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Association between caries experience and reproductive history of women; a population-based study

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Abstract

Background The underlying cause of poor oral health in women of reproductive age remains unclear. This study aimed to explore the association between caries experience and reproductive history, focusing on age at menarche, age at menopause, and number of pregnancies.

Methods This cross-sectional study analyzed women from the baseline phase of the Ravansar Non-Communicable Disease (RaNCD) cohort. Data on reproductive history, including age at menarche, number of pregnancies, age at first pregnancy, and breastfeeding duration, were collected via questionnaire. The Decayed, Missing, and Filled Teeth (DMFT) index was assessed using dental examinations conducted with standard instruments. Reproductive history was considered the exposure variable, while caries experience was the outcome. Statistical analyses, including t-tests, One-way ANOVA, and linear regression, were conducted to examine associations between reproductive history and oral health.

Results A total of 5,151 women were assessed, with a mean age of 47.56 ± 8.46 years. Of these 42.46% lived in rural areas. The mean DMFT score in the overall population was 16.47 ± 9.19. Women who used dental floss had a significantly lower median DMFT than those who did not (16 vs. 12, $P < 0.001$). In the adjusted model, DMFT increased significantly by 0.30 for each additional pregnancy (β = 0.30,95%CI:0.04,0.56). However, no significant associations were observed between age at menstruation, frequency of abortion, age at first pregnancy, or age at menopause and DMFT.

Conclusions The findings indicate that the number of pregnancies is significantly associated with caries experience. Further, longitudinal studies are needed to replicate this study findings.

Keywords Oral health, Reproductive history, Pregnancy, Menstruation, Menopause

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Background

Oral health is a critical aspect of overall well-being in women, as research suggests a potential link between reproductive history and dental health outcomes. Women experience significant hormonal fluctuations during various life stages, particularly during menstruation, pregnancy, and menopause, which may influence oral health [1].

A study conducted by Dehghanpour et al.in Iran found that the oral status of pregnant women was poor, with an average of seven decayed teeth. Additionally, older women had fewer decayed teeth but a higher number of missing teeth, suggesting a history of inadequate dental care [2]. Another study of 5,496 Iranian women reported a significant association between the Decayed, Missing, and Filled Teeth (DMFT) index and the number of pregnancies, with each additional pregnancy increasing the DMFT score by 34% [3].

Several studies have identified pregnancy as a keyfactor influencing oral health [4, 5]. For example, an observational study on pregnant women in Brazil found a high prevalence of dental pain due to untreated tooth decay [6]. Meanwhile, other studies suggest that dietary behaviors during pregnancy may also contribute to an increased risk of caries. A study byRio et al. found that pregnant women significantly increased their consumption of sweet snacks between meals, leading to higher rates of pre-cavitated carious lesions [7]. During pregnancy, a large number of women do not change their daily oral health habits, despite an increased desire to consume sweets. However, hormonal changes and elevated gingival fluid flow can heighten susceptibility to periodontal disease and gingival bleeding. Additionally, changes in taste and smell, along with nausea, may negatively impact oral hygiene, particularly in the early stages of pregnancy [7, 8].

Despite these findings, the exact causes of poor oral health in women of reproductive age remain unclear. In this study, reproductive history is examined as the primary exposure variable, while caries experience is considered as the outcome measure. This study hypothesizes that there is an association between caries experience and reproductive history. Therefore, this study aimed to investigate the association between caries experience and reproductive history, specifically considering age at menarche, age at menopause, and number of pregnancies.

