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Research Article

Keywords: Pregnancy, Oral health, Oral health education, Theory of Planned Behavior, Oral health practices.

Posted Date: November 19th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11385593/v1

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Additional Declarations: No competing interests reported.

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ABSTRACT:

Background: Pregnant women face an elevated risk of developing oral diseases, particularly gingivitis, underscoring the critical need for tailored oral health education programs during the perinatal phase. The current research assessed the effect of an education program based upon the principles of theory of planned behaviour (TPB) on promoting oral health practices and knowledge among pregnant women in Karachi, Pakistan.

Methods: This quasi-experimental study was performed on 130 pregnant women (65 in Intervention group and 65 in Control group).

The study was conducted at the Gynaecology & Obstetrics Unit-III (also known as the Maternal Fetal Medicine and Family Planning Centre) at Jinnah Postgraduate Medical Centre from December 2023 to June 2024.

A questionnaire consisting of demographic data, oral hygiene practices and TPB constructs (namely attitude, perceived behavioral control, subjective norms) was filled by trained examiners and plaque and gingival indices were recorded pre-intervention and on 3 month follow-up. The Intervention group underwent extensive face-to-face training over 3 sessions of 1 hour each, based upon the TPB model.

Results: The results showed that at 3 months follow-up the Intervention group displayed improved plaque and gingival indices, and better scores attitude, knowledge and perceived behavioural control.

Conclusion: The study highlights the positive role of TPB-driven educational programs which can be used to influence oral health behaviors in pregnant and other vulnerable populations.

Trial registration: Not applicable

BACKGROUND

The physiological changes encountered in pregnancy often extend to oral health. Elevated levels of sex hormones, particularly estrogen and progesterone, enhance gingival vascularity, increasing the risk of development of gingivitis [1]. Additionally, higher incidences of dental caries and erosions are observed during this period [2]. These oral health challenges necessitate targeted preventive oral care strategies into prenatal care.

The hypothesis that oral bacteria could contribute to systemic infections via toxin release was first introduced by William Hunter in 1900 [3]. Contemporary research has expanded this concept, linking periodontal disease—a chronic gram-negative infection—to elevated local levels of pro-inflammatory cytokines (e.g., IL-1β, IL-6, TNF-α, prostaglandin E2) [4]. These cytokines may trigger systemic inflammation or directly invade fetal membranes, thereby indirectly contributing to increased risk of preterm birth (PB) and low birth weight (LBW), [5]. While aggressive interventions like those practised in the mid-20th century such as extensive teeth extractions are obsolete, Hunter's foundational theory remains relevant; with current

studies investigating connections between periodontopathogens and systemic conditions.

Pregnant women frequently avoid dental care due to misconceptions and dental anxiety [6]. In Pakistan, this reluctance is exacerbated by systemic challenges: many dentists hesitate to treat pregnant patients due to gaps in guideline awareness, lack of knowledge of pharmacological safety, and medico-legal concerns [7]. Compounding this issue, many Pakistani women lack oral health literacy or cannot afford dental services [8-11]. While antenatal oral health educational programs are globally endorsed as cost-effective tools to improve maternal and fetal health [8], Pakistan healthcare framework lacks structured protocols, preventive strategies or accessible services for this vulnerable population [12]. This gap underscores the need of introducing cost effective, easily accessible and socially appropriate healthcare programs.

Theory of Planned Behavior (TPB) is a model used in health psychology that links beliefs to behavior by proposing that intentions are shaped by three factors: attitudes, subjective norms, and perceived behavioral control [12,13]. In the context of oral health, correcting misconceptions (e.g., viewing gum bleeding as an inevitable pregnancy symptom) could shift subjective norms, motivating better dental care [14]. Naseri-Salahshour et al. demonstrated TPB's efficacy in improving health behaviors through education, with long-impacting effects that sustained post-intervention [15]. By addressing cultural and cognitive barriers, this model can be used for designing oral health initiatives targeting pregnant women.

An economically feasible and minimally invasive oral hygiene intervention plays a promising role in overall improvement of maternal oral and systemic health and reduction of adverse pregnancy outcome. This study examines the efficacy of a TPB-based educational intervention on oral health beliefs and behaviors among pregnant women in Pakistan. By addressing knowledge gaps and dismantling systemic barriers, this intervention aims to enhance maternal oral health behaviours among pregnant women in Pakistan.

METHODS

The quasi-experimental study was conducted in the maternity ward at Jinnah Postgraduate Medical Centre (JPMC). A total of 130 pregnant women were selected for this research study using convenience sampling. Sample size was calculated using OpenEpi software. With the significance level of 95, power 80, ratio of exposed to unexposed 1:1, the sample size came at 63 per group.

