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# DMFT and OHIS Indexes in Pregnant Mothers: An Explanation Based on the Health Belief Model

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**ABSTRACT**

**Introduction**: Oral health, including dental health, is one of the most important parts of public health. The purpose of this study was to assess the factors influencing oral and dental health in pregnant mothers in urban health centers in Khorramabad, Iran in 2016, based on the Health Belief Model (HBM).

**Methods**: In this cross-sectional study, 340 pregnant mothers living in Khorramabad, Iran were selected from health centers using multi-stage random sampling. The decayed, missing, filled teeth (DMFT) index, the Oral Health Index – Simplified (OHIS), the health belief model (HBM) scale, and performance regarding oral and dental health care were measured and the data were analyzed. This data were analyzed using the SPSS 20 software and descriptive statistical tests, the Pearson correlation coefficient, and linear regression.

**Results**: The mean DMFT score was 7.8 ± 3.27 and the mean OHIS score was 2.74 ± 1.65. The Pearson correlation coefficient showed a direct and significant relationship between the constructs of the health belief model and performance ($p < 0.05$). Among the constructs of the health belief model, self-efficacy (22.2 %) had the highest predictive power. In addition, there was a positive correlation between the DMFT and OHIS scores.

**Conclusion**: The present study showed that cognitive barriers are associated with oral and dental health behaviors and they should receive attention from oral and dental health professionals. On the other hand, the most important predictive variable of oral health care among pregnant mothers is self-efficacy. Therefore, the self-efficacy of pregnant women should be boosted for them to practice good oral and dental health care.

**Keywords**: Health Belief Model, Pregnant Mothers, DMFT, OHIS.

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## Introduction

Tooth decay is one of the most common human diseases and is not limited to specific ages, sexes, races, geographical regions, seasons, or races [1]. The World Health Organization (WHO) considers oral health a necessity and part of general health throughout life, and argues that poor oral and dental health can have a profound impact on quality of life [2, 3]. The WHO set out to decrease in tooth decay and gum disease by 15% and 48% respectively among people aged 35 – 44 by 2010 [4]. Pregnant women are particularly vulnerable to caries and periodontal diseases due to their specific physiological conditions, as well as nutritional and hormonal changes. Lack of attention to this important issue can not only cause oral and dental problems, but also can endanger other bodily systems and the health of the fetus [5-7]. Studies have shown that there is a strong relationship between a mother's poor oral health and pre- and postnatal complications, including low birth weight, preeclampsia, and preterm labor. Additionally, poor dental health during pregnancy can lead to early tooth decay in the children to these mothers [8-10].

The mean DMFT index in pregnant women is higher than other members of the society. For example, the index determined in a study of Brazilian pregnant women was 10 [11], while that of expectant mothers in Ahvaz, Iran, was 6.3 ± 23.01, and of pregnant women in Arak, Iran, mean of DMFT was 5.2 ± 4.83 [12, 13]. In some studies, the average oral health index (OHIS) score was higher in pregnant women than non-pregnant women. In a study in India, the mean OHIS score in pregnant women was 1.03±0.99 and in non-pregnant women, it was 0.59±0.46. In another report, this score was 1.26±0.78 in pregnant women in Nigeria [14, 15]. According to studies by Thomas et al. and Shamsi et al., over half of pregnant women had not been visited by a dentist during their recent pregnancy. These figures indicate a poor oral health culture among pregnant women and the need to take appropriate actions [16-18].

The effectiveness of health education programs largely depends on the proper use of theories and models used in health education. This means that the better the theories regarding public health needs, the more effective the training programs become [19]. One of the effective models in health education and health promotion is the health belief model (HBM), which is used to promote preventive behaviors [20]. Based on this model, a person undertakes preventive health behaviors when he believes he is at risk of catching an illness (perceived susceptibility), and disease leads to poor results for him (perceived severity). Additionally, there are behaviors that help prevent the disease or reduce the severity of disease symptoms (perceived benefits). However, there are physical, psychological, or financial barriers to undertaking these behaviors (perceived barriers). Moreover, in order to undertake a specific behavior, one must perceive oneself as capable of undertaking the preventive behaviors (perceived self-efficacy) [21].

