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Impact of Collaborative Education and Continuous Feedback on Diabetes-Related Behaviors in Elderly Patients with Type 2 Diabetes

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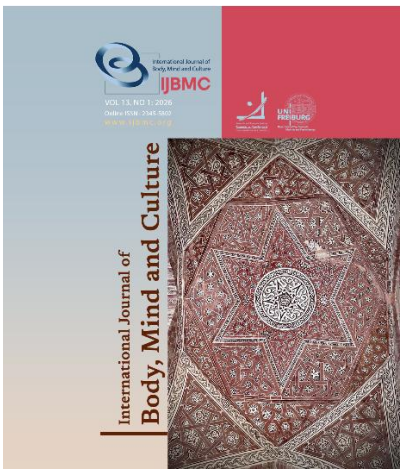

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ABSTRACT

Objective: This study assessed the effect of collaborative education combined with continuous feedback on diabetes-related behaviors, clinical indicators, and quality of life in elderly individuals with type 2 diabetes.

Methods and Materials: In this applied, semi-experimental study, a pretest–posttest design with a control group was used. Elderly adults (≥60 years) with type 2 diabetes were recruited from health centers. The intervention group attended collaborative group education sessions, while the control group received routine education. Regular individualized and group feedback was provided only to the intervention group. Data were collected using questionnaires on diabetes self-care, treatment adherence, and quality of life, along with clinical indicators (HbA1c, blood pressure, body mass index). Data were analyzed with descriptive and inferential statistics to compare changes within and between groups.

Findings: Compared with the control group, participants in the collaborative education plus feedback program showed significant improvements in self-care behaviors, treatment adherence, and quality of life. HbA1c levels and, in some cases, blood pressure and body mass index improved in the intervention group, indicating better metabolic control. Participants also reported greater motivation, self-confidence, social engagement, and a stronger sense of control over their illness.

Conclusion: Collaborative education combined with continuous feedback is an effective, human-centered strategy for modifying diabetes-related behaviors and improving clinical and psychosocial outcomes in elderly individuals. Integrating this model into routine diabetes care for older adults may support sustainable health-promoting behaviors and better overall well-being.

Keywords: Collaborative education, continuous feedback, self-care behaviors, type 2 diabetes, elderly, health education.

Introduction

Type 2 diabetes mellitus (T2DM) is one of the most important non-communicable diseases worldwide and remains a major threat to health systems, particularly in aging societies. According to the 11th edition of the International Diabetes Federation (IDF) Diabetes Atlas, about 589 million adults aged 20–79 years were living with diabetes in 2024, corresponding to roughly 11% of the global adult population, and this number is projected to reach approximately 853 million by 2050, with the vast majority of cases being T2DM (International Diabetes Federation [IDF], 2025). Older adults with diabetes have higher rates of comorbidity, polypharmacy, geriatric syndromes, and functional limitations, which complicate self-management and increase the risk of poor clinical and psychosocial outcomes (American Diabetes Association Professional Practice Committee, 2025).

Effective management of T2DM in older adults requires not only pharmacological treatment but also structured self-management education and ongoing support. The ADA Standards of Care emphasize that diabetes care for older adults must be individualized, taking into account cognitive status, functional capacity, social support, and life expectancy, while still prioritizing the prevention of symptomatic hyperglycemia and acute complications (ADA PPC, 2025). However, many older adults have limited health literacy, difficulty processing complex information, and face logistical barriers such as transportation problems or fragmented care, which reduce their ability to adhere to lifestyle recommendations and long-term treatment plans, particularly in low- and middle-income settings.

Diabetes self-management education and support (DSMES) programs have consistently been shown to improve glycemic control and self-care behaviors in adults with T2DM. Systematic reviews indicate that DSMES is associated with clinically meaningful reductions in HbA1c, especially when programs are multimodal, interactive, and delivered over sufficient contact time by multidisciplinary teams (Chrvala et al., 2016). In older adults specifically, self-management programmes yield modest but significant improvements in glycemic control, cardiovascular risk factors, and patient-reported outcomes such as self-efficacy and diabetes knowledge (Sherifali et al., 2015). More recent evidence focused on older adults highlights that diabetes self-management programmes can produce small but clinically meaningful improvements in HbA1c, patient-reported outcomes, and other clinical indicators, and that specific strategies—such as structured feedback—may enhance these effects (Alliston et al., 2024). In parallel, DSMES and DSMES-like interventions in low- and middle-income regions have demonstrated moderate effectiveness in improving glycemic control when integrated into routine care (Yimer et al., 2025).