Inclusion criteria was as follows:

1. Between 18 and 35 years of age
2. Between 12 and 20 weeks' gestation.
3. Single low risk pregnancy
4. Ability to give informed consent

Women with systemic disorders such as diabetes mellitus and metabolic syndrome were excluded from the study.

The nature, potential risks and benefits of participation in the trial was thoroughly explained to all participants. Individuals who gave informed consent were asked to sign a document written in both English and local language (Urdu), stating that they have agreed to participate in the study by their own will. Participants were given the right to withdraw at any point during the investigation.

All participants completed a baseline questionnaire administered by a trained examiner who read the questions aloud and recorded their responses. A standardized, validated questionnaire by Rajeh [16] assessed TPB constructs and oral health behaviors through 64 closed-ended questions across six sections.

The questionnaire comprised six parts:

Part 1: Demographic and Obstetric Data: This section collected information on age, sex, education level, household monthly income, occupation, smoking status, stage of pregnancy, and number of pregnancies.

Part 2: Current Oral Hygiene Behavior (OHB): This section assessed toothbrushing, flossing, mouthwash use, and the date and reason for the last dental visit, with a total score ranging from 5 to 25, where higher scores indicated better oral hygiene behavior.

Part 3: Attitude (A): Five items assessed attitudes toward specific oral health behaviors using a five-point Likert scale ranging from 1 (extremely unpleasant) to 5 (extremely pleasant), with higher scores indicating more positive attitudes.

Part 4: Subjective Norms (SN): Two items per behavior assessed subjective norms using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Part 5: Perceived Behavioral Control (PBC): Three items per behavior assessed perceived behavioral control using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating greater perceived control.

Part 6: Oral Health Knowledge (OHK): Eleven true/false questions adapted from Buunk-Werkhoven et al. [17] assessed oral health knowledge, with correct answers scored as 1 and incorrect answers as 0, yielding a total score of 0–11.

Next, a trained periodontist assessed plaque and gingival index as follows: The Plaque Index (PI) was assessed according to the criteria established by Silness and Löe (1964) [18]. The Ramjford teeth were assessed for the index. These included teeth no 16, 11, 24, 36, 31, 44). Six sites per tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, distolingual) were examined

using a sterile UNC 15 probe under controlled lighting. Plaque thickness at the gingival margin was scored as follows:

- **0**: No plaque detected.
- **1**: Thin plaque film visible only by probe movement.
- **2**: Moderate plaque deposits (visible to the naked eye).
- **3**: Abundant plaque with gingival inflammation.

The PI for each tooth was calculated as the mean score of its six sites. The participant's overall PI was derived by averaging scores across all teeth. Gingival health was evaluated using the Gingival Index (GI) by Löe and Sillness (1963) [18], with emphasis on bleeding as a key metric. After plaque assessment, the same probe was gently inserted into the gingival sulcus (≤20g pressure). Bleeding response was recorded 30 seconds post-probing. Sites were scored as:

- **0**: Healthy gingiva, no bleeding.
- **1**: Mild gingival swelling and inflammation without bleeding on probing.
- **2**: Moderate gingival swelling and inflammation with bleeding on probing.
- **3**: Severe erythema, swelling and inflammation of gingiva, with spontaneous bleeding/ulceration.

Two trained periodontists performed assessments. Inter-examiner reliability (kappa = 0.82) was established via pre-study calibration using 10% duplicate examinations. Intra-examiner agreement exceeded 90%.

In the intervention group, the educational intervention was conducted in 3 sessions of 1 hour duration based on the principles of TPB.

The first session comprised of a lecture focused upon the changes that occur in oral and dental physiological changes during pregnancy, which was followed by a group

discussion on the barriers that the participants encounter in seeking dental treatment, and practical solutions to counteract them.

In the second session, principles of dental diseases prevention and the importance of good oral hygiene was emphasized along with training on the proper use of toothbrushes and dental floss. Guided by TPB with a focus upon the role of the perceived behavioral control in enabling change of behaviour and attitude, activities incorporating role playing were included.

In the third session, a lecture was given on the possible treatments that can be provided in different phases of pregnancy, the various contraindications as well as the consequences of untreated periodontal disease.

At the 3-month follow-up visit, the participants once again filled the beliefs and behaviors sections.

RESULTS

Demographic variables (age, parity, education level) and oral hygiene practices (brushing frequency, flossing habits, time since last dental visit) were comparable between the intervention and control groups at baseline (all $p > 0.05$), with no statistically significant differences observed (Table 1).

