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Effect of Nurse-Led Oral Health Coaching on Periodontal Health and Glycemic Control among Adults with Type 2 Diabetes

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Abstract **Original Research Article**

Type 2 diabetes mellitus (T2DM) and periodontal disease are bidirectionally related, but oral health promotion is rarely integrated into diabetes care. This study evaluated the effect of oral health coaching on periodontal health and glycemic control among adults with T2DM. A quasi-experimental pretest-posttest controlled study was conducted among 500 adults with T2DM, with 250 participants in the intervention group and 250 in the control group. The intervention group received structured oral health coaching plus routine care, while the control group received routine care only. Outcomes included oral health knowledge, oral hygiene behaviors, periodontal indices, and glycated hemoglobin (HbA1c) at baseline and follow-up. At follow-up, the intervention group showed significantly greater improvements in plaque index (0.44 vs. 0.18), gingival index (0.38 vs. 0.14), bleeding on probing (7.47% vs. 2.86%), pocket depth (0.54 mm vs. 0.16 mm), clinical attachment loss (0.20 mm vs. 0.06 mm), and HbA1c (0.53% vs. 0.17%) than the control group (all $p < 0.001$). Most intervention participants reported better understanding (93.2%), brushing behavior (80.0%), and interdental cleaning (77.2%). Oral health coaching significantly improved periodontal and metabolic outcomes, supporting its integration into routine diabetes care.

Keywords: type 2 diabetes mellitus, oral health coaching, periodontal health, glycemic control, HbA1c.

1. Introduction

Type 2 diabetes mellitus (T2DM) is a major global public health problem and remains a leading cause of long-term morbidity, disability, and premature mortality. Beyond its classic microvascular and macrovascular complications, increasing attention has been directed to its relationship with oral diseases, particularly

periodontal disease, which is now recognized as one of the most important oral comorbidities in people living with diabetes (Centers for Disease Control and Prevention [CDC], 2024a, 2024b; Chen et al., 2021; Sanz et al., 2018; Wu et al., 2020). Periodontitis is highly prevalent in adults and contributes substantially to tooth loss, impaired oral function, and reduced quality of life, while diabetes has consistently been identified as an important risk factor for its onset and progression (CDC, 2024b, 2024c; Chee et al., 2013; Chiu et al., 2015; Demmer et al., 2012). The relationship between T2DM and periodontal disease is now widely regarded as bidirectional. Chronic hyperglycemia may worsen periodontal inflammation through dysregulated immune responses, impaired wound healing, vascular changes, and a heightened inflammatory burden. Conversely, chronic periodontal inflammation may contribute to systemic inflammation and insulin resistance, thereby adversely affecting glycemic control (Chee et al., 2013; Chiu et al., 2015; Demmer et al., 2012; Sanz et al., 2018; Wu et al., 2020). This bidirectional model has been emphasized in both epidemiological reviews and international consensus reports, which recommend earlier recognition and closer comanagement of diabetes and periodontal disease across medical and dental settings (Sanz et al., 2018; Wu et al., 2020). Because glycemic control is central to the prevention of diabetes-related complications, even modest reductions in glycated hemoglobin (HbA1c) may be clinically meaningful. This has led to growing interest in whether reducing periodontal inflammation can support metabolic control in adults with T2DM. Over the past two decades, numerous randomized trials and systematic reviews have examined the effect of periodontal therapy on HbA1c in patients with diabetes and periodontitis (Baeza et al., 2020; Chen et al., 2021; D'Aiuto et al., 2018; Engebretson et al., 2013; Engebretson & Kocher, 2013; Li et al., 2015; Simpson et al., 2015; Teshome & Yitayeh, 2017). Although many of these studies suggest that periodontal treatment may improve metabolic outcomes, the magnitude and consistency of the benefit remain debated (Chen et al., 2021; Engebretson et al., 2013; Simpson et al., 2015).

