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Theory of Planned Behaviour-Based Oral Health Education for Intention and Behaviour in Type 2 Diabetes

Siti Fitria Ulfah[1]✉, Imam Sarwo Edi[1], Sri Hidayati[1]

[1] Department of Dental Health, Poltekkes Kemenkes Surabaya, Surabaya, East Java, Indonesia

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Abstract

People with diabetes have an increased risk of oral health problems, yet knowledge alone may not produce consistent self-care behaviour. This study aimed to evaluate the effect of oral health education based on the Theory of Planned Behaviour on behavioural intention and self-reported oral health behaviour in people with type 2 diabetes. A quasi-experimental non-equivalent control group pretest–posttest design was conducted from May to July 2026 in Surabaya, Indonesia. One hundred purposively sampled participants were recruited from two community health centres: Kedungdoro (intervention, n = 50) and Pakis (control, n = 50). The intervention group received education using a module based on the Theory of Planned Behaviour, whereas the control group received standard oral health education. Outcomes were measured at baseline and one month later using structured questionnaires; within-group changes were analysed using the Wilcoxon signed-rank test and between-group differences using analysis of covariance adjusted for baseline scores. Scores increased in both groups, with larger gains in the intervention group. After adjustment, the intervention group had higher posttest scores for the total Theory of Planned Behaviour constructs ($p < 0.001$), behavioural intention (adjusted mean difference 0.48; 95% confidence interval 0.15–0.81; $p = 0.005$), and self-reported oral health behaviour (adjusted mean difference 0.89; 95% confidence interval 0.38–1.40; $p = 0.001$). Theory-based oral health education may strengthen both intention and daily oral care practices among people with type 2 diabetes and could be integrated into primary care chronic disease programmes, although randomised studies with clinical outcomes are needed.

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Corresponding Author:
✉ Siti Fitria Ulfah
Department of Dental Health, Poltekkes Kemenkes Surabaya, Surabaya, East Java, Indonesia
Email: mirzafitri@poltekkes-surabaya.ac.id

1. INTRODUCTION

Diabetes mellitus is a chronic disease that requires long-term management extending beyond blood glucose control. Oral health is an important component of diabetes care because of the bidirectional relationship between diabetes and periodontal disease: hyperglycaemia increases susceptibility to periodontal inflammation and tissue destruction, while periodontal disease can worsen metabolic control. A recent systematic review and meta-analysis confirmed this bidirectional relationship and emphasised the need to integrate oral health into diabetes prevention and management (Botelho et al., 2026). Oral health care should therefore be an integral part of diabetes self-care rather than a separate need.

Although the risk of oral health problems among people with diabetes is high, oral health maintenance practices are often suboptimal. A scoping review from South Asia identified gaps between knowledge, attitudes, and oral health practices among people with diabetes (Poudel et al., 2022), and a Hungarian study similarly reported that oral health practices and literacy among people with diabetes need to be strengthened and integrated into diabetes care (Lipták et al., 2025). In Indonesia, a study of diabetic patients enrolled in the Chronic Disease Management Programme (Prolanis) found a high prevalence of periodontal problems (Suharja, 2025). These studies indicate that recognising the importance of oral health does not necessarily translate into consistent daily oral care.

Health education is one approach to improving these behaviours; however, education that focuses solely on conveying information may not be sufficient to produce lasting change. A systematic review showed that oral health education for people with diabetes improves knowledge and self-care behaviours but highlighted the need for approaches more directly focused on changing daily practices (Petropoulou et al., 2024). Recent research has also shown that behavioural theory-based interventions can improve oral self-care among people with type 2 diabetes (Karimi et al., 2025). These studies, however, used the Health Belief Model, which emphasises perceived susceptibility, severity, benefits, barriers, and self-efficacy, rather than explaining how individuals form intentions and translate them into behaviour.

The Theory of Planned Behaviour (TPB) addresses this process. It proposes that behaviour is preceded by intention, which is shaped by attitudes toward the behaviour, subjective norms, and perceived behavioural control. These three constructs predict intentions to improve oral health behaviour, with attitude being among the strongest predictors (Rajeh, 2022). Intervention studies have shown that TPB-based education can improve attitudes, subjective norms, perceived behavioural control, intentions, and oral health-related behaviours (Ghasemian et al., 2024; Mohammadkhah et al., 2023), and that education combining the TPB with behaviour change techniques improves oral hygiene behaviour more than conventional education (Prihastuti et al., 2025). A recent systematic review likewise found that most experimental oral health interventions among adults were built on self-efficacy or the TPB (Thirasupa et al., 2025). The TPB therefore offers a strong foundation for programmes that go beyond increasing knowledge to fostering intentions and concrete action.

