



# Determinants of Tooth Brushing Behavior among Pregnant Women: An Application of the Pender's Health Promotion Model



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## ABSTRACT

**Aims** It is very important to maintain oral health during pregnancy because it has short- and long-term effects on the health of women and children. This study aimed to identify the factors affecting tooth brushing behavior among pregnant women based on Pender's Health Promotion Model.

**Instruments & Methods** This cross-sectional descriptive-analytical study was performed on 275 pregnant women under the coverage of the health centers of Arak, Iran, selected by cluster sampling method in 2021. Data were collected using a questionnaire, which was constructed and validated in this study. The questionnaire contained items about demographic variables and Health Promotion Model constructs. Data were analyzed in SPSS 18 software using regression models.

**Findings** The mean age of participants was 29.67±5.54. Only 24% of pregnant women brushed twice a day or more. Perceived Self-efficacy ( $\beta=0.157$ ,  $p=0.020$ ), perceived barriers of action ( $\beta=-0.138$ ,  $p=0.049$ ), and interpersonal influence (modeling) ( $\beta=0.188$ ,  $p=0.002$ ) had significant relationships with commitment to a plan of action. The pregnant women who had more self-efficacy (OR: 1.114, 95% CI: 1.012-1.225) and more commitment to a plan of action (OR: 1.802, 95% CI: 1.509-2.153) were more likely to brush their teeth twice or more a day.

**Conclusion** Perceived self-efficacy and commitment to a plan of action are determinant factors of brushing behavior in pregnant women based on Pender's Health Promotion Model.

**Keywords** Pregnancy; Health Promotion; Tooth-brushing; Oral Health; Theory

## CITATION LINKS

[1] Quality of life during ... [2] The Importance of ... [3] Assessment of the ... [4] Apical periodontitis ... [5] Association between ... [6] Periodontal disease ... [7] Effect of periodontal ... [8] Periodontal disease ... [9] Relationship between ... [10] Effect of intensive ... [11] Oral health ... [12] The association between ... [13] A survey of oral ... [14] Oral health ... [15] Oral health status ... [16] Assessment of dental ... [17] Oral health ... [18] Pregnant patient ... [19] Periodontal disease ... [20] The oral health ... [21] Impact of social ... [22] Factors affecting ... [23] The different roles ... [24] Oral health knowledge ... [25] Evaluating oral ... [26] Knowledge, attitudes ... [27] Health promotion ... [28] Oral health ... [29] Effect of education ... [30] The effect of ... [31] Educational intervention ... [32] Effect education ... [33] Effect of educational ... [34] Oral and dental ... [35] The effect of ... [36] Are stage of ... [37] The relationship ... [38] The effect of ... [39] Discovering expectant ... [40] A quantitative approach ... [41] A psychometric ... [42] Self-reported ... [43] Factors affecting ... [44] Self-reported oral ... [45] KAP Assessment ... [46] Pattern of oral ... [47] The role of ... [48] Cognitive-behavioral ... [49] Determinants of oral ... [50] Factors affecting ... [51] Predicting oral ...

## Introduction

It is very important to maintain oral health during pregnancy because it has short- and long-term effects on the health of women and children and is directly related to their quality of life [1]. Pregnant women are more vulnerable to periodontal diseases and dental caries during pregnancy due to physiological conditions, hormonal changes, and nutritional conditions [2, 3]. Many studies have shown periodontal disease as a risk factor for adverse pregnancy outcomes such as preterm birth, low birth weight, preeclampsia, abortion, etc. [4-8]. As the main etiological factor in the development of periodontal diseases is dental plaque, its control can reduce hormonal effects during pregnancy [9-11]. Tooth brushing, as a common effective method for cleaning teeth, can play a major role in plaque control and reducing the risk of periodontal diseases [12]. A variety of studies in Iran have indicated a low daily tooth brushing frequency among Iranian pregnant women. Previous studies in Kerman and Arak showed that only 29.1% and 19.1% of pregnant women brushed their teeth twice a day or more in these two cities, respectively [13, 14]. Studies in Varamin and Hamadan also showed that 64.1% and 68% of pregnant women brushed their teeth only once a day in the two cities, respectively [15, 16]. Therefore, it shows the necessity of oral health education during pregnancy.