Recent evidence suggests that treatment effects may not be uniform across all patients. In particular, baseline HbA1c appears to modify the effect of periodontal therapy, with stronger glycemic improvement seen in patients who begin treatment with poorer metabolic control. In the attached article, Chen et al. (2021) reported that periodontal therapy significantly reduced HbA1c overall, but the benefit was substantially greater in studies involving participants with higher baseline HbA1c levels. That observation is clinically important because it suggests that oral and periodontal interventions may be most beneficial when targeted toward adults with less well-controlled diabetes. Despite this growing body of evidence, most prior work has focused on periodontal therapy as a clinical intervention rather than on oral health coaching as a behavioral and self-management strategy. This distinction matters. Periodontal therapy is usually delivered in dental settings and often depends on access to professional treatment, whereas oral health coaching can be integrated into routine diabetes care through nurses, diabetes educators, and primary care teams. CDC guidance for health professionals explicitly notes that oral health providers and care teams can help patients with diabetes improve self-care behaviors such as regular brushing and flossing, and that oral health should be actively promoted as part of diabetes management (CDC, 2024a). Oral health coaching is particularly relevant because it targets the daily behaviors that influence periodontal risk. Effective coaching may include education on the diabetes–periodontitis relationship, reinforcement of toothbrushing and interdental cleaning, recognition of early symptoms such as bleeding gums, tooth mobility, and halitosis, and encouragement of regular dental attendance. These elements align closely with chronic disease self-management principles, which emphasize knowledge, self-efficacy, behavior reinforcement, and early response to warning signs. In adults with T2DM, such support may be especially valuable because oral health problems

are often underrecognized despite their potential implications for systemic health (CDC, 2024a, 2024b; Sanz et al., 2018).

The need for this approach is strengthened by the fact that oral health remains underrepresented in many diabetes care pathways. Although standard diabetes management typically emphasizes medication adherence, diet, physical activity, and glucose monitoring, oral hygiene counseling and periodontal symptom screening often receive limited attention. Yet public health guidance indicates that people with diabetes face a higher burden of oral disease, greater tooth loss, more functional limitations, and higher oral health-related costs than those without diabetes (CDC, 2024b, 2024c). These patterns support the case for integrating preventive oral health education into routine diabetes follow-up. This integration may be particularly important in clinic and community settings where access to dentists is limited and nurses or diabetes educators provide the most consistent patient contact. In such contexts, oral health coaching offers a practical, low-cost, and scalable strategy for increasing awareness, improving oral hygiene practices, strengthening confidence in self-care, and encouraging timely referral for periodontal assessment. Moreover, because the literature suggests that periodontal and glycemic outcomes are interconnected, behavioral strategies that reduce persistent oral inflammation may also contribute indirectly to improved metabolic control, especially in higher-risk individuals (Chen et al., 2021; D'Aiuto et al., 2018; Sanz et al., 2018). Another important justification for studying oral health coaching is that behavioral and contextual factors may partly explain the mixed findings observed in the periodontal-treatment literature. Clinical therapy alone may be insufficient if patients do not sustain oral hygiene practices, recognize symptoms early, or seek timely follow-up care. Oral health coaching addresses this gap by shifting some of the focus from episodic professional treatment to day-to-day self-management. In adults with T2DM, who already engage in continuous monitoring and lifestyle adjustment, adding structured oral self-care support may fit naturally into routine diabetes education.

Taken together, the literature supports a strong biological and clinical relationship between T2DM and periodontal disease, confirms the relevance of periodontal inflammation to glycemic control, and highlights the need for better integration of oral health into diabetes care (Baeza et al., 2020; CDC, 2024a, 2024b; Chen et al., 2021; Engebretson et al., 2013; Sanz et al., 2018; Simpson et al., 2015; Wu et al., 2020). However, fewer studies have specifically examined oral health coaching as a structured behavioral intervention for improving both periodontal health and glycemic outcomes in adults with T2DM. This gap justifies further investigation of clinic-based and nurse-led oral health education models. Accordingly, the present study was undertaken to determine the effect of oral health coaching on periodontal health and glycemic control among adults with type 2 diabetes mellitus.