Beyond traditional didactic education, there is growing recognition that collaborative, interactive learning and continuity-of-care strategies are particularly important for older adults with T2DM. Collaborative or team-based education emphasizes active patient participation, peer interaction, and partnership with multidisciplinary health professionals, which may enhance motivation, self-efficacy, and problem-solving skills needed for sustained behavior change (Chrvala et al., 2016; Sherifali et al., 2015). At the same time, continuity-of-care strategies—such as regular follow-up contacts, telephone or digital coaching, and structured feedback—have been shown to improve medication adherence, self-management, glycemic control, and quality of life among older adults with diabetes, particularly in Asian countries (Sari et al., 2025). Recent protocols, such as the Digital, Individualized, and Collaborative Treatment of Type 2 Diabetes in General Practice Based on Decision Aid (DICTA), further highlight the potential of combining patient-centred, collaborative approaches with continuous feedback and decision-support tools to optimize outcomes (Kristoffersen et al., 2025).

Despite this emerging evidence, there is still limited research on interventions that explicitly integrate collaborative education with systematic, continuous feedback for older adults with T2DM, especially in low- and middle-income or culturally specific contexts. Many existing programmes are short-term, provide limited follow-up, or are not tailored to the cognitive, social, and functional needs of elderly individuals, which may limit their effectiveness and sustainability (Alliston et al., 2024; Sari et al., 2025). Given the growing burden of T2DM among older adults and the need for context-appropriate, human-centred interventions, it is essential to evaluate educational models that combine collaborative learning with ongoing feedback within routine care settings. The present semi-experimental

study was therefore designed to examine the effects of a collaborative education programme accompanied by regular, individualized feedback on diabetes-related behaviours, clinical indicators, and quality of life in elderly patients with type 2 diabetes, compared with routine education.

Methods and Materials

Study design

This study used an applied, semi-experimental design with a pretest–posttest control group. The primary aim was to evaluate the effects of a collaborative education program combined with continuous feedback on diabetes-related behaviors, clinical indicators, and quality of life in elderly patients with type 2 diabetes.

Participants

Participants were elderly individuals with type 2 diabetes who were receiving routine care at primary health-care centers. Eligible participants were aged 60 years or older, had a confirmed diagnosis of type 2 diabetes for at least one year, were able to communicate and participate in group sessions, and consented to take part in the study. Exclusion criteria included severe cognitive impairment, acute medical conditions requiring hospitalization, and participation in another structured diabetes education program during the study period. Participants who completed both baseline and follow-up assessments were included in the final analysis.

Sampling and group allocation

Sampling was conducted using purposive sampling based on the above inclusion and exclusion criteria. After baseline assessment, participants were allocated to either the intervention (collaborative education + continuous feedback) group or the control (routine education) group. Efforts were made to keep the groups comparable in terms of age, sex, and duration of diabetes.

Intervention

The intervention group received a collaborative education program delivered in small group sessions. Educational content focused on essential aspects of diabetes self-management, including healthy eating, physical activity, blood glucose monitoring, medication adherence, foot care, recognition and management of hypo- and hyperglycemia, stress management, and problem-solving in daily life. Sessions were designed to be interactive and learner-centered, encouraging discussion, experience sharing, peer support, and joint goal-setting between participants and the educator.

In addition to the group sessions, participants in the intervention group received continuous feedback throughout the study period. Feedback was provided through brief face-to-face contacts or scheduled telephone calls, during which the educator reviewed participants' self-care practices, clarified misunderstandings, reinforced key messages, and helped them adjust goals and action plans. Feedback was individualized, supportive, and solution-focused, aiming to maintain motivation and strengthen self-efficacy.

The control group continued to receive routine care and standard educational advice provided by health-care staff, without the structured collaborative education sessions or the systematic feedback component.

Instruments

Data were collected using a structured questionnaire and clinical assessments. The questionnaire included sections on sociodemographic and clinical characteristics (e.g., age, sex, duration of diabetes, comorbidities) as well as standardized scales assessing diabetes self-care behaviors, treatment adherence, and quality of life. Clinical indicators were extracted from medical records or measured by trained staff and included at least glycated hemoglobin (HbA1c) and basic anthropometric or cardiovascular measures (e.g., body mass index, blood pressure), as available in the health-care centers.