On the other hand, designing health promotion interventions requires identifying the factors affecting oral health-promoting behaviors in pregnant women. Previous descriptive studies have shown that in addition to socio-economic factors, individual factors such as low health literacy, misconceptions and insufficient knowledge, as well as interpersonal factors such as social capital and family support, are effective factors in oral health during pregnancy [17-24]. At the interpersonal level, service providers such as dentists, obstetricians, midwives, health care providers and local providers play an important role in promoting the oral health of pregnant women [24-26]. Considering that Pender's Health Promotion Model (HPM) falls within middle-range theories and includes individual and interpersonal levels, it was selected as the theoretical framework of the present study. The Revised HPM encompasses factors influencing behavior, including individual characteristics and experiences and behavioral consequences. Behavior-Specific Cognitions and Affect are considered major motivational factors in the model and include perceived benefits of action, perceived barriers of action, perceived self-efficacy, affect cues to behavior,

interpersonal influencers, situational influences, commitment to a plan of action and immediate competing demands and preferences [27]. A systematic study showed that limited intervention studies during pregnancy have paid attention to environmental factors [28]. In Iran, interventional studies have been conducted about oral health during pregnancy, which are mainly based on individual theories and have not considered interpersonal factors [29-35]. Also, the limited descriptive theory-based studies conducted to determine the predictors of oral health in pregnant women have mostly covered the individual-level theories [13, 36, 37], while the HPM considers both the individual and the interpersonal level. Therefore, the present study aimed to identify the factors affecting the tooth brushing habit among pregnant women based on Pender's HPM.

## Instruments and Methods

This is a cross-sectional (descriptive-analytical) study that was conducted on 275 pregnant women visiting health centers in Arak, Iran, over July to September 2021. The total number of pregnant women with records in Arak health centers at the time of the sampling was 2047. The following formula was used to determine the sample size:  $n = p \cdot q \cdot (Z_{1-\alpha/2})^2 / d^2$

Considering  $\alpha=0.05$  and  $p=43.4$ , which indicates the prevalence of brushing behavior based on a previous study [13], and  $d=0.052$ , and applying a cluster sampling correction coefficient of 1.5 times, the final sample size of 275 people was determined.

The cluster sampling method was used to select the samples. As Arak is divided into five municipal districts, its health centers were divided based on the five districts. Several health centers were randomly selected from among the health centers of each district (18 health centers out of the 50 centers: 4 centers in Region 1, 2 centers in Region 2, 5 centers in Region 3, one center in Region 4, and 6 centers in Region 5) using the cluster sampling method and considering the population of that district. The total number of pregnant women covered by the selected health centers was extracted from the sib website (<https://sib.iums.ac.ir>), and the sample size allocated to each health center was selected using a simple sampling method. The inclusion criterion was having a pregnancy record in one of the health centers of Arak, and the exclusion criteria were having orthodontic treatment, having complex problems during pregnancy, and not completing the questionnaire. The present study was carried out in accordance with the Declaration of Helsinki. Selected

pregnant women were called, and the objectives of the study were explained. If pregnant women consented to participate in the study, they were included in the study. Informed consent was completed by all participants. Then they were briefed about how to complete the questionnaire. Considering the conditions of pregnant women, each questionnaire was filled out in a separate room, and the participants were provided with chairs to sit on. After completing the questionnaire, a toothbrush and toothpaste were given to women, and the importance of oral hygiene during pregnancy and brushing with a proper technique (Bass technique, two times a day for 2-3 minutes) were explained.

### Survey scale

The questionnaire consisted of two sections: questions related to demographic information, including age, gestational age, level of education, number of children, spouse's job, the pregnant woman's job and insurance status and questions related to Pender's model's constructs. Items related to the model's constructs were based on the literature and similar research [13,38, 39]. To determine the validity of the content, a questionnaire was sent to 8 professors of the health education and promotion field, one periodontist, and one maternal and child health specialist. Content validity was assessed through the Content Validity Ratio (CVR) and the Content Validity Index (CVI). Items with a CVR<0.62 were removed based on the Lawshe Table, and options with a CVI between 0.70 and 0.79 were revised [40, 41]. Finally, the content validity rate and content validity index were 0.85 and 0.89, respectively. To determine the face validity of the questionnaire, 15 pregnant women were interviewed about their difficulty in comprehension, possible misunderstandings or unclear meanings of the words and phrases, and necessary corrections were made. To determine the reliability of the questionnaire, it was filled out by 30 pregnant women, and Cronbach's alpha was calculated for the constructs from 0.61 to 0.84 (Table 1). Questions related to the model's constructs consist of 11 parts (46 items).