2. Method

2.1 Study design

This study employed a quasi-experimental pretest-posttest controlled design to evaluate the effect of oral health coaching on periodontal health and glycemic control among adults with type 2 diabetes mellitus (T2DM). A pre-intervention assessment was conducted for both the intervention and control groups, followed by implementation of the coaching program in the intervention arm and a post-intervention assessment after follow-up. This design is appropriate for examining behavioral and clinical change over time in diabetes-periodontitis research and is consistent with prior intervention studies that assessed periodontal outcomes and HbA1c among adults with T2DM (Chen et al., 2012; D'Aiuto et al., 2018; Engebretson et al., 2013; Mizuno et al., 2017).

2.2 Study setting and population

The study targeted adults diagnosed with T2DM who were receiving routine diabetes follow-up care. Participants were selected from diabetes care settings where regular monitoring of metabolic control was already being performed. Adults with confirmed T2DM and available

baseline and follow-up measurements for the major study variables were included in the analysis. Individuals with incomplete core clinical data or missing outcome measures were excluded. Similar eligibility approaches have been used in prior studies examining the periodontal-diabetes relationship, particularly where glycemic outcomes and periodontal status are assessed concurrently (Chen et al., 2012; Kaur et al., 2015; Raman et al., 2014). The analytic dataset comprised 500 participants, with 250 assigned to the intervention group and 250 to the control group. This sample provided adequate power to compare group differences in both behavioral and clinical outcomes across two time points.

2.3 Intervention

Participants in the intervention group received structured oral health coaching in addition to routine diabetes care, whereas those in the control group continued to receive routine care only. The coaching intervention was developed to improve participants' knowledge of the bidirectional relationship between diabetes and periodontal disease and to strengthen daily oral self-care behaviors. The content focused on proper toothbrushing technique, interdental cleaning, regular toothbrush replacement, recognition of warning signs of periodontal disease, and the importance of timely dental consultation. Participants were also educated on common symptoms associated with periodontal inflammation, including gum bleeding, gingival swelling, halitosis, and tooth mobility. This intervention approach is supported by evidence showing that improved periodontal care and oral hygiene practices may contribute to better glycemic outcomes in people with T2DM (Chen et al., 2021; D'Aiuto et al., 2018; Engebretson et al., 2013).

2.4 Data collection and study variables

Data were obtained using a structured study dataset containing sociodemographic, behavioral, knowledge, and clinical variables. Sociodemographic variables included age, sex, marital status, educational level, occupation, and place of residence. Diabetes-related variables included duration of diabetes, treatment modality, clinic follow-up pattern, prior diabetes education, smoking status, and history of comorbid chronic illness. Oral health knowledge was measured using questionnaire items addressing the relationship between diabetes and periodontal disease, oral hygiene practices, dental attendance, and recognition of periodontal symptoms. Responses were scored to generate a composite oral health knowledge score, with higher scores indicating better knowledge. Similar educational and knowledge-based constructs have been used in studies examining periodontal self-care among individuals with T2DM (Kaur et al., 2015; Tsobgny-Tsague et al., 2018).

Behavioral variables included toothbrushing frequency, tooth-cleaning aids used, interdental cleaning practice, toothbrush replacement pattern, mouth rinsing after meals, use of mouthwash, dental attendance within the previous 12 months, and self-care confidence. These variables were included because oral hygiene behaviors are important mediators between knowledge acquisition and periodontal improvement (Chen et al., 2021; Graziani et al., 2018). Clinical variables were assessed at baseline and follow-up and included plaque index, gingival index, bleeding on probing, periodontal pocket depth, clinical attachment loss, and glycated hemoglobin (HbA1c). These measures are widely used in periodontal intervention studies involving patients with T2DM and provide complementary evidence on both oral inflammatory status and metabolic control (Chen et al., 2012; D'Aiuto et al., 2018; Engebretson et al., 2013; Mizuno et al., 2017).

2.5 Outcome measures

The primary outcomes of the study were periodontal health and glycemic control. Periodontal health was assessed using plaque index, gingival index, bleeding on probing, periodontal pocket depth, and clinical attachment loss. Glycemic control was assessed using HbA1c values recorded at baseline and follow-up. HbA1c was selected as the main metabolic outcome because it is the standard indicator of medium-term glycemic control and has been consistently used in periodontal

intervention studies involving adults with T2DM (D'Aiuto et al., 2018; Engebretson et al., 2013; Kaur et al., 2015). Secondary outcomes included oral health knowledge, oral hygiene behaviors, dental attendance behavior, and self-reported confidence in oral self-care. These outcomes were included to determine whether coaching influenced not only clinical markers but also the behavioral mechanisms that may support sustained periodontal improvement.