The positive effect of the HBM on the adoption of oral and health care behaviors and the DMFT index has been confirmed in various studies [22-25]. The number of research studies conducted in Iran in the field of oral and dental care during pregnancy regarding dental plaque is rather limited. Therefore, in addition to the dental caries index (DMFT), the dental plaque and calculus index (OHIS) was used in the present study. Considering the increase in the mean DMFT score during pregnancy, the inappropriate oral health status in pregnant women, and the effect of oral health on pregnancy and its outcomes (birth weight, preterm labor, preeclampsia, etc.), this study aimed to investigate the relationship between psychological factors affecting behavior and OHIS and DMFT indices in pregnant mothers in Khorramabad, Iran.

## Methods

The present study was a cross-sectional study and the participants included 340 pregnant women referred to health centers in

Khorramabad, Iran in 2016. The inclusion criteria of the study were that the women be primiparous, residing in Khorramabad, literate, and giving informed consent to participate in the study. Exclusion criteria included being employment in dental professions and having advanced oral and dental diseases.

In this research, multi-stage random sampling method was used. To increase the accuracy of the study, and accurately represent the cultural and social characteristics of the population under study, the area of Khorramabad was divided into 5 districts (classes) of north, south, central, east and west. Within each geographical area (class), there are a number of urban health centers (cluster heads). Among the centers (cluster heads) of each district, 2 centers/bases were randomly selected for sampling (a total of 10 centers/bases in the whole city). Then, based on the population under the coverage of each health center, participants were randomly selected from each center. The number of participants was estimated using the prevalence formula as 340 people. Considering that in various studies in different societies, the prevalence of dental caries is very variable, ranging from 25% to 90% [13, 17, 26-28], in the present study, the lowest prevalence of 25% was used as a criterion for determining the sample size. Taking this value into account and setting an accuracy level of 0.05, the 95% confidence coefficient of the samples was estimated at 340 individuals.

$$n = \frac{Z^{2}_{\frac{(1-\alpha)}{2}} p.q}{d^2}$$

The data collection instrument was a questionnaire consisting of the following three sections. The first part included demographic information (demographic questions including age, level of education, occupation, gestational age in weeks, economic status, the insurance coverage status of the mother). The second consisted of the DMFT recording checklist (D = the number of decayed teeth, M = the number of missing teeth, F = the number of filled teeth) and the OHIS index (the dental plaque and calculus index). The third part consisted of questions related to the constructs of the Health Belief Model [29].

The DMFT and OHIS checklists were completed by a dentist during dental examinations. The DMFT index was used to the evaluate dental caries rate and, to evaluate dental plaque and calculus, the Oral Health Index - Simplified (OHIS) was put to use based on the Greene and Vermilion method [30]. This index is in fact a combination of the two indicators of dental plaque and dental calculus. By adding the scores of these two indexes, the OHIS value is obtained. Six surfaces of six teeth are examined in this method. These teeth include 4 posterior teeth of the four quadrants of upper and lower jaws and two anterior teeth. To determine the amount of debris as well as dental calculus, each of these surfaces was thoroughly examined. The extent and amount of debris and dental calculus on the surface of the examined teeth were determined and scores from zero to one were given: Zero means there is no debris on the tooth surface, and one means debris or calculus covers more than two thirds of the surface of the tooth. For each individual, the debris scores of all tooth surfaces were added and the sum was divided by the number of examined surfaces. The total score is determined by calculating the mean of the individuals' scores. The average score of a person or group is called the soft debris index. The same method was used to determine the simple hard calculus index in this study. The sum of the debris and calculus indices is called the Oral Health Index – Simplified (OHIS) [31]. All dental examinations were performed by a dentist to avoid any errors caused due to the differences among raters.

Questions related to the dimensions of the health belief model included 8 perceived susceptibility questions (such as to what extent mothers perceived themselves to be susceptible to dental caries and whether they considered themselves to be more vulnerable to caries than other social groups or not), 7 questions on perceived severity (including questions about the

complications that mothers or fetuses were likely to experience due to dental caries, and so on), 10 perceived benefits questions (questions about the benefits of oral and dental health and care behaviors, benefits such as preventing tooth decay, avoiding high expenditures, and positive effects on the embryo's health, etc.), 12 questions on perceived barriers (such as unfamiliarity with the proper techniques of brushing or flossing the teeth, lack of time and money to visit a dentist, feelings of malaise and boredom during pregnancy, etc.), 8 questions on self-efficacy (such as the ability to use toothbrush and dental floss correctly, the ability to overcome sleepiness and boredom, and the ability to start a low-sugar low-protein diet). The answers to all the questions in the attitudes section were marked on a standard 5-point Likert scale ranging from "completely agree" to "completely disagree". The performance checklist included 12 items about various areas such as brushing, flossing, regular visits to the dentist's, and using a fluoride mouthwash after vomiting. The first item of the checklist was measured and recorded through direct observation of the mothers' performance on a dental replica and the other performance items were completed based on the self-report statements of the mothers.