Procedure

At baseline (pretest), all participants in both groups completed the questionnaires and underwent clinical assessment. The intervention group then participated in the collaborative education sessions over a defined period, while receiving continuous feedback as described above. After completion of the program, follow-up (posttest) data were collected from both groups using the same questionnaires and clinical measures. The timing of the follow-up was kept the same for the intervention and control groups to allow valid comparison.

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Analysis

Data were analyzed using descriptive statistics (mean, standard deviation, frequency, and percentage) to summarize participants' characteristics and study variables. Baseline equivalence of the two groups was checked using independent t-tests for continuous variables and chi-square tests for categorical variables. Within-group changes from pretest to posttest were examined using paired t-tests, and between-group differences in posttest outcomes were analyzed using independent t-tests or analysis of covariance (ANCOVA) controlling for baseline scores, as appropriate. A significance level of $p < 0.05$ was considered statistically meaningful.

Ethical considerations

The study protocol was reviewed and approved by the relevant institutional ethics committee. All participants were informed about the study objectives, procedures, potential benefits and risks, and their right to withdraw at any time without affecting their routine care. Written informed consent was obtained from all participants, and confidentiality and anonymity of the collected data were strictly maintained.

Findings and Results

A total of 80 elderly individuals with type 2 diabetes completed the study, including 40 participants in the intervention (collaborative education + continuous feedback) group and 40 in the control (routine education) group. No significant differences were observed between the two groups at baseline with respect to sociodemographic or clinical characteristics (all $p > .05$). The mean age of the total sample was 68.3 ± 5.1 years, and 56.3% of participants were female. The mean duration of diabetes was approximately 11 years in both groups. Baseline HbA1c, systolic blood pressure, and body mass index (BMI) were comparable between groups (Table 1).

Table 1

Baseline sociodemographic and clinical characteristics of participants

Variable	Intervention (n = 40) Mean ± SD / n (%)	Control (n = 40) Mean ± SD / n (%)	p-value
Age (years)	68.1 ± 5.3	68.4 ± 5.0	0.78
Female sex	23 (57.5%)	22 (55.0%)	0.82
Duration of diabetes (years)	11.2 ± 6.1	11.0 ± 5.8	0.89
Education ≤ primary	26 (65.0%)	25 (62.5%)	0.82
HbA1c (%)	8.39 ± 0.78	8.34 ± 0.81	0.72
Systolic blood pressure (mmHg)	137.5 ± 14.2	138.9 ± 13.7	0.68
BMI (kg/m^2)	29.1 ± 3.6	29.4 ± 3.8	0.74

After the intervention, the collaborative education plus continuous feedback group showed substantial improvements in diabetes-related behaviors compared with both baseline and the control group. In the intervention group, the mean self-care behavior score increased from 56.3 ± 11.5 at pretest to 74.8 ± 10.2 at posttest (mean change +18.5, $p < .001$), whereas the control group showed a small, non-significant increase from 55.9 ± 12.0 to 58.1 ± 11.8 (mean change +2.2, $p = .14$). Posttest self-care scores were significantly higher in the intervention group than in the control group ($p < .001$).

Treatment adherence scores also improved significantly in the intervention group (from 11.2 ± 3.1 to 15.6 ± 2.7; mean change +4.4, $p < .001$), compared with a modest, non-significant change in the control group (from 11.0 ± 3.0 to 11.7 ± 3.2; mean change +0.7, $p = .21$). Between-group differences at posttest favored the intervention group ($p < .001$).

Similarly, diabetes-related quality of life increased from 51.8 ± 13.6 to 66.9 ± 12.7 in the intervention group (mean change +15.1, $p < .001$), while the control group showed only a slight change (52.1 ± 13.2 to 54.0 ± 13.1; mean change +1.9, $p = .19$). After adjusting for baseline scores, posttest quality-of-life scores remained significantly higher in the intervention group ($p < .001$) (Table 2).

Table 2

Comparison of behavioral outcomes between intervention and control groups

Outcome	Group	Pretest Mean ± SD	Posttest Mean ± SD	Mean change	p (within-group)	p (between-group at posttest*)
Self-care behaviors	Intervention	56.3 ± 11.5	74.8 ± 10.2	+18.5	< 0.001	< 0.001
	Control	55.9 ± 12.0	58.1 ± 11.8	+2.2	0.14	
Treatment adherence	Intervention	11.2 ± 3.1	15.6 ± 2.7	+4.4	< 0.001	< 0.001
	Control	11.0 ± 3.0	11.7 ± 3.2	+0.7	0.21	
Quality of life (total)	Intervention	51.8 ± 13.6	66.9 ± 12.7	+15.1	< 0.001	< 0.001
	Control	52.1 ± 13.2	54.0 ± 13.1	+1.9	0.19	

*Independent t-test or ANCOVA adjusted for baseline scores.

