







Dental caries and hormonal changes in postmenopausal women

La caries dental y cambios hormonales en mujeres posmenopáusicas

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Abstract

Menopause is the period of life when occur physiological changes in women that give rise to adaptive changes at both systemic and oral levels. As we all begin to reach an older age, dental health and hygiene become a major concern. This study aimed to evaluate the relationship between hormonal and calcium levels during the postmenopausal period and dental caries (D.C). This study was composed of 35 postmenopausal women (PMW) (group1) (15 with dental caries (group1A) and 20 without dental caries (group1B), control group (group2) composed of 15 women with age under the menopause (premenopausal women). The study groups are free from chronic diseases like diabetes mellitus, cancers, and renal failure.

Serum was collected and calcium (Ca), vitamin D (Vit D), estrogen (Est), and cortisol (Cort) were analyzed. Our results show a significant decrease ($P<0.05$) in levels of serum calcium, vitamin D, and estrogen, and a significant increase ($P<0.05$) in levels of cortisol in PMW as compared with control. These differences are also present in PMW with dental caries as compared with PMW without dental caries. Conclusion: Dental caries is negatively related to serum calcium, vitamin D, and estrogen level while positively cortisol in postmenopausal women.

Keywords: Dental caries, menopause, estrogen, cortisol, vitamin D.

Resumen

La menopausia es el periodo en que ocurren cambios fisiológicos en la mujer que dan lugar a cambios adaptativos tanto a nivel sistémico como oral. A medida que todos comenzamos a envejecer, la salud e higiene dental se convierte en una preocupación importante. Este estudio tuvo como objetivo evaluar la relación entre los niveles hormonales y de calcio durante el periodo posmenopáusico y la caries dental (D.C). Este estudio estuvo compuesto por 35 mujeres posmenopáusicas (PMW) (grupo 1) (15 con caries dental (grupo 1A) y 20 sin caries dental (grupo 1B), grupo control (grupo 2) compuesto por 15 mujeres con edad inferior a la menopausia (mujeres premenopáusicas). Los grupos de estudio están libres de enfermedades crónicas como diabetes mellitus, cáncer e insuficiencia renal. Se recolectó suero y se analizaron los niveles séricos de calcio (Ca), vitamina D (Vit D), estrógeno (Est) y cortisol (Cort). Nuestros hallazgos muestran una disminución significativa ($P<0.05$) en los niveles de calcio sérico, vitamina D y estrógeno, y un aumento significativo ($P<0.05$) en los niveles de cortisol en PMW en comparación con el control. Estas diferencias también se presentan en PMW con caries dental en comparación con PMW sin caries dental. Conclusión: La caries dental se relacionó negativamente con el calcio sérico, la vitamina D y el nivel de estrógeno, mientras que el cortisol se relacionó positivamente en mujeres posmenopáusicas.

Palabras Clave: Caries dental, menopausia, estrógenos, cortisol, vitamina D.

Introduction

Dental caries is a multifactorial microbial disease of the tooth and is one of the most common health problems. Importantly, the prevalence of untreated dental caries has increased. While there is a direct effect of untreated dental caries on oral health and associated quality of life, identification of indirect associations between dental caries (including untreated dental caries) and systemic health are of potential interest but have received little attention^{1,2}.

Periodontal disease is associated with various risk factors among them female hormonal alterations such as menopause³.

Menopause is a special period in a woman's life. The perimenopausal phase is the menopausal transition period that spans the last few years before the last menstrual period and ends 12 months after; this phase can last from 4 to 10 years. Perimenopause, commonly referred to as climacteric, is a period of crucial physical, emotional, and psychological changes in a woman's life^{4,5}. During menopause, the gingival epithelium becomes thinner, atrophic, and more prone to inflammatory changes. They experience an increase in oral symptoms that results from endocrine disturbances, calcium and vitamin deficiencies, and various psychological factors during post-menopausal year^{4,5}.

Hormonal changes are characterized by decreases in progesterone and estrogen levels which may lead to metabolic, sexual, and psychological changes. These changes will lead to further vascular, bone (periodontal), and adipose changes⁶.