For scoring, a correct answer received a score of 1, and a wrong answer received a score of zero. In the section of the questionnaire devoted to the constructs of the health belief model, i.e. perceived susceptibility, severity, benefits, barriers and perceived self-efficacy, the score assigned to each answer ranged from 0 to 4, such that a "completely disagree" answer received a score of zero, "disagree" received a score of 1, "undecided" received a score of 2, "agree" received a score of 3, and "completely agree" received a score of 4. In the performance checklists section, each of the correct behaviors received a score of one, and each incorrect behavior received a score of zero. Overall, each of these sections (awareness, perceived susceptibility, severity, benefits, and barriers, self-efficacy and performance) was assigned a maximum total score of 100. The reliability and validity of this instrument have been confirmed in a study by Shamsi et al. [22].

The content validity of the data collection instrument was confirmed using extensive review of research literature, surveying the opinions and comments of specialists, including dentists working in health centers, midwives, and experts in health education. After eliminating the ambiguities, the instrument was adjusted and used. The general reliability of the instrument was calculated using Cronbach's alpha as 0.84. The reliability of the perceived susceptibility section of the questionnaire was confirmed as 0.73, that of the perceived severity part of the questionnaire was confirmed as 0.70, and the reliability of the self-efficacy section was confirmed at 0.76. The reliability of the performance checklist was calculated as 0.89 using the kappa coefficient. Given that the values of Cronbach's alpha, which were calculated for each of the studied dimensions and constructs in the present study, were greater than 0.70, the reliability of the instrument was evaluated to be satisfactory and confirmed.

Data were analyzed using the SPSS software version 20, using descriptive statistics (mean, standard deviation), and analytical tests including Pearson correlation coefficient, linear regression analysis, and the significance level was set at 0.05.

## Results

Results showed that the mean age of the pregnant women in the study was 27.6 ± 4 years and the mean gestational age of the fetuses was 9.1 ± 7.6 weeks. The most frequent educational attainment level of the participants in this study was university education and the lowest educational attainment level was primary school. The most frequent economic and financial status among the participants was the middle level and the lowest economic and financial status was the low level. In the present study, 93.7% of the pregnant mothers were employed and 60.3% were under the coverage of health insurance. The mean

DMFT score in this study was 7.8 ± 3.27 and the mean OHIS score was 2.74 ± 1.65. The average score of the mothers' performance regarding oral and dental health care was 44.5 in the present study. The results of Pearson correlation coefficients among the constructs of the HBM and performance are presented in Table 1.

In order to predict the performance of the elderly based on the constructs of the health belief model, stepwise linear regression analysis was used. Among the constructs of the health belief model, self-efficacy had the strongest predictive power (22.2%). Self-efficacy, perceived barriers, and perceived susceptibility predict up to 38.3% of the variations in performance. Self-efficacy and perceived barriers predict 31.9% of the variations in performance. The results of the multiple linear regression analysis indicated that, as self-efficacy increases by 1 unit, performance increases by 36.4%; as perceived barriers increases by 1 unit, performance decreases by 30.5%; and as perceived susceptibility increases by 1 unit, performance increases by 26.4% (Table 2).

In this study, to predict the DMFT index, the two indexes of Oral Health Index - Simplified (OHIS) and performance were entered into the model. However, from these two variables, only the Oral Health Index – Simplified (OHIS) could predict DMFT scores.

The results of this study showed that there is a positive correlation between OHIS index (Oral Health Index - Simplified) and the DMFT index (Decayed Missing Filled Teeth), i.e., as the amount of plaque and dental calculus increases, the number of filled, decayed and extracted teeth increases as well (r = 0.18, p = 0.04). The prediction regression coefficient of DMFT of pregnant mothers shows that as the OHIS score increases by 1 unit, the DMFT score increases by 0.05 units (Table 3).