Methods

Participants

This cross-sectional study utilized data from the baseline phase of the Ravansar Non-Communicable Disease (RaNCD) cohort Study, part of the PERSIAN (Prospective Epidemiological Research Studies in Iran) studies [9]. The RaNCD study began in 2014 and includes 10,0047 adults aged 35 to 65 in the city of Ravansar, located in Kermanshah province and the west of Iran [10]. The study was approved by the ethics committee of Kermanshah University of Medical Sciences (KUMS.REC.1402.402). All participants provided both verbal and written informed consent. All participating women in the baseline phase of the RaNCD, who had complete data regarding fertility and oral hygiene, as well as a dental examination, were included. Those with cancer and individuals with incomplete data were excluded from the analysis (Fig. 1**).**

Data collection

All data were collected at the RaNCD cohort center following the standardized protocol of the Persian cohort studies. The study used validated questionnaires designed for the PERSIAN cohort, encompassing 19 cohort studies across Iran, including the Ravansar study. These questionnaires are publicly available in the cohort dictionary (supplementary file link: https://vc-research.kums.ac.ir/kums_content/media/image/2023/11/205477 orig.pdf).

Socioeconomic status (SES) was determined using principal component analysis (PCA) based on education level, assets ownership (e.g., house, car, motorcycle, computer, internet access), household amenities (e.g., washing machine, dishwasher, refrigerator, freezer), travel frequency, household size, and number of rooms. Subsequently, SES was categorized into three groups [11]. Physical activity levels were assessed using the standardized Persian cohort questionnaire, which accounts for sports, occupational, and leisure activities over a 24-hourperiod, measured in MET-hour/day. Dietary intake, including total energy and sugar consumption, was calculated using a validated 118-item food frequency questionnaire (FFQ) [12].

The dental examinations were conducted at the RaNCD cohort center, by a general physician following World Health Organization (WHO) guidelines for assessing the Decayed, Missing, and Filled Teeth (DMFT) index [13]. The oral health questionnaire included 14 items related to oral hygiene behaviors, including brushing and flossing frequency, as well as self-reported dental status. The DMFT index was recorded using a headlamp, an intraoral mirror, dental probe, and sterile gauze to clean tooth surfaces.

The "Reproductive History" section of the questionnaires included items on age at menarche, age at menopause, number of pregnancies, age at first pregnancy, and duration of breastfeeding. In this study, pregnancy frequency was categorized into three groups:1–3, 4–6,7 pregnancies, and more. Breastfeeding duration was classified into two groups: less than 48 months and more than 48 months the age of the first pregnancy was divided into two groups: under18 years and 18 years or