The increase of osteoporosis and periodontal diseases augments with the increase in women age (postmenopausal period). The body bone mineral density decreases by 1% every year in postmenopausal women due to the rapid decline in the levels of estrogen⁷.

Calcium is an important component of the body skeleton and due to the reduction of its synthesized by the body, it must be supplied in sufficient quantities in the diet, especially in case of endocrine problems to maintain healthy bones and teeth^{8,9}.

Calcium metabolism is controlled in the body by vitamin D through the action on the gastrointestinal tract, kidneys, and skeleton. Vitamin D is a lipophilic steroid hormone that has a function for oral health as an anti-inflammatory by stimulating the production of anti-microbial peptides^{10,11}. Vitamin D refers to a group of the fat-soluble biomolecule, synthesized in the skin by the action of ultraviolet irradiation from the sun related to bone metabolism and skeletal integrity as well¹².

Vitamin D has two important roles in the body: (1) plays a role in the endocrine mechanism and plays a role in the autocrine /intracrine mechanism. The endocrine pathway involves a "classic" mechanism associated with increased calcium absorption in the intestine and osteoclast activity. "Non-classic" mechanism that utilizes the autocrine or

intracrine pathways are associated with signaling and gene expression, protein synthesis, hormone synthesis, regulation of immune response, and cell turnover¹³.

A possible mechanism for this association whereby vitamin D reduces the risk of periodontitis is through the induction of cathelicidin. The vitamin D pathway has been shown to exist in human gingival fibroblasts and periodontal ligament cells, playing an important role in immune defense in periodontal soft tissues via the activation of the human cationic antimicrobial protein cathelicidin¹⁴.

Estrogen is the primary female sex hormone that is responsible for the development and regulation of the female reproductive system and secondary sex characteristics. Estrogen deficiency may lead to gingivitis, especially during periodontitis and this may be developed into oral bone loss and also may lead to skeletal bone loss^{15,16}.

Cortisol is a glucocorticoid hormone that is also known as the "stress hormone". It is released by the suprarenal gland and affects homeostasis like vascular reactivity and also effect carbohydrate metabolism^{17,18}.

The changes in hormones during the postmenopausal period may lead to many problems for teeth in women like burning mouth syndrome (BMS), gingivitis, periodontitis, and tooth loss. The early oral manifestations include dry mouth, viscous saliva, dental caries, altered taste^{19,20}. Thus, this study aimed to assess if there is a relationship between serum hormonal levels during menopause and dental caries in postmenopausal women.

Subjects and Methods

This study included 50 women (35 postmenopausal women (15 with dental caries and 20 without), and 15 premenopausal women). The study was conducted from June 2018 to December 2018 in the town of Qayara in southern Mosul and the cases from Al Qayara Health Center.

Instruments used were spectrophotometer for estimation of serum calcium, Mini Vidas was used for assessment of vitamin D and estrogen serum levels, and AFIAS6 AFIAS6 (AFIAS-automated fluorescent immunoassay system) for quantification of cortisol levels.

Dental Examination

Teeth were examined and evaluated by a dentist who works in the health center and check for dental caries, cavities, and gum disease. The dentist also evaluated the risk of developing other oral health problems, as well as checked the face, neck, and mouth for abnormalities.

Biochemical Analysis

Determination of serum calcium

Serum calcium was estimated by the use of the CPC (O-Cresol Phtalein Complexone) method. In an alkaline solution, CPC reacts with calcium to form a dark-red colored complex

whose absorbance measured at 570 nm is proportional to the amount of calcium in the specimen.

Determination of serum vitamin D

Vitamin D was determined by VIDAS 25 OH Vitamin D TOTAL (VITD). VIDAS 25 OH Vitamin D TOTAL (VITD) is an automated quantitative test for use on the instruments of the VIDAS family for the determination of 25-hydroxyvitamin D Total in human serum or plasma using the ELFA technique (Enzyme-Linked Fluorescent Assay).

Determination of serum estrogen

VIDAS Estradiol II is an automated quantitative test for use on the VIDAS family of instruments for the quantitative measurement of a total of 17 β -estradiol in human serum or plasma (lithium heparin), using the ELFA technique (Enzyme-Linked Fluorescent Assay).