**Table 1.** The Pearson correlation coefficient among the constructs of the health belief model.

| Variable | Awareness | Perceived Susceptibility | Perceived Severity | Perceived Benefits | Perceived Barriers | Perceived Self-Efficacy | Performance | |
|---|---|---|---|---|---|---|---|---|
| 1Awareness | r<br>p | 1 | | | | | | |
| Perceived Susceptibility | r<br>P | 0.045<br>-<br>0.616 | 1 | | | | | |
| Perceived Severity | r<br>p | 0.152<br>-<br>0.089 | * 0.277<br>*<br>0.002 | 1 | | | | |
| Perceived Benefits | r<br>p | 0.114<br>0.202 | *0.258<br>*<br>0.004 | **0.513<br>0.0001 | 1 | | | |
| Perceived Barriers | r<br>p | 0.055<br>-<br>0.541 | 0.123<br>0.172 | *0.215<br>0.016 | 0.095<br>0.290 | 1 | | |
| Perceived Self-Efficacy | r<br>p | 0.131<br>0.142 | -0.124<br>0.167 | -0.071<br>0.432 | 0.160<br>0.073 | -0.267<br>**<br>0.002 | 1 | |
| Performance | r<br>p | 0.209<br>*<br>0.019 | *0.346<br>*<br>0.0001 | *0.214<br>0.016 | 0.023<br>0.800 | -0.435<br>**<br>0.0001 | **0.487<br>0.0001 | 1 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

**Table 2.** Regression coefficients used in the prediction of the performance of pregnant mothers considering the scores of the constructs of perceived susceptibility and perceived barriers and self-efficacy presented in steps.

| Step | Source of variation | Unstandardized coefficients | | Standardized coefficients | t-value | P- value | $R^2$ |
|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Bata | | | |
| 1 | Constant | 7.773 | 0.094 | ……. | 18.176 | 0.000 | 0.22 |
| | Self-efficacy | 0.167 | 0.028 | 0.478 | 6.061 | 0.000 | |
| 2 | Constant | 5.331 | 0.693 | ……. | 7.688 | 0.000 | 0.33 |
| | Self-efficacy | 0.136 | 0.027 | 0.390 | 5.088 | 0.000* | |
| | Perceived barriers | -0.061 | 0.014 | -0.330 | -4.313 | 0.000* | |
| 3 | Constant | 3.840 | 0.773 | ……. | 4.970 | 0.000 | 0.39 |
| | Self-efficacy | 0.127 | 0.026 | 0.364 | 4.967 | 0.000* | |
| | Perceived barriers | -0.056 | 0.013 | -0.305 | -4.165 | 0.000* | |
| | Perceived susceptibility | 0.094 | 0.025 | 0.264 | 3.711 | 0.000* | |

**Table 3.** The regression coefficient of predicting the DMFT score of pregnant women.

| Model | Unstandardized Coefficients | | Standardized Coefficients | t | P-value | $R^2$ |
|---|---|---|---|---|---|---|
| | B | Std.Error | Bata | | | |
| (Constant) | 7.27 | 0.39 | | 18.6 | 0.00 | 0.32 |
| OHIs | 0.05 | 0.02 | 0.18 | 2 | 0.04 | |

## Discussion

In this study, the mean DMFT score of pregnant mothers in Khorramabad, Iran, was 7.7 ± 3.27, which was higher than the mean DMFT of pregnant mothers in Arak, Iran (5.2 ± 4.83), the pregnant mothers in Ahvaz, Iran (6.3 ± 23.01), and the pregnant mothers of India (4.44 ± 3.68). Differences in the DMFT scores in different regions of the country and other parts of the world demonstrate the effect of different geographical areas and the different cultures of various communities, different personal and nutritional habits and weaknesses in oral and dental health and care [12, 13, 32]. The mean oral and dental health performance score of the present study was 44.15 ± 5.7, which was lower than the average level (44.5 out of 100), and which was consistent with the mean performance score in the study of Shamsi et al. (43.9 ± 1.7), which was also lower than the average. One of the influential factors in this regard may be changes in the physiological conditions and the hormonal and physiological changes that the mothers undergo during this period, which, in addition to inducing fatigue and boredom, prevent the observance of oral health behaviors in the pregnant mothers. Findings from other studies show that the mothers' oral and dental health performance is not favorable [4, 12, 32]. In this regard, a study on a group of Asian expectant mothers demonstrated that about 63% of the pregnant mothers consumed higher amounts of sugar and sugary foods during pregnancy, 65% of them brushed their teeth only once a day, and about 59% of the pregnant mothers experienced bleeding of the gums while brushing [26]. In this study, there was observed a strong correlation between awareness and oral and dental health performance that indicated a fundamental need to raise the awareness of pregnant women. In the present study, there was a strong relationship among perceived susceptibility, severity, and self-efficacy with oral and dental health performance, which is consistent with the results of studies by Shamsi et al.[22]. The extent to which pregnant mothers consider themselves to be susceptible to tooth decay and the mothers' attitude towards the severity and complications of tooth decay both for themselves and for the fetus and the mothers' perceived abilities (self-efficacy) regarding oral and dental health care lead the mothers towards oral and dental health care. In the present study, there was a significant and inverse relationship between perceived barriers and oral and dental health performance, in such a way that