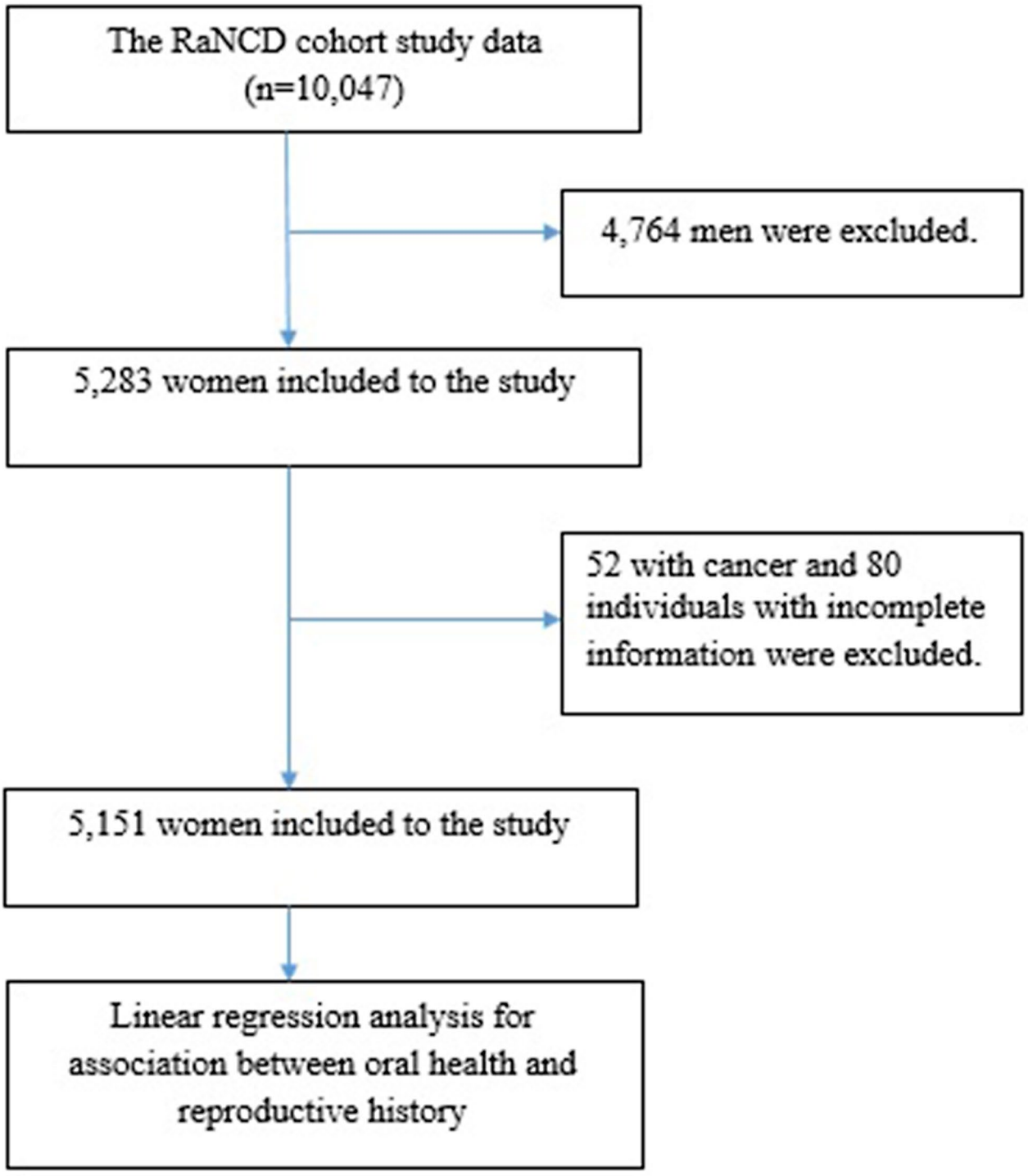

Fig. 1 Flowchart of the study participants. Abbreviation: Ravansar Non-Communicable Disease Cohort Study (RaNCD)

older. Menopausal age was categorized into two groups: under 45 years and 45 years or older. Daily caloric intake was also divided into two categories: below 2200 kcal and above 2200 kcal per day. Depression was defined based on a physician's diagnosis t or the use of antidepressant medication. A body mass index (BMI) ≥ 30 kg/m² was considered indicative of obesity [10].

Statistical analysis

The normality of quantitative data was assessed using the Kolmogorov-Smirnov test. Quantitative variables were

reported using mean ± standard deviation (SD) for normal data and median (first and third quartile) for non-normal data. Categorical variables were presented as frequencies and percentages. To compare dental status across demographic characteristics and reproductive history, independent sample t-test was applied for normally distributed quantitative variables, while the Mann-Whitney U test was utilized for non-normally distributed data. Additionally, One-way ANOVA tests was used for comparisons involving categorical variables.

To assess the association between reproductive history and oral health, univariate and multivariate linear regression models were employed. The multivariable models adjusted for age, SES, brushing habits, flossing frequency, and obesity and depression. A significance level of 0.05 and 95% confidence intervals (CIs) were utilized for the statistical inference. Analysis was performed using Stata version 14.2 (Stata Corp, College Station, TX, USA).

Table 1 Distribution of the study participants by demographic characteristics, reproductive history, and oral health

