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Comparative evaluation of periodontal status between premenopausal and postmenopausal women visiting a tertiary care hospital in Province no.1, Nepal

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Research Article

Keywords: Menopause, Nepal, Periodontal disease, Premenopausal women, Postmenopausal women.

Posted Date: April 23rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9107110/v1

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Additional Declarations: No competing interests reported.

Abstract

Background:

The multifactorial nature of periodontal disease has been shown to encompass hormonal fluctuation as one of the contributing factors in its progression. Menopause, the biological transition characterized by substantial drop in estrogen and progesterone hormone has been linked with increased severity of periodontitis.

Aim:

To compare the periodontal status between premenopausal and postmenopausal women visiting tertiary care hospital in province no.1, Nepal.

Methods:

A comparative cross-sectional study was conducted among 92 women, including 46 premenopausal and postmenopausal each. Periodontal parameters including plaque index, bleeding index, probing pocket depth, and clinical attachment loss and number of teeth loss were evaluated. Mann Whitney U test was employed to assess difference among outcome variables between two groups. Level of significance was set at $p<0.05$.

Results: The mean age of participants was 46.4 ± 8.3 years (range: 30–60 years). Plaque index scores and the number of teeth lost were significantly higher among postmenopausal women compared to premenopausal women ($p < 0.001$). No significant difference was observed in bleeding index scores between the groups ($p = 0.155$). Despite postmenopausal women exhibiting a greater number of sites with probing pocket depth, there were no significant differences in site distribution or mean probing pocket depth between the groups ($p = 0.288$; $p = 0.999$). The number of sites with clinical attachment loss was significantly higher in postmenopausal women ($p < 0.001$), while mean clinical attachment loss was comparable between groups ($p = 0.852$).

Conclusions:

Postmenopausal women showed poorer periodontal status than premenopausal,with significantly higher plaque levels, clinical attachment loss and tooth loss, emphasizing the need for tailored periodontal care for this population.

Background

The homeostasis of periodontium is influenced by multiple factors including sex steroid hormones derived from endocrine system.[1] Several studies have reported the presence of receptors for these hormones within the components of immune system. [2,3] These receptors are also expressed in the periodontal immune system including periodontal ligament cells.[4] This indicates that fluctuation in these

hormone levels can directly regulate the periodontal immune responses. The presence of dental plaque biofilm, the primary etiology of periodontal disease renders the periodontal tissues more vulnerable to periodontal pathogens ensuing its destruction particularly during periods of hormonal imbalance like menopause. Menopause is a physiologic transition in a women's life which is characterized by sharp decline in the estrogen and progesterone level. Women live about one third of their lives in the postmenopausal phase.[5]Apart from systemic adverse effects, several studies have reported association of postmenopausal women with thinning of oral mucosa, burning mouth, gingival recession, increased probing pocket depth, clinical attachment loss, alveolar bone loss.[6,7] So, it is crucial that their quality of life is well maintained through effective preventive and therapeutic strategies including timely periodontal assessment and appropriate oral health care during this phase of life. In addition, to validate this association, there are studies reporting an improvement in the periodontal parameters among women undergoing hormone replacement therapy in different regions.[8,9] In Nepal, studies have been conducted to evaluate the systemic signs and symptoms of postmenopausal women.[10,11] However, oral, specifically periodontal effects among them have not been compared with premenopausal women yet. The aim of the study was to compare the periodontal status between premenopausal and postmenopausal women visiting a tertiary care hospital in province no.1, Nepal.

Methods

Study design and setting/participants:

A comparative cross-sectional study was conducted among 92 women, including 46 premenopausal and postmenopausal each. Consecutive sampling method was used to select the participants among the females visiting the Department of Periodontology and Oral Implantology, CODS, BPKIHS, Dharan during the period of March 2024 to August 2025. After initial screening of the patients only those meeting all the inclusion and exclusion criteria were selected.