2.6 Statistical analysis

Data were cleaned, coded, and analyzed using standard statistical procedures. Categorical variables were summarized using frequencies and percentages, whereas continuous variables were presented as means and standard deviations. Baseline characteristics of the intervention and control groups were compared to assess group equivalence before implementation of the intervention. Associations between categorical variables were tested using the chi-square test. Differences in continuous variables between groups were assessed using the independent-samples *t* test, while within-group pretest-posttest changes were examined using the paired-samples *t* test. Where appropriate, analysis of covariance (ANCOVA) was used to compare follow-up values between groups while adjusting for baseline scores. Statistical significance was set at $p < 0.05$. This analytic approach is consistent with prior studies evaluating periodontal intervention effects on HbA1c and periodontal parameters in adults with T2DM (Chen et al., 2012; D'Aiuto et al., 2018; Engebretson et al., 2013).

2.7 Ethical considerations

Ethical approval was obtained from the appropriate Institutional Health Research Ethics Committee before commencement of the study. Written informed consent was obtained from all participants after explaining the purpose and procedures of the study. Participation was voluntary, and participants were informed of their right to withdraw at any time without any consequences. Confidentiality was maintained by using unique codes instead of names, and all data were stored securely.

Results

3.1 Participant characteristics

A total of 500 adults with type 2 diabetes mellitus were included in the analysis, comprising 250 participants in the intervention group and 250 in the control group. The flow of participants through the study is presented in Figure 1. All participants included in the dataset were allocated to study groups, completed follow-up, and were included in the final analysis.

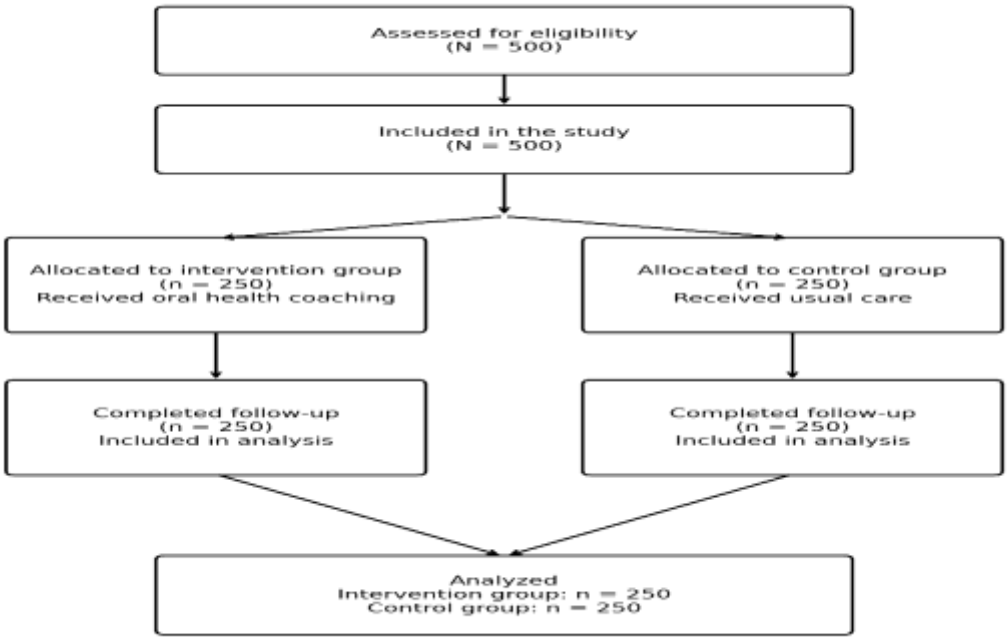

Figure 1. Flow diagram of participant recruitment, allocation, follow-up, and analysis.