The intervention also produced clinically relevant improvements in metabolic control. Mean HbA1c decreased from 8.39 ± 0.78% at baseline to 7.62 ± 0.73% at follow-up in the intervention group (mean change −0.77, p < .001). In contrast, the control group showed only a small, non-significant reduction in HbA1c (from 8.34 ± 0.81% to 8.23 ± 0.79%; mean change −0.11, p = .18). Between-group comparison at posttest indicated significantly lower HbA1c levels in the intervention group (p < .001).

Systolic blood pressure decreased modestly but significantly in the intervention group (from 137.5 ± 14.2 to 132.1 ± 13.6 mmHg; mean change −5.4, p = .02), while a slight, non-significant increase was observed in the control group (from 138.9 ± 13.7 to 139.5 ± 14.1 mmHg; mean change +0.6, p = .63). Posttest systolic blood pressure was significantly lower in the intervention group (p = .03) (Table 3).

BMI showed a small but significant decline in the intervention group (from 29.1 ± 3.6 to 28.5 ± 3.4 kg/m^2; mean change −0.6, p = .04), whereas the control group remained essentially unchanged (29.4 ± 3.8 to 29.5 ± 3.9 kg/m^2; mean change +0.1, p = .71). The between-group difference in posttest BMI was in favor of the intervention group but did not reach conventional statistical significance (p = .08).

Table 3

Comparison of clinical indicators between intervention and control groups

Indicator	Group	Pretest Mean ± SD	Posttest Mean ± SD	Mean change	p (within-group)	p (between-group at posttest)
HbA1c (%)	Intervention	8.39 ± 0.78	7.62 ± 0.73	−0.77	< 0.001	< 0.001
	Control	8.34 ± 0.81	8.23 ± 0.79	−0.11	0.18	
Systolic BP (mmHg)	Intervention	137.5 ± 14.2	132.1 ± 13.6	−5.4	0.02	0.03
	Control	138.9 ± 13.7	139.5 ± 14.1	+0.6	0.63	
BMI (kg/m^2)	Intervention	29.1 ± 3.6	28.5 ± 3.4	−0.6	0.04	0.08
	Control	29.4 ± 3.8	29.5 ± 3.9	+0.1	0.71	

Overall, the collaborative education program combined with continuous feedback led to: Significant improvements in diabetes self-care behaviors and treatment adherence among elderly participants. Higher diabetes-related quality of life in the intervention group compared with the control group. Clinically meaningful reductions in HbA1c and modest but favorable changes in systolic blood pressure and BMI. These findings support the effectiveness of collaborative, feedback-based educational strategies for improving both behavioral and clinical outcomes in elderly individuals with type 2 diabetes.

Discussion and Conclusion

The present semi-experimental study examined the effects of a collaborative education program combined with continuous feedback on diabetes-related behaviors, clinical indicators, and quality of life in elderly individuals with type 2 diabetes. Overall, the findings showed that, compared with routine education, the intervention produced substantial improvements in self-care behaviors, treatment adherence, and diabetes-related quality of life, as well as clinically meaningful reductions in HbA1c and modest improvements in blood pressure and body mass index. These results support the initial hypothesis that a human-centered model integrating collaborative learning and ongoing feedback can enhance both behavioral and metabolic outcomes in older adults with type 2 diabetes.

Our findings are consistent with the broader

literature highlighting the benefits of diabetes self-management education and support (DSMES). The 2020 DSMES consensus report emphasizes that structured, ongoing education and support are associated with improved glycemic control, self-care behaviors, and quality of life in adults with type 2 diabetes (Powers et al., 2020). Likewise, a systematic review and meta-analysis by Sherifali et al. (2015) reported that diabetes self-management programs in older adults yield small but significant reductions in HbA1c, lipids, and blood pressure, suggesting that even modest improvements can be clinically relevant in this population. More recently, Alliston et al. (2024) found that diabetes self-management programs for older adults improve both clinical and patient-reported outcomes, particularly when interventions are multi-component and tailored to age-related needs. Our results, which show robust gains in self-care and quality of life alongside improved HbA1c, are broadly in line with these conclusions.