Inclusion Criteria

a) Women of age group 30–60 years Premenopausal women (Group I, Women with a regular menstrual cycle of 21–35 days) and Postmenopausal women (Group II, Women who have gone for 2 years without a menstrual cycle b) Women who gave consent to participate in the study.

Exclusion Criteria

a) Current Smokers b) Pregnancy c) Systemic conditions known to affect periodontal health like Diabetes Mellitus d) Undergone any type of periodontal therapy or taken antibiotics within 6 months e) Under medications known to cause gingival enlargement like calcium-channel blockers, anti-convulsants and immunosuppressants f) Having menses during examination (for premenopausal).

Sampling Method

Sample size was calculated based on mean clinical attachment loss (CAL) recordings made on 15 premenopausal and 15 postmenopausal women attending department of Periodontology & Oral Implantology OPD from December 1 to December 30 2022 as a part of pilot evaluation. Mean CAL premenopausal ($\mu_1 \pm \sigma_1$) = 1.9 ± 0.8, Mean CAL postmenopausal ($\mu_2 \pm \sigma_2$) = 2.52 ± 1.2

Considering level of significance at 95% and power of 80%, sample size is calculated based on difference in mean CAL in two groups:

Sample size(n) = 2 $(Z_{1-\alpha/2} + Z_{1-\beta})^2$ σ^2/d^2 where,

$Z_{1-\alpha/2}$ at 95% level of significance = 1.96,

$Z_{1-\beta}$ at 80% power = 0.84 and $\sigma^2 = \sigma_1^2 + \sigma_2^2/2$. Now,

n = 2 $(1.96 + 0.84)^2$ $(0.8 + 1.2/2)^2$/ $(2.52–1.9)^2$

= 2 (7.84) (1)/ 0.3844

= 15.68/0.3844 = 40.79 ≈ 41

Considering probable nonresponse, sample size is inflated by 10% to 46 in each group.

Data Collection Procedure and Tools:

The study was conducted among women aged 30–60 years visiting the department of Periodontology & Oral Implantology, B. P. Koirala Institute of Health Sciences, a tertiary care center in province no. 1, Nepal. Personal, dental and medical history were recorded and participants were enrolled in the study based on the inclusion criteria. Before participation, all eligible women were informed about the study objectives and procedures, and written informed consent was obtained. A questionnaire regarding the age of menopause, frequency of brushing, use of interdental aid and frequency of dental visit were recorded. The participants were categorized into two groups based on history of menstrual cycle. The women who were still having regular menstrual cycle were grouped under Premenopausal (Group I) and those whose cycle had ceased since last two years were categorized as Postmenopausal women (Group II).

Under adequate light, mouth mirror, dental explorer and University of North Carolina-15 (UNC 15) probe were used to record the plaque index (Silness and Loe, 1964),[12] bleeding index (Ainamo and Bay, 1975),[13] probing pocket depth, clinical attachment loss and missing teeth. probing pocket depth, clinical attachment loss and missing teeth/tooth loss. Probing pocket depth (PPD) is the distance from the gingival margin to the bottom of the probeable crevice (i.e., where the probe tip stops). Clinical attachment loss (CAL) is the apical migration of the dentogingival junction which is measured from

cementoenamel junction to the base of sulcus.[14] Similarly, the outcomes of number of sites with PPD and CAL were also assessed.

Statistical Analysis:

The clinical data obtained were recorded, tabulated, and transferred to a Microsoft Excel sheet where further statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software version 21 (Chicago USA). Descriptive analysis of the patients included frequency and proportion for qualitative outcomes, while mean and standard deviation (or, median and interquartile range) for quantitative outcomes. Assumption for Normality was assessed using Shapiro Wilk test. Mann Whitney U test assessed difference of study outcomes in two groups.. The p value < 0.05 was considered statistically significant at 95% confidence interval.

Results

This study included 92 female participants with mean (± SD) age of 46.4 (± 8.3) years. The participants were equally distributed among premenopausal and postmenopausal women with age range of 30–60 years.

The mean (± SD) age of menopause among post-menopausal women (n = 46) was reported to be 47.1 (± 4.2) years. The range for age of menopause was 40–55 years.

