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Original Research Article

Comparative evaluation of salivary pH, gingival status and dental caries among menstrual and post-menopausal women in Chengalpattu district, Tamil Nadu: a cross-sectional study

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ABSTRACT

Background: Hormonal fluctuations during different life stages in women can influence oral health, particularly salivary pH, gingival status, and dental caries susceptibility. Aim was to compare salivary pH, gingival status, and dental caries experience among menstrual and post-menopausal women in the Chengalpattu district.

Methods: A cross-sectional study was conducted among 80 women, divided into two groups: menstrual women (n=40) and post-menopausal women (n=40). Salivary pH was measured using pH indicator strips. Gingival status was assessed using the Loe and Silness Gingival Index (1963), and dental caries experience was recorded using the DMFT index (1938). Data were analyzed using SPSS software.

Results: The mean salivary pH was significantly lower in post-menopausal women (5.91 ± 0.81) compared to menstrual women (6.46 ± 0.98) ($p < 0.05$). The mean DMFT score was significantly higher among post-menopausal women (10.23 ± 5.97) than menstrual women (4.33 ± 3.73) ($p = 0.000$). No significant difference was noted in gingival index scores between the groups ($p = 0.8$).

Conclusions: Post-menopausal women exhibited lower salivary pH and higher dental caries experience, suggesting that hormonal decline during menopause may adversely affect oral health. However, gingival health remained comparable between the two groups. Regular preventive dental care is essential, especially for women undergoing menopausal transition.

Keywords: Dental caries, Gingival index, Hormonal changes, Menstrual women, Post-menopausal, Salivary pH

INTRODUCTION

The health needs of women are distinct due to the substantial changes they undergo throughout their lives, especially hormonal shifts that can affect various oral tissues.¹ Women are at a higher risk of oral health problems during five critical phases characterized by hormonal changes: puberty, certain points in the menstrual cycle, the use of birth control pills, pregnancy, and menopause. These phases can significantly impact the metabolism of periodontal tissues or influence the rates of salivary flow and its buffering capacity.² Women nearing menopause

may show increased gingival inflammation even without a corresponding rise in plaque levels. During this period, the subgingival microflora becomes more susceptible to frequent attacks by pathogens, resulting in a higher risk of bleeding.³

Estrogen plays a role in the cytodifferentiation of stratified squamous epithelium and the synthesis and maintenance of collagen fibers. Research has shown that estradiol promotes cell proliferation in cultures of gingival fibroblasts in menstrual women.⁴ Different types of cells, such as periosteal fibroblasts, lamina propria fibroblasts,

periodontal ligament fibroblasts, and osteoblasts, possess estrogen receptors. The influence of estrogen on these cells impacts the epithelial barrier's capacity to protect against pathogens.³

The histological resemblance between the mucosa of the mouth and vagina indicates that the oral epithelium may react to hormonal shifts. Fluctuations in estrogen levels during menopause can affect oral structures such as salivary glands, temporomandibular joints, oral mucosa, and jawbones. Furthermore, menopause has been associated with alterations in taste bud functionality and neural pathways.²

According to Kahar et al, adult females exhibit a higher proportion of lifetime caries (77.9%) and untreated decay (66.4%) compared to males. Regular dental check-ups, good oral hygiene practices, and a balanced diet can help prevent dental caries in women.⁵

Saliva is considered as the most important natural defence against dental caries and oral diseases.⁶ A decrease or alterations in salivary parameters can lead to dental caries and other oral health problems. When salivary pH drops, it creates an acidogenic environment that fosters the growth of acid-producing bacteria, further contributing to caries and perpetuating a cycle of decreasing pH.²

Hence, the study was aimed to evaluate and compare salivary pH, gingival health status, and dental caries experience among menstrual and post-menopausal women in Chengalpattu district.

METHODS

Study characteristics

A cross-sectional study was conducted in Chengalpattu district among menstrual and post-menopausal women. Prior to data collection, Informed consent was obtained from the subjects. Ethical clearance was taken from institutional ethics committee number: KIDS/IEC/2025/III/001. Study carried out from May 2025 to October 2025 in Karpaga Vinayaga Institute of Dental Sciences, Chengalpet.

Sample size derivation

Using the G Power version 3.1.9.2 software, the sample size was calculated with the following parameters: power =95%, effect size =0.8, and α error =0.05 according to a study conducted by Sindhusa et al.² The estimated sample size was 74 and it was rounded off to 80, with 40 samples in each group.