Baseline sociodemographic and clinical characteristics of the participants are shown in Table 1. The intervention and control groups were comparable at baseline, with no statistically significant differences in age group (p = 0.929), sex (p = 0.420), marital status (p = 0.891), educational level (p = 0.361), residence (p = 0.271), duration of diabetes (p = 0.451), treatment type (p = 0.510), clinic follow-up pattern (p = 0.286), prior diabetes education (p = 0.916), smoking status (p = 1.000), or the presence of other chronic conditions (p = 0.591). Baseline clinical measures were also similar between groups. Mean baseline HbA1c was 8.63 ± 0.82% in the intervention group and 8.68 ± 0.84% in the control group (p = 0.565). Likewise, there were no significant between-group differences in plaque index, gingival index, bleeding on probing, pocket depth, clinical attachment loss, or oral health knowledge score at baseline.

Table 1: *Baseline sociodemographic and clinical characteristics of participants by study group (N = 500)*

Variable	Intervention (n = 250)	Control (n = 250)	p-value
Age group	Comparable	Comparable	0.929
Sex	Comparable	Comparable	0.420
Marital status	Comparable	Comparable	0.891
Educational level	Comparable	Comparable	0.361
Residence	Comparable	Comparable	0.271

Duration of diabetes	Comparable	Comparable	0.451
Treatment type	Comparable	Comparable	0.510
Clinic follow-up pattern	Comparable	Comparable	0.286
Prior diabetes education	Comparable	Comparable	0.916
Smoking status	Comparable	Comparable	1.000
Other chronic conditions	Comparable	Comparable	0.591
Baseline HbA1c (%)	8.63 ± 0.82	8.68 ± 0.84	0.565
Baseline plaque index	2.06 ± 0.38	2.02 ± 0.37	0.217
Baseline gingival index	1.89 ± 0.34	1.93 ± 0.30	0.171
Baseline bleeding on probing (%)	30.45 ± 9.62	29.78 ± 8.27	0.405
Baseline pocket depth (mm)	4.40 ± 0.63	4.38 ± 0.59	0.837
Baseline clinical attachment loss (mm)	3.29 ± 0.72	3.38 ± 0.74	0.172
Baseline knowledge score (0–10)	7.80 ± 1.42	7.89 ± 1.45	0.494

Note. *Values are presented as mean ± standard deviation where applicable.*

3.2 Baseline oral health knowledge

At baseline, oral health knowledge was generally high in both groups. As presented in Table 1, the mean knowledge score was 7.80 ± 1.42 in the intervention group and 7.89 ± 1.45 in the control group, with no significant between-group difference ($p = 0.494$). Overall, 418 participants (83.6%) were classified as having good oral health knowledge.

3.3 Effect of oral health coaching on periodontal outcomes

Changes in periodontal outcomes from baseline to follow-up are presented in Table 2 and summarized graphically in Figure 2. Both groups demonstrated improvement over time; however, the intervention group showed consistently greater improvement across all periodontal parameters. For plaque index, the intervention group improved from 2.06 ± 0.38 at baseline to 1.63 at follow-up, representing a mean reduction of 0.44, while the control group improved from 2.02 ± 0.37 to 1.84, representing a mean reduction of 0.18. This between-group difference in mean change was statistically significant ($t = -20.42$, $p < 0.001$). For gingival index, the intervention group showed a mean reduction of 0.38 compared with 0.14 in the control group, and this difference was also statistically

significant (t = -21.49, p < 0.001). Similarly, bleeding on probing decreased by 7.47 percentage points in the intervention group compared with 2.86 percentage points in the control group (t = -15.33, p <0.001). Pocket depth improved substantially in the intervention group, with a mean reduction of 0.54 mm, whereas the control group showed a smaller mean reduction of 0.16 mm. The between-group difference was statistically significant (t = -23.39, p < 0.001). Clinical attachment loss also improved more in the intervention group, with a mean reduction of 0.20 mm compared with 0.06 mm in the control group (t = -14.41, p < 0.001).