A key contribution of the present study is its focus on the combined use of collaborative education and continuous feedback. Collaborative, interactive formats—characterized by group discussion, peer support, and shared problem-solving—are thought to enhance self-efficacy and motivation, which are central mechanisms for sustaining behavior change in diabetes management (Powers et al., 2020; Sherifali et al., 2015). Continuous feedback, delivered through regular face-to-face or telephone contacts, likely reinforced these gains by helping participants monitor their progress, adjust goals, and address barriers in real time. This is in line with evidence that continuity-of-care strategies, including regular follow-up and sustained relationships with providers, are associated with better medication adherence, self-management, and quality of life among people with type 2 diabetes (Hsieh et al., 2020; Sari et al., 2025).

The magnitude of HbA1c reduction observed in the intervention group in our sample (approximately 0.7–0.8 percentage points) is comparable to, or somewhat larger than, the effect sizes reported in meta-analyses of DSMES and continuity-of-care interventions. Sherifali et al. (2015) and Alliston et al. (2024) both noted small-to-moderate reductions in HbA1c, while Sari et al. (2025) concluded that continuity-of-care strategies often improve glycemic control, self-efficacy, and physical activity among older adults with diabetes. Integrated care models that combine education, structured follow-up, and multidisciplinary collaboration have similarly been shown to improve self-management and quality of life in chronic disease populations (Valentijn et al., 2024). Our findings add to this evidence by suggesting that, in elderly patients, embedding continuous feedback within a collaborative, group-based educational framework may be particularly effective.

The results also resonate with the American Diabetes Association's Standards of Care for older adults, which underscore the importance of individualized, person-centered care that accounts for cognitive status, functional capacity, comorbidities, and social context (American Diabetes Association Professional Practice Committee, 2025). In our study, the collaborative sessions allowed participants to share experiences and adapt recommendations to their own circumstances, while the feedback component provided tailored guidance over time. The observed improvements in quality of life—including better emotional well-being and perceived control—are consistent with the ADA's emphasis on aligning diabetes care with what "matters most" to older adults, rather than focusing solely on numerical targets.

From a practical standpoint, the intervention tested here appears relatively feasible for primary health-care settings, especially in low- and middle-income countries. Group-based education can be delivered efficiently by trained nurses or diabetes educators, and brief, structured follow-up contacts (by phone or in person) require modest additional resources. Given the increasing number of older adults with diabetes, such models may offer a cost-conscious strategy to strengthen DSMES and continuity of care within existing systems. Future implementation studies should formally assess cost-effectiveness and explore adaptations using digital technologies (e.g., mobile messaging, telehealth) to deliver feedback and support at scale.

This study has several strengths, including its focus on an elderly population, the use of a comparison group receiving routine education, and the simultaneous assessment of behavioral, clinical, and quality-of-life outcomes. Nonetheless, some limitations should be acknowledged. First, the semi-experimental design without randomization limits the ability to draw strong causal inferences, and residual confounding cannot be excluded. Second, the sample was drawn from a limited number of primary health-care centers, which may

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reduce generalizability to other regions or health-system contexts. Third, follow-up was relatively short, so it is unclear whether the observed improvements in behaviors and HbA1c can be sustained over longer periods. Fourth, key behavioral outcomes were based on self-report, which may be subject to recall and social desirability biases. Future research should employ randomized controlled designs with larger, more diverse samples, longer follow-up, and, where possible, objective measures of self-management behaviors and adherence. In addition, qualitative studies could enrich understanding of how older adults experience collaborative education and feedback, and identify factors that facilitate or hinder engagement.

This study suggests that a collaborative education program combined with continuous feedback can meaningfully improve diabetes-related behaviors, glycemic control, and quality of life in elderly individuals with type 2 diabetes, compared with routine education alone. By fostering active participation, peer support, and individualized, ongoing guidance, the intervention aligns well with contemporary recommendations for person-centered care and DSMES in older adults. Integrating such collaborative, feedback-based models into routine primary care may represent a practical and effective strategy to support healthy aging with diabetes, particularly in resource-constrained settings. Further rigorous, long-term research is warranted to confirm these findings, evaluate cost-effectiveness, and explore scalable delivery formats, including digital and hybrid approaches.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. An ethical consideration in this study was that participation was entirely optional.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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