Table 1
Baseline characteristic of participants in premenopausal and postmenopausal women (N = 92)

		Premenopausal Women (I) (n = 46)	Postmenopausal Women (II) (n = 46)	p value
Age	mean (± SD)	39.78 ± 5.55	52.98 ± 4.25	**< 0.001***
	median (IQR)	40.00 (35.00–51.00)	53.00 (49.00–56.25)	
Plaque Index	mean (± SD)	1.25 ± 0.51	1.77 ± 0.58	**< 0.001***
	median (IQR)	1.21 (0.91–1.68)	2.0 (1.13–2.15)	
Bleeding Index	mean (± SD)	69.5% ± 27.09%	75.84% ± 29.74%	0.155*
	median (IQR)	76.75% (51.62% – 97.11%)	88.94% (54.54% – 100%)	
Missing	mean (± SD)	0.26 ± 0.83	1.52 ± 2.34	**< 0.001***
	median (IQR)	0.00 (0.00–0.00)	0.00 (0.00–3.00)	

*Mann Whitney U test; **Bold** signifies statistical significance at p < 0.05

Plaque index scores and the number of missing teeth were significantly higher among postmenopausal women as compared to premenopausal women ($p < 0.001$).

There was no statistically significant difference in bleeding index between the groups ($p = 0.155$). (Table 1)

Table 2
Comparison of probing pocket depth (PPD) among premenopausal and postmenopausal women (N = 92).

		Premenopausal Women (I)	Postmenopausal Women (II)	P value
No. of sites with Probing pocket depth (PPD)	n	46	46	0.288*
	mean (± SD)	12.61 ± 18.39	15.76 ± 19.60	
	median (IQR)	6.00 (0.75–12.75)	8.00 (2.0–20.00)	
Mean Probing pocket depth (PPD)	n	35	38	0.999*
	mean (± SD)	4.95 ± 1.11	4.91 ± 1.04	
	median (IQR)	4.50 (4.2–5.71)	4.76 (4.07–5.45)	

*Mann Whitney U test

There was no statistically significant difference in number of sites with probing pocket depth among postmenopausal women as compared to premenopausal women (p = 0.288). Similarly, there was no difference in mean probing pocket depth between two groups (p = 0.999). (Table 2)

Table 3
Comparison of clinical attachment loss (CAL) among premenopausal and postmenopausal women (N = 92).

		Premenopausal Women (I)	Postmenopausal Women (II)	P value
No. of sites with Clinical attachment loss	n	46	46	**< 0.001***
	mean (± SD)	21.04 ± 28.57	50.80 ± 29.85	
	median (IQR)	11 (0–28.50)	54 (27.75–77.25)	
Mean Clinical attachment loss (CAL)	n	30	46	0.852*
	mean (± SD)	9.84 ± 33.68	3.67 ± 1.50	
	median (IQR)	3.36 (2.64–5.00)	3.60 (2.62–4.94)	

*Mann Whitney U test; **Bold** signifies statistical significance at p < 0.05

The sites with clinical attachment loss were significantly higher among postmenopausal women as compared to premenopausal women (p < 0.001). There was no difference in mean clinical attachment

loss between the groups (p = 0.852). (Table 3)

Table 4
Comparison of responses to oral health behavior questions among premenopausal and postmenopausal women (N = 92).

	Premenopausal Women (I) (n = 46)	**Postmenopausal Women (II) (n = 46)**	**Total (N = 92)**
Did you brush your teeth yesterday?			
Yes	46, 100%	42, 91.3%	88, 95.7%
No	0	4, 8.7%	4, 4.3%
Do you use dental floss to maintain your oral hygiene?			
Yes	4, 8.7%	4, 8.7%	8, 8.7%
No	42, 91.3%	42, 91.3%	84, 91.3%
Have you visited a dentist for an oral health check-up in the past year, even if you didn't have any problems?			
Yes	10, 21.7%	9, 19.6%	19, 20.7%
No	36, 78.3%	37, 80.4%	73, 79.3%

Majority (95.7%) of the participants reported brushing the teeth. Use of dental floss and regular dental visit was less frequent (8.7% and 20.7%, respectively) among study participants. (Table 4)

Discussion

Various studies have been conducted globally to assess the periodontal status in postmenopausal women. The results, however, have been reported to be inconsistent due to methodological heterogeneity, including variation in eligibility criteria, study design, etc.[6,15] Such disparity indicates a need for further investigation on the status of periodontal health in this population. This study was thus designed after taking into account the confounders.