Items related to perceived benefits (e.g., "I think tooth brushing reduces the risk of gum diseases"), perceived

barriers (e.g., "Nausea during pregnancy prevents me from brushing my teeth"), perceived self-efficacy (e.g., "How sure are you to brush your teeth even if you feel sick and bored"), positive affect cues to behavior (e.g., "I feel happy and refreshed when I brush my teeth), negative affect cues to behavior (e.g., "I feel bored when I brush my teeth), situational influences (e.g., "Placing a toothbrush and toothpaste inside a glass in the kitchen can remind me to brush twice a day), immediate competing demands or preferences (e.g., "I prefer to go to bed and not brush my teeth at nights when I feel so tired) were rated based on a five-point scale (from "strongly disagree" = 0 to "strongly agree" = 4). The interpersonal influences (social norms) construct (e.g., "To what extent does your spouse expect you to brush your teeth and encourage you to do so?) scored as follows: always = 4, often = 3, sometimes = 2, rarely = 1, never = 0. Also, interpersonal influences (modeling) construct (e.g., "How often does your spouse brush?) scored as follows: never = 1, sometimes (once every two or three days) = 2, once a day = 3, twice a day = 4, three times a day = 5 and, I don't know = 0. Commitment to a plan of action was measured using two items ("How committed are you to brush your teeth regularly, twice a day"? And "How committed are you to brush your teeth thoroughly for two to three minutes each time you do so?). It was scored as follows: very high = 4, high = 3, somewhat = 2, a little = 1, never = 0. Behavior was measured using one question (i.e., how often do you brush your teeth): Code 1 was given to brushing twice or more a day, and code 0 was given to brushing lower frequency.

### Statistical analysis

Data were entered in SPSS 18 software and analyzed using regression models. The significance level of the tests was considered 0.05. Multiple logistic regression was used to investigate the relationship between demographic characteristics and model structures with the desired number of brushing times per day (twice a day) by the backward method. Also, multiple linear regression was used to evaluate the predictability of model structures regarding commitment to a plan of action.

**Table 1)** Number of questions, the range of scores, and Cronbach's alpha for the constructs of the health promotion model

Variable	Number of questions	Cronbach's alpha coefficients	Range of scores
Perceived benefits of action	8	0.81	0-32
Perceived barriers of action	5	0.74	0-20
Perceived self-efficacy	5	0.79	0-20
Positive affect cues to behavior	3	0.79	0-12
Negative affect cues to behavior	3	0.84	0-12
Interpersonal influences (modeling)	5	0.61	0-25
Interpersonal influences (social norms)	4	0.79	0-16
Situational influences	7	0.76	0-28
Commitment to a plan of action	2	0.62	0-8
Immediate competing demands and preferences	3	0.65	0-12

## Findings

The mean age of participants was  $29.67 \pm 5.54$  and ranged from 18 to 46 years. A total of 123 (44.72%) participants had experienced their first pregnancy, and 88% were housewives. The characteristics of the participants are presented in detail in Table 2.

**Table 2)** Frequency of demographic characteristics of the studied pregnant women (n=275)

Characteristics	Frequency	Percentage
<b>Age</b>		
Under 25 years	63	22.9
26 to 35 years	168	61.1
More than 36 years	44	16
<b>Education</b>		
Under diploma	53	19.27
Diploma	116	42.5
Academic	106	38.5
<b>Number of children</b>		
No children	123	44.72
One child or more	152	55.3
<b>Gestational age</b>		
First trimester	26	9.5
Second trimester	103	37.5
Third trimester	146	53.1
<b>Insurance status</b>		
Yes	233	84.7
No	42	15.3
<b>Occupation</b>		
Housewife	242	88
Employed	33	12
<b>Spouse's job</b>		
Unemployed	6	2.2
Employed	87	31.6
Self-employment	182	66.2

2.9% of the participants did not brush their teeth, 14.5% brushed once every 2 to 3 days, half of the participants

brushed once a day (58.9%), and 23.6% brushed twice or more.