Variables	Frequency (%) or mean ± SD [a]
Age (year), mean ± SD	47.56 ± 8.46
Residence	
Urban	2964 (57.54)
Rural	2187 (42.46)
Socio-economic status, n (%)	
1(lowest)	2350 (45.62)
2	1756 (34.09)
3(Highest)	1045 (20.29)
Physical activity (Met-h/day [b]), n (%)	
Light	1339 (25.99)
Moderate	3249 (63.08)
High	563 (10.93)
Frequency of tooth brushing, n (%)	
At least once a day	2846 (55.25)
Less than once a day	2305 (44.75)
Use flossing, n (%)	
No	4571 (88.74)
Yes	580 (11.26)
Frequency of tooth Flossing (week)	6.74 ± 5.88
Decayed teeth, mean ± SD	2.65 ± 3.49
Missed teeth, mean ± SD	12.43 ± 10.42
Filled teeth, mean ± SD	1.38 ± 2.50
DMFT [c], mean ± SD	16.47 ± 9.19
Breast feeding duration (month), mean ± SD	88.15 ± 52.18
Frequency of pregnancies, mean ± SD	4.64 ± 2.75
Age of the first pregnancy (years), mean ± SD	20.05 ± 4.69
Menstrual age (years), mean ± SD	13.82 ± 1.72
Menopausal age (years)	49.49 ± 5.65
Frequency of abortion, mean ± SD	0.35 ± 0.71
Energy intake (kcal/day)	2348.34 ± 376.35
Sugar intake (gr/ day)	135.60 ± 63.57
Depression, n (%)	212 (4.12)
Obesity, n (%)	2104 (48.85)

Abbreviations: [a] Standard deviation (SD); [b] Metabolic equivalent per hour per day (Met-h/day); [c] the sum of the number of Decayed, missing due to caries, and Filled Teeth in the permanent teeth (DMFT)

Results

This study included 5,151 women with mean age of 47.56 ± 8.46 years, who participated in the baseline phase of the RaNCD cohort study. Among the participants, 42.46% resided in rural areas, 45.62% had low SES, and 63.08% engaged in moderate physical activity. Additionally, 44.75% brushed their teeth less than once a day, and only 11.26% used dental floss.

The mean DMFT score in the total population was 16.47 ± 9.19. The average breastfeeding duration among participants was 88.15 ± 52.18 months, while the mean number of pregnancies was 4.64 ± 2.75. The mean age at first pregnancy was 20.05 ± 4.69 years. Additionally, 4.12% of women had depression, and 48.85% were classified as obese (Table 1).

The median DMFT varied significantly across different age groups. Women aged 35 to 50 years had a median DMFT of 12, whereas those aged 50 to 65 years had a median DMFT of 24, indicating a notable increase with age. Additionally, women from higher SES backgrounds had a significantly lower median DMFT than those from moderate and low SES groups ($P < 0.001$).

Oral hygiene behaviors were also associated with DMFT scores. Women who brushed their teeth less than once per day had a significantly higher median number of missing teeth compared to those who brushed at least once daily (6 vs. 18, $P < 0.001$). Similarly, the median DMFT was significantly lower among women who used dental floss compared to those who did not (16 vs. 12, $P < 0.001$).

Reproductive history was another key factor influencing DMFT scores. Women with seven or more pregnancies had a significantly higher median DMFT than those with fewer than seven pregnancies ($P < 0.001$). Similarly, women whose first pregnancy occurred before the age of 18 had a significantly higher median DMFT than those who had their first pregnancy later in life ($P < 0.001$). Additionally, obesity and place of residence were significant predictors of DMFT scores, with obese women ($P < 0.001$) and those living in rural areas ($P = 0.001$) exhibiting higher median DMFT values. Dietary factors were also relevant, as women with a daily caloric intake exceeding 2,200 kcal/day had significantly higher median DMFT scores ($P < 0.001$) (Table 2).

To further evaluate the association between the number of pregnancies and DMFT scores, regression models were conducted. In the unadjusted model, each additional pregnancy was associated with an increase in DMFT ($\beta = 1.69$, 95% CI: 1.61, 1.77). Even after adjusting for age, SES, brushing habits, flossing frequency,

Table 2 Median DMFT (Decayed, missing, and filled Teeth) score by demographic and lifestyle variables