Menopause is a routine, non-pathological condition involving the permanent cessation of menses for at least 12 months.[16] Post menopause is defined as the phase dating from menopause until after a period of 12 spontaneous amenorrhea has been observed.[5] Hence, only females who had been in the menopause phase for at least two years were included in the study. Regarding age eligibility, maximum age limit set for the study participants was upto sixty years. This criterion is expected to minimize the possibility of including the females with osteoporosis in the study. Osteoporosis is considered one of the risk indicators for periodontal disease,[14] the prevalence of which is higher among postmenopausal females above sixty years of age.[17] Similar data have been reported in Nepal.[18]

The present study concluded that plaque index scores, number of teeth lost and sites with clinical attachment loss were significantly higher among postmenopausal compared to premenopausal women. However, there was no significant difference in bleeding on probing and probing pocket depth. These findings depict the periodontal destruction associated with the postmenopausal stage of women's life.

The mean plaque index score in this study has been shown to be significantly higher among postmenopausal compared to premenopausal women. Most of the studies have demonstrated that the plaque index score is invariably higher among postmenopausal women, suggesting relatively poor plaque control in this population.[15,19] Various factors have been attributed to this result including cumulative accumulation of dental plaque biofilm with diminished motor function and manual dexterity, several systemic comorbidities associated with increasing age.[14,20] These might lead to lack of urge to spare time for tedious oral hygiene practices. More importantly, the physiologic changes that occur as a result of estrogen deficiency during menopause such as reduced salivary flow subsequently favoring plaque retention are equally accountable.[21]

In the present study, the number of teeth lost was significantly higher among postmenopausal compared to premenopausal women, which is in accordance with the study done by Alves et al.[22] The studies by Bhattarai et al and Yakar et alare also in agreement with this finding, for which the reason for tooth loss was reported to be tooth decay.[23,24] Also, these studies did not exclude participants with smoking habits, unlike the present study, which excluded the confounding factors like smoking, systemic disease, and others. So, the reason for the significantly higher number of tooth losses could be either pulpal or periodontal destruction, or even both, as a result of higher plaque index score among them. Pan et al. suggested poor oral hygiene as a major contributing factor for tooth loss during menopause, rather than bone mineral density.[25] Furthermore, tooth loss is of complex etiology, reflecting cumulative conditions of oral health over time.[26]

Regarding clinical attachment level, the important parameter in the assessment of periodontal status, the number of sites with clinical attachment loss was significantly higher among postmenopausal compared to premenopausal women. However, there was no difference in mean clinical attachment loss between the groups. This finding is in agreement with several other studies.[22] Alves et al. reported slightly higher attachment loss among postmenopausal women, though statistically not significant.[22] Rafiei et al observed that hormonal fluctuation is not associated with degradation of periodontal tissues when other factors are taken into consideration, including brushing frequency, education regarding oral hygiene maintenance.[27] Moreover, menopause is an age-associated biologic transition, thus the age of the postmenopausal participants being significantly greater than that of the premenopausal group was an anticipated finding in the study. Hence, the increasing age could be considered as a contributing factor for the site-specific attachment loss reported in this study. In addition, the infrequent use of dental floss and infrequent dental visits as reported by the participants with higher plaque index score could also be attributed to such finding. On the other hand, there are several studies that have shown a strong association between periodontal disease and menopause.[15,28]