However, most TPB studies in oral health have focused on pregnant women, university students, or the general adult population, whereas oral health education studies among people with diabetes have predominantly used other frameworks. Evidence on TPB-based oral health education for people with diabetes, particularly studies assessing both behavioural intention and actual behaviour within a single intervention, remains limited, even though people with diabetes require consistent self-care because their periodontal risk persists throughout the course of the disease. The novelty of this study

lies in applying a TPB-based intervention specifically to people with type 2 diabetes in primary care and assessing two stages of behaviour change, namely the formation of intention and its enactment in daily oral health behaviour. This study aimed to analyse the effect of TPB-based oral health education on the TPB constructs, behavioural intention, and self-reported oral health behaviour among people with type 2 diabetes. We hypothesised that participants receiving TPB-based education would show greater improvements in intention and behaviour than those receiving standard education.

2. METHODS

This study used a quasi-experimental non-equivalent control group pretest–posttest design to compare changes in behavioural intention and oral health behaviour between participants receiving TPB-based oral health education and those receiving standard education. The study was conducted at two community health centres (puskesmas) in Surabaya, Indonesia: Kedungdoro Community Health Centre (intervention site) and Pakis Community Health Centre (control site). Data were collected from May to July 2026.

The study population comprised patients with type 2 diabetes mellitus registered in the service areas of Kedungdoro (n = 133) and Pakis (n = 100) Community Health Centres. Participants were selected using purposive sampling. Inclusion criteria were a diagnosis of type 2 diabetes mellitus, adult or older adult age, the ability to communicate effectively, literacy, and willingness to participate throughout the study. Patients with cognitive impairment, communication disorders, or diabetes complications that hindered participation were excluded. A total of 100 participants were enrolled, 50 at each site. The sample size of 50 per group was determined by recruitment feasibility, the availability of eligible patients at each centre, and the research team's capacity to deliver the education and conduct one-month follow-up assessments. Participants were not individually randomised; because each study arm was represented by a single health centre, intervention status was completely confounded with study site. All 100 participants completed the baseline and follow-up assessments with complete questionnaires, so no imputation was required.

After providing informed consent, participants in both groups completed a pretest. The intervention group then received oral health education using a TPB-based module developed for this study. In addition to providing information on oral health in diabetes, the module was designed to foster positive attitudes toward oral health maintenance (attitude), strengthen supportive social influences (subjective norm), help participants identify and overcome barriers and build confidence in their ability to perform self-care (perceived behavioural control), and encourage the formation of intentions and action plans. The control group received standard oral health education in accordance with routine care at the health centre, without TPB-based components. Sessions for the two groups were held separately at their respective health centres to minimise contamination. Posttest measurements were conducted one month after the educational activities were completed, using the same instrument.

The independent variable was TPB-based oral health education, and the primary outcomes were behavioural intention and self-reported oral health behaviour. Behavioural intention was defined as the strength of participants' desire, plans, and commitment to maintain oral health, and oral health behaviour as the actions actually taken to maintain oral health in daily life, including oral hygiene practices. The TPB constructs were assessed as secondary outcomes: attitude (positive or negative evaluation of oral health behaviour), subjective norm (perceived expectations or support from significant others), and perceived behavioural control (perceived ability and ease of performing oral health behaviours despite barriers). All variables were measured using a structured

questionnaire with four-point Likert items (strongly agree, agree, disagree, strongly disagree) scored 1–4 according to the favourable or unfavourable direction of each statement, so that higher scores indicate conditions more supportive of oral health maintenance. The questionnaire comprised five attitude items, four subjective norm items, four perceived behavioural control items, three intention items, and four behaviour items. Content validity was assessed by dentist, public health and General Practitioner in Charge of the Noncommunicable Disease Programme at the Community Health Centre, and internal consistency was tested in pilot sample, n = 30 respondents, yielding Cronbach's alpha of 0,927.

Descriptive statistics were used to summarise participant characteristics and study variables, with categorical data presented as frequencies and percentages and numerical data as means, standard deviations, medians, and ranges. Normality was assessed using the Shapiro–Wilk test, which indicated that pretest and posttest scores were not normally distributed. Within-group pretest–posttest changes were therefore analysed using the Wilcoxon signed-rank test. Between-group differences were assessed using analysis of covariance (ANCOVA), with the posttest score as the dependent variable, group as the factor, and the corresponding pretest score as the covariate; adjusted mean differences with 95% confidence intervals (CI) were reported, and R^2 was reported as the proportion of variance in posttest scores explained by the full model. Statistical significance was set at $p < 0.05$. Analyses were performed using IBM SPSS Statistics version 22.