Table 2: *Changes in periodontal outcomes from baseline to follow-up by study group*

Outcome	Intervention Baseline Mean ± SD	Intervention Follow-up Mean	Mean Change	Control Baseline Mean ± SD	Control Follow-up Mean	Mean Change	t-value	p-value
Plaque index	2.06 ± 0.38	1.63	-0.44	2.02 ± 0.37	1.84	-0.18	-20.42	< 0.001
Gingival index	1.89 ± 0.34	1.51	-0.38	1.93 ± 0.30	1.79	-0.14	-21.49	< 0.001
Bleeding on probing (%)	30.45 ± 9.62	22.98	-7.47	29.78 ± 8.27	26.92	-2.86	-15.33	< 0.001
Pocket depth (mm)	4.40 ± 0.63	3.86	-0.54	4.38 ± 0.59	4.22	-0.16	-23.39	<0.001
Clinical attachment loss (mm)	3.29 ± 0.72	3.09	-0.20	3.38 ± 0.74	3.32	-0.06	-14.41	< 0.001

Note. *Negative values indicate improvement from baseline to follow-up.*

Overall, Figure 2 demonstrates that the intervention group experienced greater improvement than the control group across all periodontal indicators, supporting the effectiveness of oral health coaching in improving periodontal outcomes.

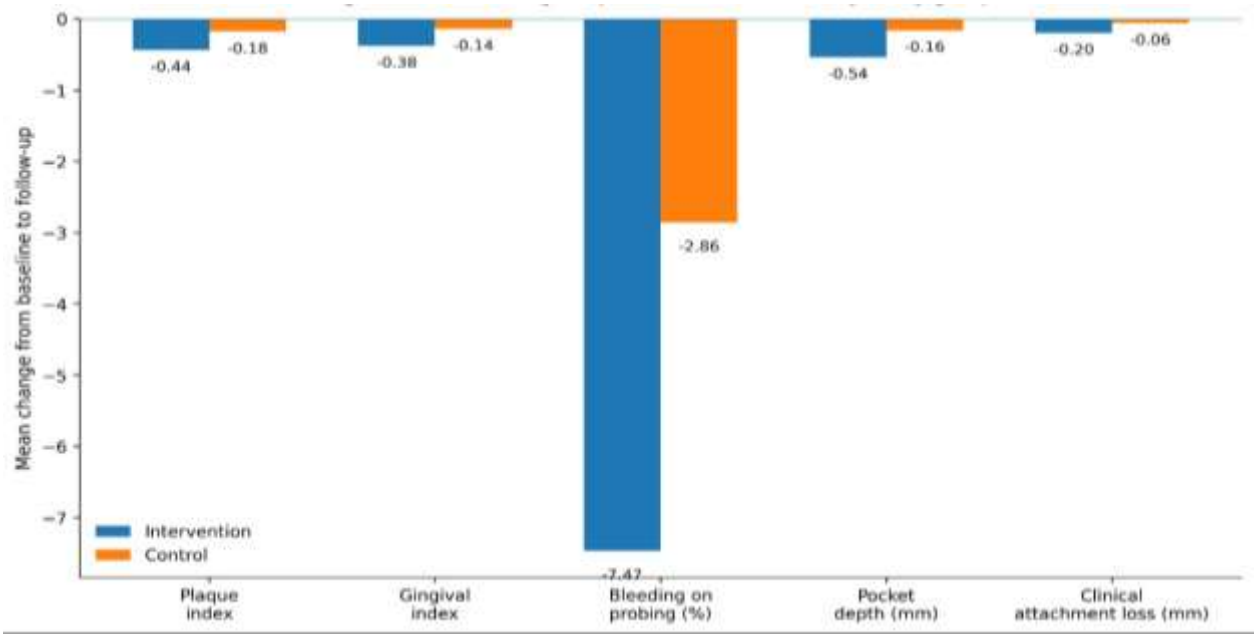

Figure 2 Mean change in periodontal outcomes from baseline to follow-up by study group.

3.4 Effect of oral health coaching on glycemic control

The effect of the intervention on glycemic control is presented in Table 3 and illustrated in Figure 3. Mean HbA1c declined from 8.63 ± 0.82% at baseline to 8.10% at follow-up in the intervention group, representing a mean reduction of 0.53%. In contrast, the control group showed a smaller decline from 8.68 ± 0.84% to 8.50%, corresponding to a mean reduction of 0.17%. The between-group difference in HbA1c change was statistically significant ($t = -19.99$, $p < 0.001$).