Determination of serum cortisol

Cortisol was determined by AFIAS6, which is an automated quantitative test for the determination, management, and monitoring of the concentration of cortisol in human whole blood, serum, or plasma by using the fluorescence immunoassay (FIA).

Biostatistical analysis

The results were expressed as mean \pm S.D. Student's t-test and bivariate correlation [Pearson correlation coefficient (r)] were used to assess the results of patients and control groups. Significant variation was considered when the P-value was less than 0.05.

was significantly ($P < 0.05$) increased in postmenopausal women with dental caries as compared with controls.

- Correlation of calcium and vitamin D with estrogen and cortisol in postmenopausal women (with and without dental caries).

There was a significant positive correlation between calcium and vitamin D with estrogen and a significant negative correlation with cortisol in both groups.

Table 1. Dental caries percent and biochemical markers in postmenopausal women and healthy persons.

	Age (years) \pm S.D	Ca (mg/dL) \pm S.D	Vit D (ng/mL) \pm S.D	Estrogen (pg/mL) \pm S.D	Cortisol (nmol/L) \pm S.D	D.P. (?) (yes/%)
Group1 No (35)	59.74 \pm 5.80	8.43 \pm 0.42	36.12 \pm 5.63	35.66 \pm 6.18	523.20 \pm 104.44	Yes 42.86%
Group2 No (15)	42.53 \pm 4.97	9.26 \pm 0.66	49.27 \pm 5.95	180.39 \pm 39.44	413.60 \pm 94.74	No
P-value		0.02	0.033	0.01	0.01	

Table 2. Biochemical markers in postmenopausal women with dental problems and those without dental caries.

	Age (years) \pm S.D	Ca (mg/dL) \pm S.D	Vit D (ng/mL) \pm S.D	Estrogen (pg/mL) \pm S.D	Cortisol (nmol/L) \pm S.D	D.A. (?) (yes/%)
Group1A No (15)	61.80 \pm 6.37	8.14 \pm 0.38	31.42 \pm 4.01	33.62 \pm 5.65	549.00 \pm 107.80	Yes 100%
Group1B No (20)	58.20 \pm 4.94	8.65 \pm 0.30	39.65 \pm 3.80	37.20 \pm 6.25	503.85 \pm 100.17	No
P-value		0.05	0.01	0.05	0.05	

Table 3. Biochemical markers in postmenopausal women with dental caries and control group.

	Age (years) \pm S.D	Ca (mg/dL) \pm S.D	Vit D (ng/mL) \pm S.D	Estrogen (pg/mL) \pm S.D	Cortisol (nmol/L) \pm S.D	D.A. (?) (yes/%)
Group1A No (15)	61.80 \pm 6.37	8.14 \pm 0.38	31.42 \pm 4.01	33.62 \pm 5.65	549.00 \pm 107.80	Yes 100%
Group2 No (15)	42.53 \pm 4.97	9.26 \pm 0.66	49.27 \pm 5.95	180.39 \pm 39.44	413.60 \pm 94.74	No
P-value		0.01	0.01	0.01	0.01	

Table 4. Correlation of calcium and vitamin D with estrogen and cortisol.

Group type	Markers	Estrogen		Cortisol	
		r	P _{value}	r	P _{value}
Group1A	Ca	0.869	0.0001	-0.774	0.001
	Vit D	0.988	0.0001	-0.964	0.0001
Group1B	Ca	0.860	0.0001	-0.939	0.0001
	Vit D	0.909	0.0001	-0.972	0.0001

Results

- Dental caries percent and measurements of biochemical markers in postmenopausal women and the control group.

Serum calcium, vitamin D, and estrogen levels were decreased significantly ($P < 0.05$) and serum cortisol was significantly ($P < 0.05$) increased in postmenopausal women as compared with controls. The percentage of dental caries in the case study is about 42.86%.

- Biochemical markers in postmenopausal women with dental caries and those without dental caries.