The study was approved by the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya (approval number EA/4452/KEPK-Poltekkes_Sby/V/2026). All participants were informed of the study purpose, procedures, benefits, confidentiality of their data, and their right to withdraw without any consequence for the health services they receive, and written informed consent was obtained before data collection. The study was conducted in accordance with the ethical principles of health research.

3. RESULTS AND DISCUSSION

All 100 participants completed the study. Women predominated in both groups (78.0% in the control group and 90.0% in the intervention group), and most participants had completed senior high school and were not employed (Table 1). The control group was on average about five years older than the intervention group (63.62 ± 9.29 vs 58.40 ± 7.77 years) and included more employed and retired participants.

Table 1. Characteristics of participants by study group.

Characteristic	Control (n = 50)	Intervention (n = 50)
Gender, n (%)		
Male	11 (22.0)	5 (10.0)
Female	39 (78.0)	45 (90.0)
Age (years)		
Mean ± SD	63.62 ± 9.29	58.40 ± 7.77
Median (range)	63.00 (45–85)	57.50 (40–71)
Education, n (%)		
No schooling	1 (2.0)	0 (0.0)
Elementary school	14 (28.0)	7 (14.0)
Junior high school	6 (12.0)	12 (24.0)
Senior high school	25 (50.0)	27 (54.0)
Bachelor's degree	4 (8.0)	4 (8.0)

Characteristic	Control (n = 50)	Intervention (n = 50)
Employment, n (%)		
Unemployed	36 (72.0)	48 (96.0)
Self-employed	2 (4.0)	0 (0.0)
Private sector employee	7 (14.0)	2 (4.0)
Retired	5 (10.0)	0 (0.0)

SD = standard deviation.

Scores for all TPB constructs increased in both groups, with consistently larger gains in the intervention group (Table 2). The total TPB score increased by 8.48 points in the intervention group compared with 4.80 points in the control group, and posttest scores remained significantly higher in the intervention group after adjustment for baseline (ANCOVA $p < 0.001$). Among the individual constructs, the largest between-group difference in change was observed for attitude (3.22 vs 1.16 points), followed by subjective norm (2.68 vs 1.92) and perceived behavioural control (2.58 vs 1.72). The ANCOVA models explained 43.0%, 18.3%, and 13.6% of the variance in posttest attitude, subjective norm, and perceived behavioural control scores, respectively.

Table 2. Changes in theory of planned behaviour constructs before and after the intervention.

Variable	Group	Pretest mean ± SD	Posttest mean ± SD	Δ mean ± SD	Wilcoxon p	ANCOVA p	R^2
TPB total	Control	42.64 ± 5.06	47.44 ± 4.36	4.80 ± 5.45	<0.001	<0.001	0.304
	Intervention	42.56 ± 5.33	51.04 ± 1.51	8.48 ± 5.04	<0.001		
Attitude	Control	16.68 ± 2.21	17.84 ± 1.93	1.16 ± 1.89	<0.001	<0.001	0.430
	Intervention	16.48 ± 2.32	19.70 ± 0.71	3.22 ± 2.27	<0.001		
Subjective norm	Control	12.68 ± 2.21	14.60 ± 1.65	1.92 ± 2.41	<0.001	0.001	0.183
	Intervention	12.86 ± 1.74	15.54 ± 0.88	2.68 ± 1.63	<0.001		
Perceived behavioural control	Control	13.28 ± 1.73	15.00 ± 1.65	1.72 ± 2.11	<0.001	0.001	0.136
	Intervention	13.22 ± 1.82	15.80 ± 0.45	2.58 ± 1.75	<0.001		

Δ = posttest minus pretest score; SD = standard deviation; ANCOVA = analysis of covariance adjusted for the corresponding pretest score; R^2 = proportion of variance in posttest scores explained by the full ANCOVA model; TPB = Theory of Planned Behaviour.