Variables	Condition of the teeth Median (Q1, Q3)			
	Decayed	Missed	Filled	DMFT
Age (year)				
35–50 years	2 (0, 4)	6 (3, 11)	0 (0, 3)	12 (8,17)
51–65 years	1 (0,3)	20 (11, 32)	0 (0, 0)	24 (16.32)
***P*value**				**< 0.001**
Socio-economic status				
1(lowest)	2 (0, 4)	13 (7, 27)	0 (0, 0)	18 (11, 30)
2	2 (0, 4)	9 (4, 17)	0 (0, 2)	14 (9, 22)
3(Highest)	1 (0, 3)	6 (3, 11)	2 (0, 3)	12 (8, 17)
***P*value**				**< 0.001**
Physical activity (Met-h/day)				
Light	2 (0, 4)	9 (4, 20)	0 (0, 2)	15 (9, 25)
Moderate	2 (0, 4)	9 (4, 16)	0 (0, 2)	14 (9, 22)
High	2 (0, 4)	12 (6, 22)	0 (0, 0)	17 (10, 26)
***P*value**				**< 0.001**
Residence				
Urban	2 (0, 4)	8 (4, 16)	0 (0, 3)	14 (9, 22)
Rural	1 (0, 3)	11 (6, 22)	0 (0, 0)	15 (9, 25)
***P*value**				**0.001**
Frequency of tooth brushing				
At least once a day	2 (1, 4)	6 (3, 10)	1 (0, 4)	12 (8, 16)
Less than once a day	1 (0, 4)	18 (9, 32)	0 (0,0)	23 (14, 32)
***P*value**				**< 0.001**
Use flossing				
No	2 (0, 4)	11 (5,22)	0 (0, 1)	16 (10, 26)
Yes	2 (0, 3)	5 (3, 8)	3 (0, 6)	12 (8, 15)
***P*value**				**< 0.001**
Breast feeding duration				
< 48 months	2 (0, 4)	6 (3, 10)	0 (0, 4)	12 (7, 16)
> 48 months	2 (0, 4)	12 (6, 25)	0 (0, 1)	17 (11, 28)
***P*value**				**< 0.001**
Frequency of pregnancies				
0	2 (0, 3)	0 (0, 3)	5 (3, 9)	11 (7, 15)
1–3 times	2 (0, 4)	6 (3, 10)	0 (0, 4)	12 (7,16)
4–6 times	2 (0, 4)	10 (5, 18)	0 (0, 2)	16 (10, 23)
7 and more	0 (0, 3)	22 (12, 32)	0 (0,0)	26 (17, 32)
***P*value**				**< 0.001**
Age of the first pregnancy				
18 year and less	1 (0, 4)	12 (6, 24)	0 (0, 1)	17 (11, 27)
> 18 years	2 (0, 4)	8 (4, 16)	0 (0, 2)	14 (9, 22)
***P*value**				**< 0.001**
Menopausal age				
< 45 years	0 (0, 3)	16 (9, 32)	0 (0, 0)	21 (14, 32)
> 45 years	0 (0, 3)	22 (12, 32)	0 (0, 0)	26 (17, 32)
***P*value**				**< 0.001**
Abortion				
Yes	2 (0, 4)	9 (5, 20)	0 (0, 2)	15 (10, 25)
No	2 (0, 4)	10 (5, 19)	0 (0, 2)	15 (10, 24)
***P*value**				**0.787**
Depression				
Yes	2 (0, 4)	8 (5, 18)	0 (0, 2)	14 (9, 22)
No	2 (0, 4)	9 (4, 18)	0 (0, 2)	15 (9, 23)

Table 2 (continued)

Variables	Condition of the teeth Median (Q1, Q3)			
	Decayed	Missed	Filled	DMFT
***P*value**				**0.781**
Obesity				
Yes	2 (0, 4)	8 (4, 15)	0 (0, 2)	14 (9, 20)
No	2 (0, 4)	9 (4, 20)	0 (0, 2)	15 (9, 25)
***P*value**				**< 0.001**
Energy intake				
< 2200 kcal/day	2 (0, 4)	8 (4, 15)	0 (0, 2)	14 (9, 22)
> 2200 kcal/day	2 (0, 4)	10 (5, 21)	0 (0, 2)	15 (10, 25)
***P*value**				**< 0.001**

P-value obtained by t-test for normal quantitative variables, Mann-Whitney U-test for non-normal quantitative variables, One-way ANOVA test for qualitative variables