Inclusion and exclusion criteria

Inclusion criteria include subjects aged 18 years and above falling into menstruating criteria; Subjects who have at least 20 natural teeth for valid periodontal and caries

assessment; subjects willing to participate and provide informed consent. Exclusion criteria include subjects with any systemic diseases known to influence salivary flow or pH (e.g., uncontrolled diabetes, renal disease); pregnant or lactating women; subjects those currently on hormonal therapy, steroids, or long-term medications affecting oral health; subjects those who have undergone major periodontal therapy or dental treatment in the past 6 months; subjects with oral lesions.

Data collection

Group A comprised of menstrual women and group B comprised of post-menopausal women of 40 women in each group respectively.

Outcome assessment

Estimation of salivary pH

Salivary pH levels were assessed using pH strips (SMS Universal PH test strips) inserted into the mouth, with the resulting colour change matched to a standardized colour chart to determine the pH value.

Estimation of gingival status

Gingival status was assessed in menstrual and post-menopausal women through a clinical examination using the Loe and Silness Gingival Index (1963), with a probe and mouth mirror, to obtain an interpretation of their gingival health.

Estimation of dental caries

Dental caries assessment was conducted on all subjects using the DMFT index (1938), with a probe and mouth mirror, to record decayed, missing, and filled teeth and calculate the total DMFT score.

Statistical analysis

The collected data were entered in excel sheet and analyzed using SPSS software version 20. Descriptive statistics were used for assessing correct quality identification in 3 parameters of salivary PH, gingival status and dental caries. To evaluate the significance of the parameters used between two groups, independent student t-test was used. $P < 0.05$ were regarded as statistically significant.

RESULTS

In the present study, Table 1 represents the demographic data (age) between groups and the mean age of the participant was 46.15 ± 16.35 years. In respect to salivary pH statistical significance was found between the groups ($p < 0.05$) and mean salivary pH values in menstrual group (6.46 ± 0.98), and in menopausal group (5.91 ± 0.81),

respectively (Table 2) indicating a lower salivary pH in post-menopausal women.

Table 1: Demographic data (age) between groups.

| Variables | Mean±SD |
|--------------------|------------|
| Age (years) | |
| Menstrual | 31.90±8.07 |
| Post-menopausal | 60.40±7.75 |

Table 2: Comparison of salivary pH between groups.

| Group | N | Mean±SD | P value |
|------------------------|----|-----------|---------|
| Menstrual | 40 | 6.46±0.98 | 0.006* |
| Post-menopausal | 40 | 5.91±0.81 | |

P<0.05 statistically significant.

Regarding the DMFT score, the mean DMFT was high among menopausal group (10.23±5.97) when compared to the menstrual group (4.33±3.73) and it was found to be statistically significant (p=0.000), revealing that post-menopausal women had a greater caries experience compared with menstrual women (Table 3).

Table 3: Comparison of dental caries (DMFT index) between groups.

| Group | N | Mean±SD | P value |
|------------------------|----|------------|---------|
| Menstrual | 40 | 4.33±3.73 | 0.000 |
| Post-menopausal | 40 | 10.23±5.97 | |

Table 4: Comparison of gingival index between groups.

| Group | N | Mean±SD | P value |
|------------------------|----|---------|---------|
| Menstrual | 40 | 0.7±0.4 | 0.852* |
| Post-menopausal | 40 | 0.7±0.5 | |

P<0.05 statistically significant.

Table 4 shows the gingival status of menstrual group (0.7±0.4) and menopausal (0.7±0.5) group and it was not statistically significant (p=0.852), suggesting similar gingival health status.

DISCUSSION

This study compared salivary pH, gingival status, and dental caries among menstrual and post-menopausal women in the Chengalpattu district to assess the impact of hormonal variations on oral health.