The pronounced change in attitude suggests that the TPB-based module was particularly effective in helping participants understand that diabetes increases the risk of oral disease and in conveying the benefits of preventive measures and the consequences of neglect. This finding is consistent with Rajeh (2022), who identified attitude as the strongest predictor of the intention to improve oral health behaviour, and with Mohammadkhah et al. (2023), who found that TPB-based education improved attitudes,

subjective norms, perceived behavioural control, and oral health behaviours among pregnant women. Education designed around behavioural determinants thus appears more effective than education that merely increases knowledge. Theory-based behaviour change interventions can strengthen beliefs, motivation, intentions, and self-care, particularly when they include action planning (Chan et al., 2023), and perceived behavioural control shapes both intention and preventive oral health practice (Khairinisa et al., 2023). Comparable benefits of TPB-based structured education have been reported among Indonesian patients with chronic kidney disease undergoing haemodialysis (Setiani et al., 2026), supporting the applicability of this framework to chronic disease self-care in Indonesia.

The smaller gains in subjective norm and perceived behavioural control indicate that a short educational intervention can change participants' perspectives more readily than their social environment or practical barriers. Sairat and Phoosuwan (2024), in a study of 401 people with type 2 diabetes, reported that oral health behaviour was associated not only with attitudes but also with oral health literacy, educational level, diabetes complications, and access to dental services. Similarly, Alexa et al. (2025) showed that low awareness and socioeconomic status affect periodontal health and the use of dental services among people with diabetes. The role of the social environment is also evident in other chronic diseases managed in Indonesian primary care; for example, family support was strongly associated with physical activity among hypertensive patients at a community health centre (Khotimah et al., 2026), suggesting that involving family members could strengthen the subjective norm component of future interventions. Education may therefore improve attitudes but cannot, in the short term, alter all factors that shape social support and perceived control.

Table 3. Effect of TPB-based education on behavioural intention and self-reported oral health behaviour.

Variable	Group	Pretest mean ± SD	Posttest mean ± SD	Δ mean ± SD	Wilcoxon p	Adjusted mean difference (95% CI)	ANCOVA p	R^2
Intention	Control	9.46 ± 1.58	11.38 ± 1.09	1.92 ± 1.91	<0.001	0.48 (0.15–0.81)	0.005	0.106
	Intervention	9.46 ± 1.83	11.86 ± 0.49	2.40 ± 1.60	<0.001			
Oral health behaviour	Control	12.16 ± 1.69	14.58 ± 1.68	2.42 ± 2.00	<0.001	0.89 (0.38–1.40)	0.001	0.202
	Intervention	12.20 ± 1.85	15.48 ± 0.91	3.28 ± 1.65	<0.001			

Adjusted mean difference = intervention minus control posttest score adjusted for the corresponding pretest score. CI = confidence interval; other abbreviations as in Table 2.

Table 3 shows that behavioural intention scores were identical in both groups at baseline (9.46) and increased to 11.86 ± 0.49 in the intervention group and 11.38 ± 1.09 in the control group. Self-reported oral health behaviour increased from 12.20 ± 1.85 to 15.48 ± 0.91 in the intervention group and from 12.16 ± 1.69 to 14.58 ± 1.68 in the control group. After adjustment for baseline scores, the intervention group had higher posttest scores for both behavioural intention (adjusted mean difference 0.48; 95% CI 0.15–0.81;

p = 0.005) and oral health behaviour (adjusted mean difference 0.89; 95% CI 0.38–1.40; p = 0.001).

These findings suggest that TPB-based education can strengthen both the formation of intention and its enactment in daily practice. This is notable because intention does not always translate into behaviour. Among Indonesian dentists, the TPB explained 55.3% of the variance in intention to provide preventive care but only 17.8% of the variance in actual practice, reflecting barriers that impede the translation of intention into action (Khairinisa et al., 2023). Education alone may increase knowledge without producing meaningful changes in behaviour; a systematic review found that oral health training consistently improved knowledge but rarely changed practice (Haghi Ashtiani et al., 2022). Among Indonesian patients with acute coronary syndrome and type 2 diabetes, nurse-led education produced a large gain in knowledge but only a small improvement in self-management (Anggreni et al., 2026), and among schoolchildren, fatigue, forgetfulness, low motivation, and inconsistent supervision hindered the application of oral health knowledge (Faisal et al., 2026). Moreover, good knowledge and attitudes do not necessarily lead to good practice: in Tanzania, most people with diabetes held positive attitudes toward oral health, yet only 20.6% reported good oral health practices (Singh et al., 2024). Education delivered actively and repeatedly, for instance by health professionals and through social media, has been shown to improve oral health knowledge and some behaviours such as toothbrushing and flossing (Haghdoost et al., 2023), and counselling with interactive media has improved toothbrushing behaviour (Dewi et al., 2024). By addressing attitudes, social support, and perceived control and by encouraging action planning, the TPB-based module may help to bridge this intention–behaviour gap (Chan et al., 2023).