pregnant women who thought less to barriers (such as pain or gingival hemorrhage while flossing), performed oral and dental health behaviors more frequently, which is consistent with studies by Mazlumi et al., Solhi et al., Shamsi et al., Gharlipour et al., and Broudent et al., but is not consistent with results obtained in a study by Kuhner et al.[2, 22, 31, 33-35]. In the present study, there was not found a significant relationship between perceived benefits and oral and dental health performance, which is consistent with the findings of Mazlumi et al., but was not in line with the results of studies by Shamsi et al., Solhi et al., Gharlipour et al.[3, 12, 31, 33].

In the present study, among the constructs of the health belief model, self-efficacy had the most predictive power. Considering the importance of self-efficacy, individuals are prompted to conduct health-related behaviors, and even adopt health-related behaviors when they are confronted with challenges, only when they feel they are in control of health behaviors. In this study, self-efficacy, perceived barriers, and perceived susceptibility were able to predict variations in performance. In the study by Shamsi et al., barriers to the use of floss were three factors predicting the health behavior of flossing [12, 24]. In a study conducted in Yazd, Iran, on students, self-efficacy and perceived barriers predicted a total of 29% of behavioral variance.

In the study by Shamsi et al., perceived barriers and self-efficacy had the best explanatory power for brushing behavior, and this model accounted for 43% of the brushing behavior [22, 36]. Other studies have also confirmed the positive effect of self-efficacy, as well as the role of perceived barriers on the adoption of oral and dental health behavior, and have pointed out that the health belief model is an appropriate explanation for flossing behaviors [12, 25, 37, 38]. In this study, the mean obtained OHIS score was 2.74 ± 1.65, which indicates that the oral and dental health condition of pregnant mothers residing in Khorramabad, Iran, is at an average level, which is consistent with results obtained in a study by Gharizadeh et al. conducted in Ahvaz, Iran [13]. In this study, there was found a positive correlation between OHIS and DMFT scores, such that as the Oral Health Index – Simplified (OHIS) score increased by 1 unit, DMFT index score increased by 5%. In the study by Gharizadeh et al., too, the highest DMFT score mean was observed in individuals with poor OHIS status [13]. In a study by Gupta et al. conducted in India, pregnant mothers with a poor oral and dental health condition had 2.5 times more decayed teeth. Concomitant poor oral and dental health during pregnancy and frequent exposure to sucrose-rich food can cause early lesions leading to caries. Given the hormonal and other changes that occur during pregnancy such as nausea, conditions leading to dental caries become more likely in pregnant women. On the other hand, it is believed that dental plaque plays a key role in the development of dental caries and the purpose of oral and dental health is to remove this microbial layer from all dental surfaces [39, 40].

## Conclusion

Considering the results of this study, increases in perceived self-efficacy, susceptibility, and barriers, makes it possible to improve oral and dental care and health performance to a desirable level, so that decreasing dental plaque can help prevent the increase of dental caries in pregnant women. In this regard, given the importance of oral and dental health in the health of pregnant mothers and their fetuses, and the effect of oral and dental health on pregnancy and its outcomes, it seems necessary to design educational and training programs based on the constructs of the health belief model to improve the understanding and awareness of pregnant mothers regarding oral and dental care in prenatal care.

### Limitations

In this study we were unable to actually see the behavior for oral health care, for the data collection of this parameter, we used self-reporting method, rather than a more objective data-gathering method. In this study, primiparous mothers were selected, so that the participants had not received previous training from midwives, had not had previous experience in dental changes from

previous pregnancies and so had less bias in their answers, and no changes in their dental health could be traced to previous pregnancies

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## Conflict of Interest

All authors have read and approved the content of the article. The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Availability of data and materials

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

## List of Abbreviations

DMFT: Decayed, Missing, Filled Teeth
OHIS: Oral Health Index – Simplified
HBM: Health Belief Model

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