The score of commitment to a plan of action showed a very low level of the participants' commitment to a regular schedule for brushing twice a day and brushing thoroughly for 2 to 3 minutes (Table 3).

Perceived self-efficacy ( $\beta=0.157$ ,  $p=0.020$ ), perceived barriers of action ( $\beta=-0.138$ ,  $p=0.049$ ), and interpersonal influences ( $\beta=0.188$ ,  $p=0.002$ ) had significant relationships with commitment to a plan of action (Table 4).

An increase in each score of perceived self-efficacy and interpersonal influences led to an increase in the probability of commitment to a plan of action by 15% and 18%, respectively, and a decrease in each score of perceived barriers of action led to an increase in the probability of commitment to a plan of action by 13%. Interpersonal influences (modeling) had the greatest predictive power. In general, the constructs of Pender's HPM accounted for 21% of the changes in the commitment to a plan of action among the pregnant women under study.

Also, the perceived self-efficacy and commitment to a plan of action had significant relationships with tooth-brushing behavior in the adjusted model. Women who had more self-efficacy (OR: 1.114, 95% CI: 1.012-1.225) and more commitment to a plan of action (OR: 1.802, 95% CI: 1.509-2.153) were more likely to brush twice or more a day (Table 5).

**Table 3)** Description of Health Promotion Model constructs among participated pregnant women

Variable	Mean $\pm$ SD	Percentage
Perceived benefits of action	24.94 $\pm$ 3.98	77.93
Perceived barriers of action	7.84 $\pm$ 3.77	39.2
Perceived self-efficacy	12.26 $\pm$ 4.31	61.3
Positive affect cues to behavior	10.68 $\pm$ 1.59	89
Negative affect cues to behavior	2.53 $\pm$ 1.81	21.08
Interpersonal influences (modeling)	11.04 $\pm$ 3.66	44.16
Interpersonal influences (social norms)	10.52 $\pm$ 4.31	65.75
Situational influences	18.26 $\pm$ 4.32	65.21
Commitment to a plan of action	1.39 $\pm$ 2.24	17.37
Immediate competing demands and preferences	5.58 $\pm$ 2.58	46.5

**Table 4)** Predicting the commitment to a plan of action based on the model constructs using multiple linear regression analysis.

Independent variables	Unstandardized coefficients		Standardized coefficients		P-value	95% confidence interval for regression coefficients (B)		Adjusted R <sup>2</sup> (%)
	B	Standard error	Beta	t		Lower bound	Upper bound	
Constant number	-4.455	1.642	-	-2.713	0.007	-7.689	-1.222	0.21
Age(year)	0.042	0.215	0.012	0.195	0.846	-0.381	0.464	
Education	0.111	0.198	0.036	0.559	0.577	-0.279	0.500	
Number of children	0.153	0.269	0.034	0.568	0.570	-0.376	0.682	
Gestational age	0.251	0.184	0.074	1.361	0.175	-0.112	0.614	
Insurance status	0.385	0.350	0.062	1.101	0.272	-0.303	1.073	
Occupation	0.292	0.405	0.042	0.721	0.472	-0.506	1.089	
Spouse's job	0.221	0.240	0.051	0.920	0.358	-0.252	0.693	
Perceived benefits	0.062	0.039	0.110	1.589	0.113	-0.015	-0.015	
Perceived barriers	-0.082	0.042	-0.138	-1.976	0.049	-0.164	-0.164	
Perceived self-efficacy	0.082	0.035	0.157	2.350	0.020	0.013	0.013	
Positive affect cues to behavior	0.083	0.096	0.058	0.860	0.391	-0.107	-0.107	
Negative affect cues to behavior	-0.039	0.083	-0.028	-0.473	0.636	-0.204	-0.204	
Interpersonal influences (modeling)	0.095	0.031	0.188	3.113	0.002	0.035	0.035	
Interpersonal influences (social norms)	0.060	0.036	0.098	1.658	0.098	-0.011	-0.011	