Table 1 Baseline sociodemographic characteristics and oral hygiene practices of partices of participants by study group

Variable	Column1	ntervention		Control		P-value
		Number	%	Number	%	
Number of pregnancy	1	21	32.3	28	43.1	0.196
	2	22	33.8	24	36.9	
	3	17	26.2	11	16.9	
	4	5	7.7	1	1.5	
	5	0	0	1	1.5	
Education	Primary	57	87.7	57	87.7	0.999
	Secondary	8	12.3	8	12.3	
Occupation	Employed	4	6.2	18	27.7	0.102
	Student	2	3.1	0	0	
	Unemployed	59	90.8	47	72.3	
Brushing Frequency	< once a day	3	4.6	0	0	0.18
	Once a day	51	78.5	56	86.2	
	Twice a day	11	16.9	9	13.8	
Flossing Frequency	Never	60	92.3	59	90.8	0.753
	Once a week	5	7.7	6	9.2	
Last dental visit	<6 months ago	5	7.7	5	7.7	0.999
	>2 years ago	6	9.2	6	9.2	
	Never	54	83.1	54	83.1	
Reason for last visit	Check up/scaling	4	6.2	5	7.7	0.91
	No prior dental visit	54	83.1	54	83.1	
	Pain	7	10.8	6	9.2	

Values are n (%). P-values were calculated using chi-square

**p < 0.05*

Similarly, inter-group comparisons of Oral Health Behavior Index (OHBI), Attitude, Subjective Norms, and Perceived Behavioural Control scores revealed no significant baseline disparities ($p > 0.05$) (Table 2).

Table 2 Oral health beliefs, knowledge and clinical indices at baseline and 3-month follow-up by group

Variable	Group	Before the intervention	3 months after the inte	p-value
Oral Health Behaviour Index	Intervention	10.40 ± 2.524	21.03 ± 2.710	**0.0028***
	Control	9.80 ± 2.202	10.25 ± 2.733	0.392
	p-value	0.151	**0.001** *	
Attitude	Intervention	10.91 ± 2.542	21.05 ± 2.730	**0.001***
	Control	10.91 ± 2.473	10.91 ± 2.473	0.092
	p-value	0.999	**0.001***	
Subjective Norm	Intervention	10.17 ± 2.133	21.05 ± 2.730	**0.012***
	Control	10.11 ± 2.379	10.11 ± 2.379	0.142
	p-value	0.876	**0.006***	
Perceived Behavioural Contrc	Intervention	11.09 ± 2.777	21.17 ± 2.565	**0.027***
	Control	9.97 ± 2.250	10.22 ± 2.267	0.092
	p-value	0.112	**0.001***	
Oral Health Knowledge	Intervention	4.34 ± 1.603	8.49 ± 1.778	**0.015***
	Control	4.08 ± 1.744	4.23 ± 1.637	0.96
	p-value	0.375	**0.004***	
Plaque Score	Intervention	1.726 ± 0.5691	1.294 ± 0.4690	**0.008***
	Control	1.563 ± 0.6635	1.808 ± 0.4731	0.45
	p-value	0.134	**0.006***	
Gingival Index	Intervention	1.445 ± 0.5791	0.935 ± 0.4211	**0.023***
	Control	1.358 ± 0.6740	1.572 ± 0.6122	0.32
	p-value	0.435	0.102	

*Values are mean ± SD (n = 65 per group).Within-group p-values compare baseline and 3-month follow-up (paired t-test); between-group p-values compare intervention and control at each time point (independent-samples t-test)*p < 0.05*

Statistically significant differences were seen between the two groups across several variables. The OHBI scores in the intervention group went from 10.40 ± 2.524 to 21.03 ± 2.710 (p=0.002), while in the control group an insignificant (p= 0.392) difference, from 9.80 ± 2.202 to 10.25 ± 2.733. Intra-group comparison was statistically insignificant at baseline (p=0.151), but statistically different at followup (p=0.001).

Similar results were seen in Attitude, where a statistically significant difference (p=0.001) was observed in the Intervention group in followup as compared to baseline, while an insignificant difference was seen in the Control group (p=0.092). Significant difference (0.001) was seen at the followup in intra-group analysis.

Perceived Behavioural Control (PBC), reflecting participants' self-efficacy in modifying oral hygiene behaviors, showed no baseline differences between groups ($p = 0.112$). However, post-intervention PBC scores increased significantly in the intervention group ($p = 0.001$), indicating enhanced motivation to adopt improved practices.

Oral hygiene knowledge tested the level of knowledge regarding dental hygiene and its implications on the body. Once again an improvement was noted within the Intervention group at followup compared to baseline (0.015), and not in the control group (0.96).