There was no difference in mean probing pocket depth between the groups. However, the sites with probing pocket depth were higher among postmenopausal compared to premenopausal women, though statistically insignificant. Similar results have been reported by Alves et al.[22]

This finding could be attributed to the fact that the shallow pocket depth could have been associated with gingival recession. Moreover, probing pocket depth in several clinical trials is not been shown to be a reliable and sensitive parameter to assess the change in periodontal status over time.[29] Hence, the depth of the pocket does not always determine the presence or severity of periodontitis. Contrarily, Sahaney et al observed a statistically significant difference between the two groups, with the mean PPD score in the premenopausal women being 1.89 ± 0.49 mm, while in the postmenopausal women group, 5.02 ± 0.45 mm.[15]

No significant difference in percentage bleeding on probing between the groups was recorded in this study. Several other studies seem to support this finding.[19,22,24] These studies together explain that the gingival changes, including bleeding on probing, are not influenced solely by fluctuation in the sex hormone once oral hygiene habits and level of plaque are optimal.[30] The same applies to this study, as both the groups reported regular tooth brushing habits and exhibited fair plaque index score. However, there are studies reporting an association between bleeding on probing and menopause. In particular, such an association has been demonstrated in studies involving women under hormone replacement therapy, indicating that hormone supplements play a role in modulating gingival response rather than its deficiency.[31,32] These findings may contribute in guiding the formulation/tailoring of treatment plans among postmenopausal women.

The study is not without limitations. The results of the study may not be generalized to a broader population as it recorded the data from a single province. Along with clinical parameters, radiographic assessment of bone level would have provided more objective evidence of periodontal status. Moreover, menopausal history was confirmed through self-reported menstrual history. Biochemical assessment of estrogen hormone, which could have strengthened the eligibility criteria of the participants. However, further longitudinal multicenter studies considering biochemical evaluation are recommended for generalizability and validation of the findings of the study. Despite the limitations, the study provides valuable insight on menopause-related periodontal changes by evaluating the specific population in a tertiary care institution in eastern Nepal, a region where the evidence on this aspect is lacking. In addition to contributing baseline data to the existing global literature, the findings further sensitize the conduction of broader and national level research considering biochemical evaluation as well to corroborate the periodontal status of postmenopausal women across the nation.

Conclusions

The study confirms periodontal burden among postmenopausal compared to premenopausal women. Despite the comparable probing pocket depth and bleeding on probing between the groups, the wider distribution of attachment loss and a greater number of tooth loss among postmenopausal group along

with significant difference in plaque accumulation, substantiates the increased incidence of periodontal destruction. Routine periodontal evaluation and precision preventive therapy should be incorporated in the healthcare of females early during their transition to postmenopausal phase of life. Also, the practitioner should actively participate in creating awareness amongst the females about menopause related oral health problems so that such issues are unraveled timely. This, in turn will help to maintain their optimal oral as well as periodontal health.

Abbreviations

BPKIHS
B.P.Koirala Institute of Health Sciences
CODS
College of Dental Surgery
CAL
Clinical Attachment Loss
IQR
Interquartile Range
PPD
Probing Pocket Depth
SD
Standard Deviation

Declarations

Ethics approval and consent to participate

The study was done in adherence to the ethical principles of the Declaration of Helsinki and approval for the study was obtained from the Institutional Review Committee (IRC) at B.P.Koirala Institute of Health Sciences (Ref. No. 571/079/080-IRC, Code No.: IRC/2451/023, 17th February, 2023). Participants were informed about the objectives, benefits, and risks of the study and provided written informed consent. Participation was entirely voluntary, and the rights of participants were respected throughout the study.

Consent for publication

Not applicable

Funding

No source of funding.

Author Contribution

PA was involved in the design of the study, data collection and analysis, report writing and manuscript preparation. SS, KA, SA were involved in design of the study, data analysis and drafting the manuscript. UJ was involved in statistical analysis and review of the report. All authors read and approved the final draft of the manuscript.

Acknowledgement

The authors would like to acknowledge all the participants for their valuable time and information during the research.

Data Availability

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

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