling this initiative. The RSSDI UP Chapter deserves commendation for implementing and sustaining this impactful program despite pandemic-related challenges.

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Conflicts of interest

None.

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