Serum calcium, vitamin D, and estrogen levels were decreased significantly ($P < 0.05$) and serum cortisol was significantly ($P < 0.05$) increased in postmenopausal women with dental caries as compared with those without dental caries.

- Biochemical markers in postmenopausal women with dental caries and control group.

Serum calcium, vitamin D, and estrogen levels were decreased significantly ($P < 0.05$) and serum cortisol

Figure 1. Correlation between calcium and vitamin D in postmenopausal women with dental caries.

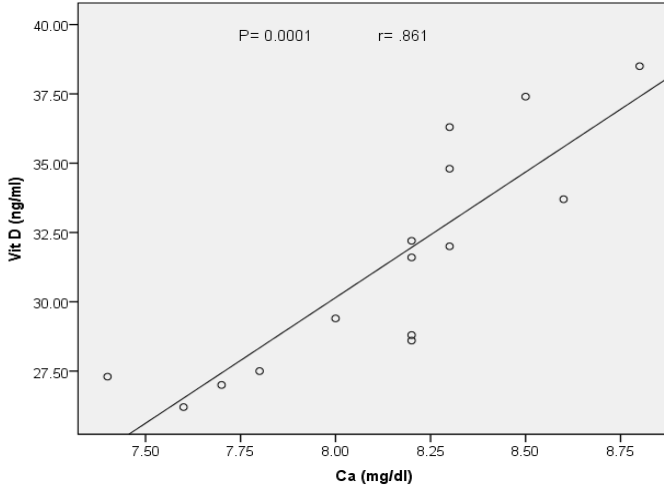


Figure 2. Correlation between calcium and estrogen in postmenopausal women with dental caries.

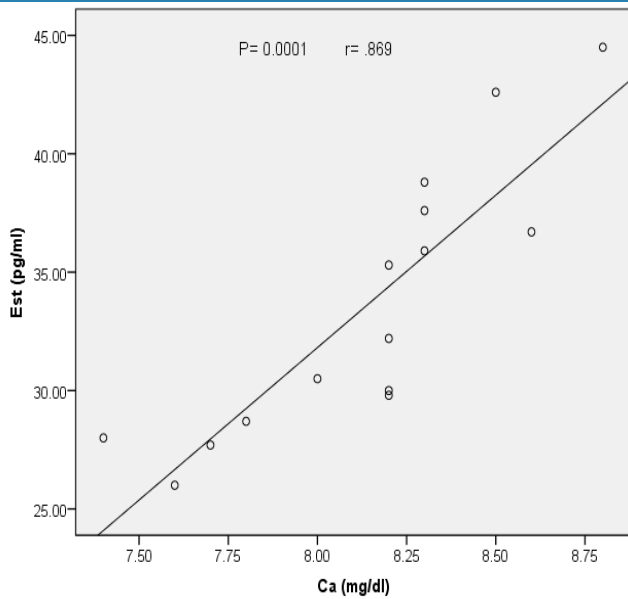


Figure 3. Correlation between calcium and cortisol in postmenopausal women with dental caries.

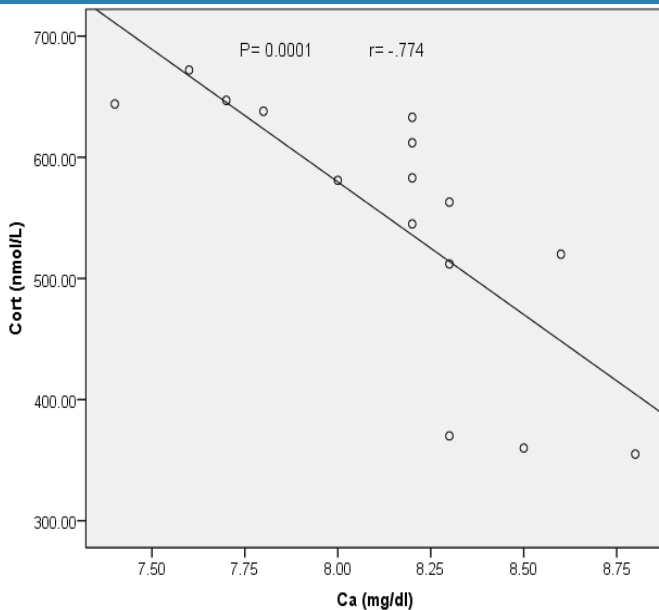


Figure 4. Correlation between vitamin D and estrogen in postmenopausal women with dental caries.