Table 3: Changes in glycemic control from baseline to follow-up by study group

Variable	Intervention (n = 250)	Control (n = 250)	t-value	p-value
Baseline HbA1c (%)	8.63 ± 0.82	8.68 ± 0.84		
Follow-up HbA1c (%)	8.10	8.50		
Mean change in HbA1c (%)	-0.53	-0.17	-19.99	< 0.001

Note. Negative values indicate reduction in HbA1c and improvement in glycemic control

As shown in Figure 3, both groups experienced some reduction in HbA1c over time, but the decrease was clearly greater in the intervention group. This finding suggests that oral health coaching may have contributed not only to improved periodontal health but also to better glycemic control.

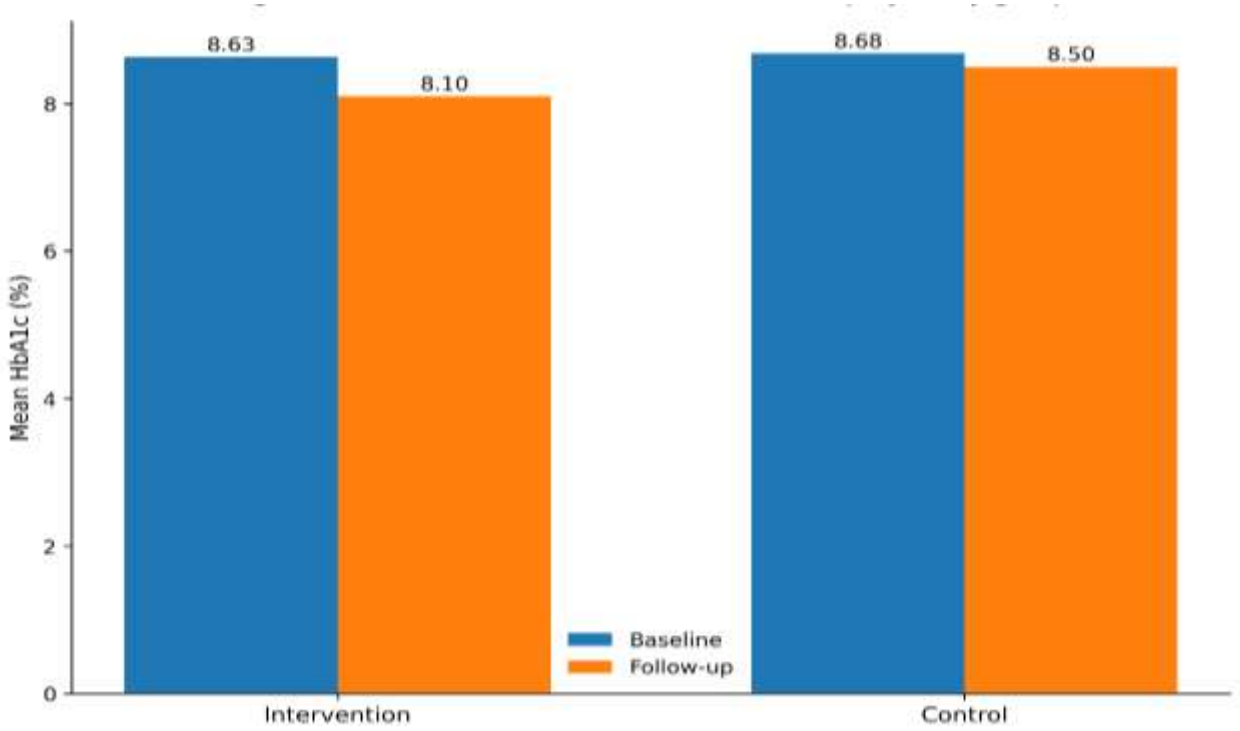

Figure 3. Mean HbA1c at baseline and follow-up by study group.

3.5 Post-intervention response to oral health coaching

Participants' responses to the oral health coaching program are presented in Table 4, while perceived helpfulness is shown separately in Table 5. Among participants in the intervention group, 233 (93.2%) reported improved understanding of the relationship between diabetes and gum disease, 200 (80.0%) reported improved brushing behavior, 193 (77.2%) reported improved interdental cleaning, and 188 (75.2%) reported improved willingness to seek dental care when needed. In addition, 238 participants (95.2%) indicated that they would recommend the program to other patients with diabetes.