Oral hygiene levels were assessed using Plaque Index and Gingival Index. At baseline there was an insignificant difference between both groups in plaque index (p=0.134) and gingival index (0.435). On follow-up a significant difference was observed between the groups in plaque score (0.006) but not in gingival index (0.102).

DISCUSSION

The present study was designed using the principles of Theory of Planned Behaviour (TPB) to target key TPB constructs (attitude, perceived behavioural control, subjective norms) to promote oral health practices amongst pregnant women. The results of the study indicate that the intervention program was indeed effective in improving the oral health knowledge, attitude and practices.

The study cohort comprised 130 women aged 18 to 25, with majority being in their first (37.7%) and second pregnancies (35.4%). Socioeconomic demographics revealed that most participants had received primary-level education only (87.3%) and were unemployed 81.5%. Oral hygiene practices were notably low: with most women reporting that they only brushed once a day (82.3%), never flossed (91.5%) and never visited a dentist (83.1%). These findings underscore that poor oral hygiene was a common problem across all women presenting to the JPMC maternity ward.

The efficacy of the educational program can be seen by the significant differences noted in the mean scores of knowledge, attitude, social norms and behavioural control in the intervention group. Guided by the Theory of Planned Behaviour, this educational program worked upon shifting attitudes and beliefs regarding oral hygiene practices to positively influence norms and practices regarding it. A similar study by Ebrahimipour et al., also noted an improvement in knowledge, attitude and perceived behavioural control amongst pregnant women who underwent an oral health educational program [19]. These findings could help dentists in educating patients and improving oral health behaviour and practises.

The TPB is based upon the principle that the stronger a person's intention to act is, the greater is the likelihood of them performing that particular task or behaviour [20]. In the current study, the educational program was designed at identifying and correcting the barriers to oral hygiene, linking them with the perceived behavioural control and subjective norms. Studies have shown that oral health education programs can improve knowledge, attitudes and practices, leading to enhanced plaque control and a reduction in gingival diseases and caries [21,22].

In a study to identify determinants of oral hygiene practices, Brein et al. applied the theory of planned behaviour and identified a strong association between brushing and attitude and perceived behavioural control. These findings underscore the importance of dentists and dental hygienists incorporating the use of these psychological constructs into patient-centric interventions for more effective patient home care [23]. Similar results were found by Mohammadkhah et al. who applied TPB on pregnant women to educate them about oral health, where they found a positive change in knowledge, attitude and practises by the application of principles of TPB [24].

In the intervention group, oral health care education was provided in a series of small group face-to-face sessions in a combination of lectures and discussions. This was done in accordance with a study conducted by Karimi et al. that highlighted the importance of lectures on knowledge and attitude, as compared to pamphlets and other modes of information transfer [25]. Face-to-face interactions continue to be the gold standard for education, reinforcing knowledge retention and fostering enduring positive changes in behavior.

In Pakistan, widespread myths and misconceptions with regards to oral health care in pregnancy, which creates barriers to accessing care [26]. In order to address these community misconceptions, clear and targeted educational programs should be delivered through structured sessions in accessible settings like local clinics.

The current study has notable limitations. Firstly, it was conducted in a single centre, and is not representative of the entire population. Most participants were primary educated and not working. Further assessment using working women, who have greater education must be undertaken to assess how socioeconomic factors influence outcomes. Secondly, the pre-natal oral health assessment was not done, and it cannot be ascertained whether the level of oral hygiene was directly linked to pregnancy. We also recommend the use of other psychological theories to reinforce oral hygiene practices.

CONCLUSIONS:

This study demonstrated the efficacy of a TPB-based educational intervention on oral health beliefs and behaviors among pregnant women in Pakistan, underscoring its potential role in maternal oral health education.

KEYWORDS:

Pregnancy; Oral health; Oral health education; Theory of Planned Behavior; Oral health practices.

DECLARATIONS:

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Institutional Review Board, Jinnah Postgraduate Medical Centre, approval No F.2-81/2023-GENL/156/JMPC.

The study was conducted in accordance with the relevant ethical guidelines and regulations.

Consent to participate

Written informed consent was obtained from all participants before their participation in the study.

CONSENT FOR PUBLICATION

Not applicable

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during this study are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests

CONFLICT OF INTEREST

None to declare

FUNDING

None.

AUTHORS' CONTRIBUTIONS

Dr. Tahira Hyder: concept and design of the research study, acquisition of data, drafting manuscript, approval of final version, accountable for accuracy and integrity.

Dr. Farzeen Tanwir:design of study, data analysis, supervision and approval of final version

Dr.Nighat Shah:design of study, data acquisition, critical analysis, final approval

Dr. Uroosha Jam: data collection. Drafting manuscript, final approval.

Dr. Aliya Nadeem: data collection, drafting manuscript, final approval

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