

## The Relationship Between Estrogen Levels and Periodontal Status in Postmenopausal Women

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### Abstract

Postmenopause is a stage after menopause which is characterised by permanent cessation of menstruation. A decrease in estrogen levels occurs in postmenopausal women. Reduced estrogen levels cause various changes in the body, including in the periodontal tissue. This study aimed to analyse the relationship between estrogen levels and periodontal status in postmenopausal women. Material and Methods used in the study was fifty-nine women, 46–67 years old, who were participating in osteoporotic exercise at East Bekasi, were recruited for a cross-sectional study. The women were interviewed and underwent a periodontal examination for gingival bleeding, loss of attachment and periodontal pockets. A blood sample was taken to assess estradiol blood levels by ELISA. As the results: Based on the Pearson correlation test, there was no significant correlation ( $p > .05$ ) between estrogen levels and the gingival bleeding index ( $p = .78$ ). The ANOVA test showed that there was no significant correlation between estrogen levels and the loss of attachment ( $p = .22$ ), periodontal pockets ( $p = .43$ ) or duration of the postmenopausal period ( $p = .40$ ). Conclusion: There was no significant correlation between estrogen levels and periodontal status also estrogen levels and the duration of the postmenopausal period.

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### Introduction

The number of women in Indonesia over 50 years old estimated to enter menopause is 15.5 million. By 2020, the number of women entering menopause is expected to increase to 30.3 million.<sup>1</sup> Menopause is a physiological condition in women that is marked by permanent cessation of menstruation and indicated by the absence of a menstrual cycle for 12 months. A transition from the reproductive phase to the non-reproductive phase occurs because of the decreased production of estrogen hormones by the ovaries.<sup>2,3</sup>

The postmenopausal phase occurs after menopause, and is defined as beginning 12

months after the end of menstruation. At this time, estrogen levels are low ( $\leq 55$  pg/ml).<sup>4,5</sup> Menopause is associated with physical and mental changes in women's lives that may impact their health.<sup>6,7</sup> Some factors that may affect menopause are age, occupation, education level, systemic disease, number of births, marital status<sup>8</sup>, age at menarche, body mass index, physical activity and socioeconomic status.<sup>9</sup>

Estrogen plays a role in cell proliferation, differentiation and growth of keratinocytes and fibroblasts.<sup>10</sup> The effects of estrogen on the periodontal tissues include increasing cellular proliferation in the bloodstream, stimulating phagocytosis from polymorphonuclear (PMN), stimulating the synthesis and maturation of connective tissue, stimulating proliferation of gingival fibroblasts, inhibiting PMN chemotaxis, suppressing leukocyte production of bone marrow, inhibiting proinflammatory cytokines and suppressing T cell-mediated inflammation.<sup>11</sup>

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Menopause initiates many changes in physiology. Estrogen hormone levels can fluctuate rapidly as a woman enters menopause. This fluctuation is key to symptoms associated with the oral cavity.<sup>12</sup> Estrogen deficiency in postmenopausal women can cause thinning of the oral mucosa, oral discomfort (burning mouth), gingival recession, xerostomia, altered taste sensation, alveolar bone loss and alveolar ridge resorption.<sup>13</sup>

Haas et al.<sup>14</sup> concluded that postmenopausal women who did not undergo estrogen hormone therapy had a greater chance of having periodontitis than did premenopausal women. Desai et al.<sup>15</sup> showed that estrogen deficiency in menopause is associated with increased production of interleukin-6 (IL-6), which stimulates bone resorption. IL-6 is a major predictor of postmenopausal bone loss, and that effect appears to be more pronounced in the first decade of menopause.

Masulili et al.<sup>16</sup>, in a study of 62 subjects ages 50 to 62 years, concluded that there is no difference between attachment loss and bone density. Zulkeple et al.<sup>17</sup> showed that postmenopausal women have increased severity of chronic periodontitis and tooth loss. It is important to follow up with these patients to avoid further progression of the disease.

Much controversy was found in previous studies assessing the relationship between periodontal status and estrogen levels. The aim of this study was to analyse the relationship between periodontal status and estrogen levels in postmenopausal women.

### Materials and Methods

A cross-sectional study was carried out with fifty-nine women gymnasts in East Bekasi, West Java, Indonesia. Inclusion criteria were: postmenopausal women, ages 45-70 years, with their natural teeth. Women who had had malignancy, systemic disease, radiation therapy, hormonal therapy, hysterectomy or tubectomy, or who were smokers, vegetarians or alcoholics were excluded from the study. All subjects approved and signed an informed consent before being included in this study.