Table 3 Association between reproductive history and DMFT index based on linear regression analysis

	Unadjusted	Model 1	Model 2	Model 3
Main exposure	**β (95% CI)**	**β (95% CI)**	**β (95% CI)**	**β (95% CI)**
Frequency of pregnancies	1.69 (1.61, 1.77)	0.64 (0.53, 0.75)	0.27 (-0.01, 0.55)	0.30 (0.04, 0.56)
Age of the first pregnancy	-0.37 (-0.43, -0.31)	-0.10 (-0.15, -0.05)	-0.01 (-0.10, 0.11)	-0.03 (-0.10, 0.05)
Menstrual age	0.10 (-0.07, 0.22)	0.01 (-0.11, 0.12)	-0.06 (-0.34, 0.23)	-0.07 (-0.12, 0.17)
Menopausal age	0.21 (0.14, 0.28)	0.02 (-0.06, 0.09)	-0.29 (-0.63, 0.05)	-0.10 (-0.33, 0.11)
Frequency of abortion	0.18 (-0.18, 0.56)	0.03 (-0.28, 0.33)	-0.20 (-0.80, 0.40)	-0.25 (-0.85, 0.34)

Model 1: adjusted for age and SES; Model 2: adjusted for age, SES, brushing and flossing; Model 3: adjusted for age, SES, brushing, flossing, obesity, residence, physical activity, energy intake and sugar intake

Abbreviations: DMFT; The sum of the number of Decayed, missing due to caries, and Filled Teeth in the permanent teeth

depression, obesity, energy intake, and sugar consumption, the association remained significant (β = 0.30, 95% CI: 0.04, 0.56), confirming that women with a higher number of pregnancies had higher average DMFT scores. However, after adjusting for the same confounding variables, no significant associations were observed between DMFT and age at menarche (β = -0.07, 95% CI: -0.12, 0.17), frequency of abortion (β = -0.25, 95% CI: -0.85, 0.34), or age at menopause (β = -0.10, 95% CI: -0.33, 0.11) (Table 3**).**

Discussion

This study aimed to investigate the association between caries experience and reproductive history among women in the RaNCD cohort study. The findings demonstrated that, after adjusting for potential confounders, an increasing number of pregnancies was associated with higher DMFT scores, underscoring the need for greater awareness of maternal oral health. However, it is possible that women's caries experience is also influenced by their oral hygiene habits.

Consistent with our findings, Gorgi et al. reported in the Tabari cohort study that the DMFT index increased significantly with the number of pregnancies [3]. Conversely, Hefzollesan et al. found no significant relationship between the reproductive history (including number of pregnancies, age at first pregnancy, age at menarche, and age at menopause) and oral hygiene [14]. This suggests that oral health habits and dietary factors may mediate the association between pregnancy history and DMFT. In this study, more than half of women brushed their teeth at least once a day, whereas 44.75% brushed less than once a day, and only 11.26% used dental floss. The median DMFT increased with the number of pregnancies (12 for 1–3 pregnancies, 16 for 4–6 pregnancies, and 26 for ≥7 pregnancies). However, after adjusting for oral hygiene habits the association between number of pregnancies and DMFT median was no longer significant, aligning with findings from the Tabari and Azar cohort studies [3, 14].

A study conducted by Azar cohort (East Azarbaijan province, Iran) found that less than half of the women brushed their teeth daily [14]. Similarly, a review study showed that 56% of pregnant women did not seek dental care, and only 35% had a dental visit within the first year postpartum [15]. Since the third trimester of pregnancy and the postpartum period are critical times for increased caries risk, targeted oral health interventions during these stages are recommended [16].

Pregnancy is associated with changes in dietary habits, which may contribute to increased caries risk. Studies indicate that pregnant women tend to consume more sweet snacks between meals [17, 18]. However, these dietary changes are often not accompanied by

improvements in oral hygiene practices, further increasing susceptibility to caries [7, 8, 19].