**Table 5)** Crude model and adjusted model for predicting the tooth brushing behavior based on the constructs of the Health Promotion Model using multiple logistic regression analysis by a backward method

Independent variables	Crude model		P-value	Adjusted model		P-value
	OR	95% CI		OR	95% CI	
<b>Age (year)</b>						
Under 25 years	1	1		-	-	
26 to 35 years	0.658	0.283-1.529	0.184	-	-	-
More than 36 years	0.509	0.246-1.052		-	-	
<b>Education</b>						
Under diploma	1	1		-	-	
Diploma	0.381	0.876-0.168	0.004	-	-	-
Academic	0.389	0.208-0.726		-	-	
<b>Number of children</b>						
No children	1.552	0.890-2.707	0.121	0.538	0.263-1.103	0.091
One child or more	1	1		1	1	
<b>Gestational age</b>						
First trimester	0.346	0.098-1.215		0.828	0.195-3.511	
Second trimester	0.762	0.423-1.373	0.209	1.167	0.293-4.465	0.500
Third trimester	1	1		1	1	
<b>Insurance status</b>						
Yes	1.012	0.468-2.189	0.975	-	-	-
No	1	1		-	-	
<b>Occupation</b>						
Housewife	0.312	1.47-6.61	0.003	2.079	0.785-5.503	0.141
Employed	1	1		1	1	
<b>Spouse's job</b>						
Unemployed	1	1		-	-	
Employed	2.13	0.23-19.14	0.292	-	-	-
Free job	1.36	1.55-12.15		-	-	
<b>Health Promotion Model constructs</b>						
Perceived benefits of action	1.123	1.041-1.211	0.003	-	-	-
Perceived barriers of action	0.803	0.734-0.879	<0.001	-	-	-
Perceived self-efficacy	1.123	1.041-1.211	0.001	1.114	1.012-1.225	0.027
Positive affect cues to behavior	1.431	1.151-1.781	<0.001	-	-	-
Negative affect cues to behavior	0.781	0.661-0.924	0.004	-	-	-
Interpersonal influences (modeling)	1.123	1.048-1.203	0.001	-	-	-
Interpersonal influences (social norms)	1.164	1.069-1.271	0.001	-	-	-
Situational influences	1.017	0.953-1.084	0.618	1.068	0.983-1.160	0.120
Commitment to plan of action	1.877	1.600-2.226	<0.001	1.802	1.509-2.153	0.000
Immediate competing demands and preferences	0.689	0.605-0.784	<0.001	-	-	-

## Discussion

Gingival and periodontal health during pregnancy is affected by a variety of modifiable and non-modifiable factors. One of these modifiable factors is tooth brushing, which is the simplest method of removal of bacterial plaque that is considered as the major culprit in periodontal disease. Tooth brushing is influenced by various cognitive and social factors, and understanding these factors can help healthcare planners in designing effective health promotion interventions. Therefore, the present study was conducted based on Pender's HPM to identify factors affecting tooth brushing behavior among pregnant women in Arak.

The results of the present study revealed the pregnant women enrolled in the present study did not have an appropriate frequency of tooth brushing per day, and only 24% of them brushed twice a day. In line with the results of the present study, various studies in Iran have shown that Iranian pregnant women brush their teeth less frequently than required. For example, Afshar's study in Kerman showed that only 29.1% of women brushed their

teeth twice a day or more [14]. Dehghanipour's study in Varamin showed that 61.4% of mothers brushed their teeth only once a day [15]. Comparing the findings of the present study with those of Shamsi *et al.*'s study [13], conducted on pregnant women in Arak in 2012, an increase in tooth brushing frequency can be seen. However, the results of both studies showed that the participants generally brushed their teeth less frequently than required. Studies on pregnant women in other countries have shown different results about self-reported brushing habits of twice a day. This rate has been 84% as in Beneyto *et al.*'s study [42] in Spain, 79.4% in Amin *et al.*'s study [43] in Edmonton, Canada, 64% in Honkala *et al.*'s study [44] in Kuwait, 20.9% in Avula *et al.*'s study [45] in Hyderabad, India, and 29% in Lasisi *et al.*'s study [46] in Nigeria. These differences can be due to different socio-cultural backgrounds.