Demographic data were collected through interviews of the subjects. Each subject underwent a periodontal examination in the

Periodontic Clinic at the Dental Hospital, Faculty of Dentistry, Universitas Indonesia. Estradiol levels were determined at the *Makmal Terpadu Imuno endokrinologi* Clinic, Faculty of Medicine, Universitas Indonesia.

This research project was approved by the Dental Research Ethical Committee, Faculty of Dentistry, Universitas Indonesia.

The periodontal examination consisted of papillary bleeding index (PBI), attachment loss (AL), and pocket depth (PD) measurements. AL and PD were measured using a periodontal probe. All measurements were assessed at six surfaces per tooth: mesio-buccal, mid-buccal, disto-buccal, mesio-lingual, mid-lingual and disto-lingual. PD was defined as follows: mild if PDs were less than 4mm at 1–80 sites or 4–6mm at 1–8 sites, with no PD greater than 6mm; moderate if PDs were less than 4mm at 1–80 sites or 4–6mm at more than 8 sites, with no PD greater than 6mm; severe if PDs were greater than 4mm at more than 80 sites or 4–6 mm at more than 8 sites, with more than one site having a PD of greater than 6 mm.

Clinical AL was determined by measuring the distance from the cement to enamel junction to the base of the pocket, using a periodontal probe. Clinical AL was defined as follows: mild if AL was less than 4mm at 1–80 sites or 4–6mm at 1–11 sites, with no AL greater than 6mm; moderate if AL was less than 4mm at 1–80 sites or 4–6mm at 1–11 sites, with no AL greater than 6mm; severe if AL was greater than 4mm at more than 80 sites or 4–6mm at more than 11 sites, with AL greater than 6mm at more than 6 sites.<sup>18</sup>

Estradiol levels were determined by obtaining a 5ml venous blood sample from each participant. The blood samples were centrifuged at 3000 revolution per minute (rpm) for 10 minutes at 18°C, and the serum was frozen at -20°C. Plasma estradiol levels (pg/ml) were measured by the enzyme-linked immune sorbent assay (ELISA) technique (*Abbott AXsym System* series 34-3205/R6).

Statistical analyses used included the Kolmogorov-Smirnov for data normality, and the Pearson test, Chi-Square and ANOVA test for bivariate analysis. Duration of menopause was measured in years.

## Results

The study included fifty-nine participants, 46–67 years old, with education ranging from no formal education to college degrees.

The duration of the postmenopausal period ranged from 1 to 20 years.

**Table 1.** Demographic Data from Study Participant

	N	Percentage
Age (years)		
≤50	2	3.4
51–55	12	20.3
56–60	24	40.7
61–65	20	33.9
>65	1	1.7
Education		
None	3	5.1
Primary School	5	8.5
Secondary School	14	23.7
High School	35	59.3
College	2	3.4
Duration of Menopause (years)		
<5	19	32.2
5–10	25	42.4
>10	15	25.4

**Table 2.** Estrogen Levels, Attachment Levels and Pocket Depths of Study Participants

	N	Percentage
Estrogen Level		
< 20 pg/ml	58	98.3
20–41pg/ml	1	1.7
Attachment Level		
Mild	21	35.6
Moderate	17	28.8
Severe	21	35.6
Pocket depth		
Mild	38	64.4
Moderate	13	22.0
Severe	8	13.6

**Table 3.** Association of Estrogen Levels with Attachment Levels, Pocket Depths and Duration of Menopause

	N	Estrogen Levels (pg/ml)		p
		Mean (SD)	Min–Max	
Attachment Loss (mm)				.22*
Mild	21	5.05 (5.74)	1–19	
Moderate	17	7.41 (5.66)	1–20	
Severe	21	8.10 (6.14)	1–21	
Pocket depth (mm)				.43*
Mild	38	0.00 (6.04)	1–20	
Moderate	13	5.00 (3.80)	1–11	
Severe	8	8.00 (8.00)	1–21	
Duration of menopause (years)				.40*
< 5	19	8.32 (6.63)	1–21	
5–10	25	6.28 (5.96)	1–20	
>10	15	5.80 (4.79)	1–13	

ANOVA test;  $p < .05$  is significant

The ANOVA test showed no significant association ( $p > .05$ ) between estrogen levels and attachment levels, pocket depths or duration of menopause (Table 3).