In the present study, salivary pH was found to be significant between menstrual women and post-menopausal women and it also showed that pH of post-menopausal women is significantly lower than the menstrual women, this result is similar to the results of Sindhusa et al, and Saluja et al.²

A decrease in salivary pH indicates a more acidic oral environment, which promotes tooth demineralization and favours the growth of acidogenic bacteria, leading to dental caries.^{7,8} As reported by Dodds et al stimulation of salivary flow enhances the flushing action of saliva and increases bicarbonate and remineralizing ions, which help maintain oral pH and reduce caries incidence.⁹ In the present study, post-menopausal women exhibited significantly lower salivary pH compared to menstrual women, suggesting that declining estrogen levels during menopause adversely affect salivary gland function and buffering capacity.^{6,9}

The findings are consistent with the study by Sindhusa et al(2024), who observed that menopausal women had the lowest salivary pH and the highest DMFT scores, emphasizing that hormonal decline during menopause alters salivary composition.² Similarly, Pulin et al reported that although salivary flow rate did not vary significantly among menstruating, pregnant, and postmenopausal women, postmenopausal women had a markedly lower salivary pH, which may predispose them to enamel demineralization and caries.¹⁰ Mahesh et al also reported that post-menopausal women exhibited reduced salivary flow, decreased buffering capacity, and lower pH, confirming that hormonal changes directly impact saliva's protective properties.¹

In dental caries experience, when the salivary pH drops below the critical level (approximately 5.5), demineralization of enamel begins, leading to caries formation.² In this study, post-menopausal women showed significantly higher DMFT scores, indicating a higher caries risk than menstrual women.⁷

In previous studies of Sindhusa et al who found that menopausal women had a higher caries experience (increased DMFT) corresponding to lower salivary pH.² Pulin et al suggested that decreased salivary pH, combined with reduced sweet taste perception in postmenopausal women, may increase preference for sweeter foods, further contributing to caries development.¹¹ Likewise, Beedubail and Kashyap noted that salivary pH varies during menstrual phases, with acidic shifts during ovulation and premenstrual stages potentially increasing caries risk due to a more favorable environment for bacterial colonization.¹²

Overall, the findings of the present study and prior literature strongly suggest that hormonal changes during menopause reduce salivary pH and buffering capacity, thereby increasing the risk for dental caries. Regular preventive dental care, fluoride use, and dietary counselling should be emphasized for post-menopausal women to reduce caries incidence.²

In contrast to salivary pH and dental caries, the present study found no statistically significant difference in gingival index scores between menstrual and post-menopausal women. This suggests that both groups had

comparable gingival health, which may reflect similar oral hygiene practices and plaque control behaviors. However, it is well established that hormonal fluctuations can modulate gingival responses to dental plaque.¹²

According to Abd Awad et al hormonal imbalances during different menstrual phases can alter vascular response and immune regulation in periodontal tissues, leading to increased gingival inflammation and bleeding. Estrogen affects the connective tissue metabolism and vascular permeability of gingiva, making tissues more susceptible to inflammatory changes.¹³ Though the current study did not observe a significant difference in gingival status, it is possible that subtle subclinical changes were not captured by the clinical index used or that good oral hygiene among participants minimized hormonal effects on gingival tissues.^{3,14}

Mahesh et al further supported that reduced estrogen levels in post-menopausal women can influence connective tissue metabolism, potentially contributing to gingival inflammation and oral dryness.^{15,16} Nevertheless, the absence of a significant difference in gingival index in this study could be due to adequate plaque control and awareness of oral hygiene among participants.¹

The limitation of the study is that being a cross-sectional study design and being the relatively small group of population. Secondly, in this study only two stages of female life were taken, menstrual and post-menopausal whereas early menstrual and late menopausal women can be involved in future studies. Future research should employ longitudinal, or cohort designs to clarify causal relationships between salivary characteristics and menstrual changes.

CONCLUSION

The present cross-sectional study conducted among menstrual and post-menopausal women in the Chengalpattu district revealed notable differences in certain oral health parameters influenced by hormonal changes.

A significant reduction in salivary pH was observed among post-menopausal women compared to menstrual women, indicating a more acidic oral environment that may predispose them to dental diseases. Similarly, dental caries experience (DMFT index) was significantly higher in post-menopausal women, suggesting that hormonal alterations and associated changes in salivary parameter which could contribute to increased caries susceptibility.

However, the gingival status between the two groups showed no statistically significant difference, which may be attributed to comparable oral hygiene practices or plaque control measures among the participants.

Overall, the findings highlight the importance of periodic oral health monitoring and preventive dental care for

women, particularly during and after menopause, to mitigate the adverse effects of hormonal fluctuations on oral health. Awareness programs emphasizing the role of hormonal changes on oral tissues, along with maintaining optimal oral hygiene and regular dental visits, can play a crucial role in promoting oral and systemic well-being among women across different life stages.

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Ethical approval: The study was approved by the Institutional Ethics Committee No: KIDS/IEC/2025/III/001

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