Similar to findings from north of Iran [3], our study found that the DMFT scores were higher in older women, reflecting the cumulative effects of long-term risk exposure. It is well established that the severity and prevalence of dental caries increase over time, which aligns with expected patterns of oral health deterioration. In this study, we also observed that women with higher SES had a lower median DMFT score. This finding is consistent with previous research identifying low SES as a significant risk factor for increased tooth decay and higher DMFT scores in women [3, 20]. Based on these results, it can be concluded that women from lower SES backgrounds tend to have more pregnancies and, at the same time, face greater challenges in maintaining adequate nutrition and oral hygiene.

Oziegbe et al. similarly reported that low-income and middle-income women exhibit lower rates of healthcare utilization, often delaying dental treatment and resorting to tooth extractions rather than restorative procedures [21]. Additionally, a study conducted in Brazil and Sweden highlighted persistent SES-related disparities in dental care access, with individuals from higher SES backgrounds being more likely to visit a dentist regularly [22].

Our findings also indicate that women who breastfed for more than 48 months had significantly higher median DMFT scores compared to those who breastfed for a shorter duration. Furthermore, women whose first pregnancy occurred before the age of 18 had a higher average DMFT score than those who became pregnant later in life. Since DMFT naturally increases over time, it is possible that these associations are partially explained by aging-related factors. However, as time was not controlled for in this study, the regression analysis did not establish a direct relationship between age at first pregnancy and DMFT. Regarding hormonal factors, no statistically significant association was observed between DMFT and either age at menarche or age at menopause. However, previous studies suggest that hormonal fluctuations may influence oral health. For instance, Golzaei et al. found that ovulation and the premenstrual phase are associated with a significant increase in gingival inflammation [23]. Similarly, menopause has been linked to a decline in salivary pH, which can contribute to a higher risk of dental caries, periodontal disease, taste alterations, and sensations of dryness and burning in the mouth [24–26]. Additionally, research has shown that postmenopausal women experience a notable reduction in both salivary pH and flow rate, leading to higher Oral Hygiene Index (OHI) and DMFT scores [27].

The study is limited by its cross-sectional design, meaning that the observed relationships are not causal, and longitudinal studies are necessary. Furthermore, information about participants' diet during pregnancies was not accessible, and no accurate information on the number of dental visits during the reproductive period were available. However, the study's strengths include its large sample size and the control of key confounding variables. The results are generalizable to Iranian women, particularly those from western Iran.

Conclusions

In summary, this study found a significant association between a higher number of pregnancies and poorer oral health, as reflected in increased DMFT scores. However, no significant correlations were observed between DMFT and the onset age of menstruation or menopause. These findings underscore the importance of oral hygiene practices, particularly regular flossing, in maintaining dental health among women. Given these results, targeted interventions to improve oral health behaviors—especially among women with multiple pregnancies—are recommended. Integrating oral hygiene education, such as proper brushing, flossing, and dietary modifications, into routine maternal healthcare programs may help mitigate the risk of dental caries. Future longitudinal studies are needed to explore the underlying mechanisms behind these associations.

Abbreviations

RaNCD	Ravansar non-communicable disease
DMFT	Decayed, missing, and filled teeth index
SES	Socio-economic status
PCA	Principal component analysis
WHO	World health organization
CI	Confidence interval

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-025-06164-2.

Supplementary Material 1

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Author contributions

Roya Safari Faramani, Farid Najafi, Mitra Darbandi and Narges Ziaei analyzed the data, drafted the manuscript and prepared figures. Mitra Darbandi and Mahsa Miryan collected the data. Roya Safari Faramani, Farid Najafi, Mitra Darbandi, Narges Ziaei, and Mahsa Miryan designed this work and revised the manuscript. All authors approved the final manuscript and agreed to be accountable for all aspects of the work.

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Data availability
The data analyzed in the study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
The study was approved by the ethics committee of Kermanshah University of Medical Sciences (KUMS.REC.1402.402). All methods were carried out in accordance with relevant guidelines and regulations. All the participants were provided oral and written informed consent. All methods were carried out by relevant guidelines and regulations. This study was conducted by the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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