Strengthening oral self-care is clinically relevant for people with diabetes. Among adults with diabetes in the United States, flossing was associated with lower odds of periodontitis and lower HbA1c levels (Zhang et al., 2023), and a community self-management intervention combining diabetes and periodontal care improved oral health behaviours, periodontal status, and glycaemic control among patients with type 2 diabetes and periodontitis (Zhang et al., 2025). At the same time, people with diabetes face persistent barriers to care: many remain unaware of oral health risks or have inadequate practices (Elsous et al., 2025), use dental services less often than the general population (Pyo et al., 2025), and experience disparities in preventive dental care (Lu & Yoshida, 2025), while a diabetes diagnosis alone does not increase dental service use (Nurminen & Rättö, 2023). Integrating TPB-based oral health education into existing chronic disease services, such as *Prolanis*, individual counselling, and group education at *puskesmas*, could therefore help close these gaps (Pyo et al., 2025). Such integration is also relevant to other chronic conditions; for instance, moderate to severe gingival inflammation was found in most patients with chronic kidney disease attending community health centres in Semarang (Subekti et al., 2026), underscoring the need to embed oral health promotion within primary care chronic disease programmes.

The between-group differences should nevertheless be interpreted with caution. The adjusted differences were modest in absolute terms, and because no minimal clinically important difference has been established for these scales, their practical significance remains uncertain. Higher questionnaire scores should not be interpreted as evidence of improved clinical oral health. Posttest scores in the intervention group clustered near the upper end of the scales with small standard deviations, suggesting a possible ceiling effect that may have limited the detection of further change. Moreover, the R^2 values describe the variance explained by the full ANCOVA models, including baseline scores, rather than the proportion of change attributable to the intervention.

This study has several limitations. First, intervention status was completely confounded with study site; differences between the two health centres in services, personnel, routine education, patient characteristics, and access to dental care may have contributed to the observed differences, and adjustment for baseline scores cannot separate the intervention effect from these site-related factors. The groups also differed in age and employment status, which were not adjusted for. Second, purposive sampling limits the generalisability of the findings to the wider population with diabetes. Third, intention and behaviour were self-reported and therefore subject to recall and social desirability bias. Fourth, ANCOVA was applied although outcome distributions were not normal, and the one-month follow-up was too short to assess the sustainability of behaviour change. Future studies should use randomised or cluster-randomised designs with multiple sites, longer follow-up, and clinical indicators such as plaque index, periodontal status, and HbA1c.

4. CONCLUSION

Oral health education based on the Theory of Planned Behaviour was associated with greater improvements in attitudes, subjective norms, perceived behavioural control, behavioural intention, and self-reported oral health behaviour among people with type 2 diabetes than standard education. The largest gain was observed in attitudes, indicating that theory-based education helps patients appreciate the importance of oral health, feel more capable of maintaining it, and translate their intentions into daily oral care practices, although the confounding of intervention with study site warrants cautious interpretation.

TPB-based oral health education may be considered for integration into primary care services for people with diabetes, for example through Prolanis activities, individual counselling, or group education at community health centres. Future research should employ randomised multi-site designs, longer follow-up periods, and clinical indicators such as plaque index, periodontal status, and HbA1c to determine whether behavioural improvements translate into better oral and metabolic health.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICAL CONSIDERATIONS

The study was approved by the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya (approval number EA/4452/KEPK-Poltekkes_Sby/V/2026). All participants were informed of the study purpose, procedures, benefits, confidentiality of their data, and their right to withdraw without any consequence for the health services they receive, and written informed consent was obtained before data collection. The study was conducted in accordance with the ethical principles of health research.

AUTHOR CONTRIBUTIONS

Siti Fitria Ulfah contributed to investigation, data curation, formal analysis, and writing – review and editing. Imam Sarwo Edi contributed to conceptualisation, methodology, supervision, project administration, and writing – original draft. Sri Hidayati contributed to methodology, investigation, and writing – review and editing. All authors reviewed and approved the final manuscript.

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DECLARATION OF ARTIFICIAL INTELLIGENCE USE

Generative artificial intelligence (AI) was used solely to improve the language, grammar, readability, organisation, and formatting of the manuscript. The authors performed all scientific work, including study design, data collection, data analysis, interpretation of the findings, and final manuscript preparation, and take full responsibility for the accuracy, originality, and integrity of the manuscript.

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