The results of the present study indicated that perceived self-efficacy, perceived barriers of action, and interpersonal influences had statistically significant relationships with commitment to a plan of action in pregnant women. In line with the results

of the present study, in Haghi *et al.*'s study [47] and Banaye Jedd *et al.*'s study [48], perceived self-efficacy and perceived barriers of action were predictors of commitment to a plan of action. Also, consistent with Banaye Jedd *et al.*'s study [48], interpersonal influences were the predictors of commitment to a plan of action. Overall, the HPM constructs explained 21% of the changes in commitment to a plan of action in pregnant women in the present study. In the study of Haghi *et al.* [47] and Banaye Jedd *et al.* [48], the HPM constructs described 58% and 26.4% of the changes in commitment to a plan of action among students, respectively.

Based on the HPM model, self-efficacy can influence commitment to a plan of action both directly and indirectly. In the indirect effect, the model suggests that perceived self-efficacy affects commitment to the action plan through perceived barriers. As such, individuals with higher self-efficacy perceive fewer barriers in their minds concerning accomplishing health behaviors, and thus they most probably commit to the action plan. Barriers are often considered mental barriers and personal costs to do certain behaviors [27]. The present study, in line with other studies [13, 16], has reported misconceptions about brushing (such as: believing that brushing two to three times a day damages the gums, etc.), impatience, fatigue, and nausea to be among the perceived barriers of action to the tooth brushing behavior during pregnancy. Therefore, offering solutions to overcome the barriers (such as: discussing the misconceptions about brushing, recommending brushing at any time of the day when a pregnant woman is in a better mental and physical condition and not necessarily before bed or after meals, etc.) can be effective in overcoming the perceived barriers of action and adhering to a plan of action. Furthermore, interpersonal influences determine individuals' readiness to engage in health-promoting behaviors [27]. When the family and family members (spouse, mother, etc.) are committed to healthy behaviors, they can be both a role models and a source of support for the individual. Therefore, taking account of these factors can also be important in the design of interventions.

The findings of the present study indicated that among the HPM constructs, perceived self-efficacy and commitment to a plan of action had a statistically significant relationship with tooth-brushing behavior in pregnant women. In line with the findings of the present study, Rahmani *et al.* [22], Banaye Jedd *et al.* [48], Shamsi *et al.* [13], Haghi *et al.* [47], Vakili *et al.* [49], Kim *et al.* [50], and Charkazi *et al.* [51] reported the perceived self-efficacy as a predictor of oral health

behaviors. Given the important role of self-efficacy, individuals are motivated to perform health behaviors and even do them to respond to challenges when they feel that they can control health behaviors. Therefore, a pregnant woman will continue her healthy behavior even when she experiences problems such as sensitive gums, possible bleeding while brushing, nausea, and feeling tired and bored during pregnancy.

The results of the present study, in line with the results of other studies [47-49, 51], showed commitment to a plan of action to be a determinant of oral health behaviors. According to the theoretical framework of the HPM, people usually get more involved in planned behaviors than in unplanned ones. Therefore, having a regular brushing schedule at a specific time and place in the day, regardless of the immediate competing preferences of the behavior, can play a role in increasing the commitment to oral health behaviors in pregnant women.

### Strengths and limitations

The strength of the present study was the sampling that was done from all of the health centers in the city. Considering that the health centers cover about 85% of all pregnant women in the city, the sample size can represent the target population. The limitation of the current study and similar studies is that the information related to the behavior is self-reported. It is recommended to conduct future studies in different areas and setting, which may have a different socio-cultural background. It is also suggested to conduct studies with a theoretical framework that consider different determinants in relation to oral health during pregnancy.

It is hoped that the results of the present study will be used in designing health promotion interventions to improve tooth brushing behavior among pregnant women.

### Conclusion

The studied pregnant women do not brush their teeth frequently enough (at least 2 times a day). Perceived self-efficacy and commitment to a plan of action are determinants of tooth-brushing behavior among pregnant women.

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**Ethical Permission:** This study was approved by the Research Ethical Committee of Hamadan University of Medical Sciences (IR.UMSHA.REC.1399.863). Informed consent was completed by all participants.

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