### Discussion

The term *menopause* is derived from the Greek words *meno*, meaning month, and *pausis*, meaning stopped or terminated. Scientifically, menopause is a physiological event that marks the end of a woman's fertile age, with permanent cessation of the menstrual cycle. Menopause causes ovarian activity to cease, and the ovaries no longer produce the sex hormones, particularly estrogen, due to ovarian fatigue. Estrogen deficiency contributes to the pathobiology of multiple chronic diseases in postmenopausal women, creating a therapeutic challenge.<sup>19,20</sup>

Periodontal disease is an inflammatory disease in which microbial etiologic factors induce a series of host responses that mediate inflammatory events. In susceptible individuals, inflammatory dysregulation and immune pathways lead to chronic inflammation, tissue damage and disease.<sup>21</sup>

The Pearson test revealed no significant relationship between estrogen levels and PBI ( $p = 0.78$ ). All subjects had minimum estrogen levels.

Periodontal tissue is affected by hormonal action, so strict preventive measures should be used to minimize inflammatory problems, gingival and mucosal infections and risk of tooth loss.<sup>19</sup>

A study by Alves et al.<sup>22</sup> comparing premenopausal women with postmenopausal women found no statistically significant differences for periodontal parameters, and concluded that menopause does not significantly influence the severity of periodontal diseases or tooth loss. Factors other than menopause may exert a greater influence on periodontal disease severity. Tarkkila<sup>23</sup> found no association between periodontal status and hormone replacement therapy, even though hormone replacement therapy can decrease the number of periodontal pathogens.

However, Varghese et al.<sup>24</sup> concluded that plaque index, gingival index, PD and clinical

AL were significantly different between premenopausal and postmenopausal women, and postmenopausal women had a greater chance of having periodontitis.

Noronha et al.<sup>25</sup> showed that the oral hygiene index (OHI) and the decayed, missing and filled teeth (DMFT) index were higher in postmenopausal women compared to fertile women, and OHI and DMFT indices were significantly increased with periodontal diseases. Decrease of bone density can lead to faster loss of teeth, and changes of salivary flow and composition may increase OHI and DMFT. Suresh<sup>26</sup> found a positive association of periodontitis with bone mineral density (BMD) in postmenopausal women. The clinical AL was significantly higher and BMD was significantly lower in postmenopausal women than in premenopausal women.

The maximum age for subjects in the current study was 70 years, in accordance with the study by Yoldemir<sup>27</sup>, which included postmenopausal women aged 41–70 years. For the current study, subjects were excluded if they had a history of malignancy and were currently undergoing radiation therapy, had a previous hysterectomy, ovariectomy or tubectomy, had a history of or were currently undergoing hormone replacement therapy, or were suffering from systemic diseases. These exclusions were used to avoid factors that affect menopause and to allow researchers to examine estrogen levels in women who experienced natural menopause.<sup>28</sup> However, it was relatively difficult to find subjects who are menopausal but do not have a history of systemic disease. The results of this study showed no significant relationship between estrogen levels and periodontal AL, PD or duration of menopause in postmenopausal women.

This study was conducted in a population that is involved in osteoporotic gymnastics. Physical exercises such as gymnastics can improve endothelial function and decrease inflammation, and improve cardiac regulation, bone density and structure, muscle function, chromosomal function and cognitive function.<sup>29</sup> Regular physical activity is useful in preventing weight gain, improving body composition and improving functional strength and capacity. Exercise has the potential to improve bone mass and reduce the risk of fractures in postmenopausal women.<sup>30</sup>

From this study, no significant association between estrogen levels and gingival bleeding was found. This may have been because an increase in plasma hormone levels causes an excessive immune response if the amount of bacterial plaque increases. Inflammatory mediators may be affected by estrogen hormone levels, which could be attributed to the production of prostaglandins by the involvement of estradiol.<sup>13</sup> Although some literature suggests a direct relationship between estrogen levels and postmenopausal duration, no significant correlation between estrogen levels and postmenopausal duration was found in this study.

There was no correlation between estrogen levels and the periodontal status of postmenopausal women in this study. This was probably because estrogen was not the only factor contributing to periodontal disease, and the measurement of periodontal status was limited to measures of PBI, AL and PD. The relationship between menopause and periodontal disease is very difficult to discern, due to the many factors involved.<sup>22</sup>

## Conclusion

This study demonstrated no correlation between estrogen levels and periodontal status in postmenopausal women, and no correlation between postmenopausal duration and estrogen levels in postmenopausal women.

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## Declaration of Interest

The authors declare no conflict of interest.

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