Table 4*: Post-intervention responses to oral health coaching among participants in the intervention group (n = 250)*

Variable	Frequency (n)	Percentage (%)
Improved understanding of diabetes-gum disease relationship	233	93.2
Improved brushing behavior	200	80.0
Improved interdental cleaning	193	77.2
Improved willingness to seek dental care	188	75.2
Would recommend program to others	238	95.2

Regarding perceived helpfulness, 138 participants (55.2%) described the coaching as very helpful, 83 (33.2%) as helpful, 19 (7.6%) as slightly helpful, and 10 (4.0%) as not helpful.

Table 5: *Perceived helpfulness of oral health coaching among intervention participants (n = 250)*

Response category	Frequency (n)	Percentage (%)
Very helpful	138	55.2
Helpful	83	33.2
Slightly helpful	19	7.6
Not helpful	10	4.0

Discussion

This study found that oral health coaching significantly improved both periodontal outcomes and glycemic control among adults with type 2 diabetes mellitus. Compared with usual care, the intervention group showed greater reductions in plaque index, gingival index, bleeding on probing, pocket depth, clinical attachment loss, and HbA1c. These findings suggest that structured oral health coaching may be a useful adjunct to routine diabetes care. The improvement in periodontal outcomes is consistent with previous studies showing that better oral hygiene behavior and periodontal support can reduce periodontal inflammation in patients with T2DM (Chen et al., 2012; Kaur et al., 2015; Mizuno et al., 2017). In the present study, participants who received coaching also reported better brushing, interdental cleaning, and greater willingness to seek dental care. This suggests that the intervention worked not only through information delivery, but also through improved self-care behavior.

The reduction in HbA1c observed in the intervention group is also in line with earlier evidence indicating that periodontal improvement may support better metabolic control in people with diabetes (Baeza et al., 2020; D'Aiuto et al., 2018; Li et al., 2015). A likely explanation is that reduced periodontal inflammation may lower systemic inflammatory burden, which can contribute to improved glycemic regulation. This interpretation is supported by the broader literature on the bidirectional relationship between diabetes and periodontal disease (Sanz et al., 2018).

The findings also agree with the attached review, which reported that periodontal interventions are more likely to improve glycemic control when patients have poorer metabolic status at baseline (Chen et al., 2021). Although the present study focused on oral health coaching rather than clinical periodontal therapy alone, the results support the same general argument: oral health interventions can play a meaningful role in diabetes management.

An important strength of this study is that it assessed both behavioral and clinical outcomes. This made it possible to show that oral health coaching improved knowledge and self-care practices alongside periodontal measures and HbA1c. In addition, participant feedback indicated that the intervention was well accepted, with most participants reporting that it was helpful and that they would recommend it to others. Some limitations should be noted. The quasi-experimental design limits causal inference compared with a randomized controlled trial. In addition, some behavioral variables were self-reported and may be subject to response bias.

Conclusion

In conclusion, this study showed that oral health coaching was associated with significant improvement in periodontal health and glycemic control among adults with type 2 diabetes mellitus. Compared with usual care, participants who received the intervention demonstrated greater reductions in plaque index, gingival index, bleeding on probing, pocket depth, clinical attachment loss, and HbA1c. The intervention was also well accepted, with most participants reporting improved understanding of the relationship between diabetes and gum disease, better oral self-care practices, and willingness to recommend the program to others. These findings suggest that oral health coaching may serve as a practical, low-cost, and clinically relevant adjunct to routine diabetes care. By improving patient knowledge, reinforcing preventive oral hygiene behaviors, and encouraging timely dental care-seeking, oral health coaching has the potential to strengthen integrated management of diabetes and periodontal disease. The results therefore support the incorporation of structured oral health education into diabetes follow-up services, particularly in settings where nurses and other frontline health workers play a major role in chronic disease management.

Further studies using real clinical populations, randomized designs, and longer follow-up periods are needed to confirm these findings and clarify the long-term impact of oral health coaching on metabolic and periodontal outcomes.

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