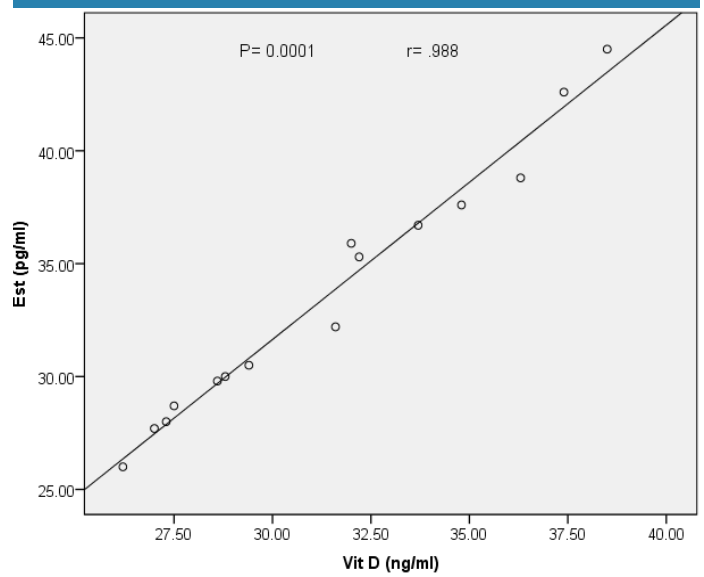


Figure 5. Correlation between vitamin D and cortisol in postmenopausal women with dental caries.

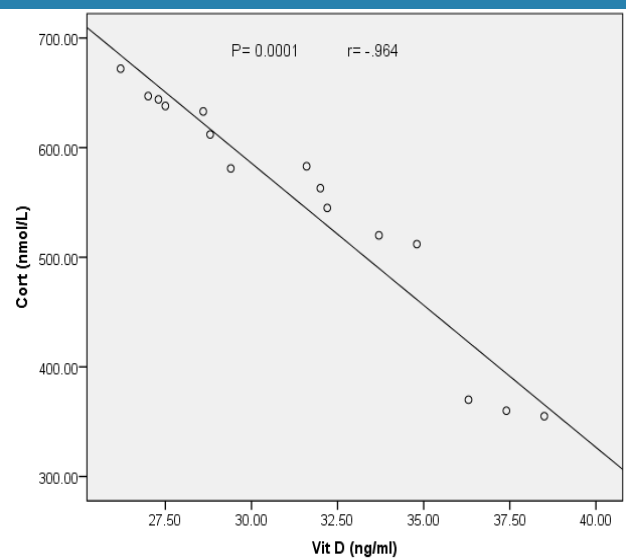
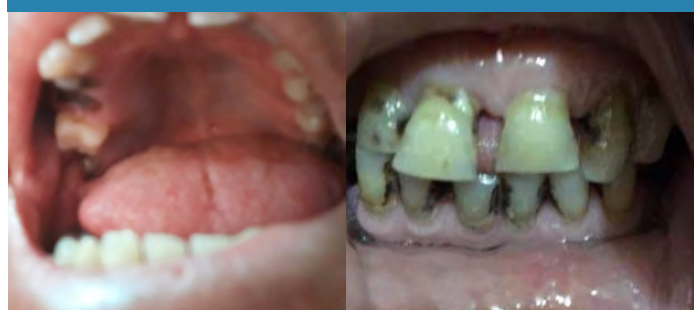


Figure 6. Pictures of affected teeth in postmenopausal women.



Dental caries and periodontal diseases are known as the top oral health burden²¹. The hormone is increased by decreased calcium or increased phosphate. High parathyroid hormone damages the bone and alters the levels of phosphate and calcium in the bone^{22,23}. The results show a significant reduction in concentrations of serum calcium in postmenopausal women as compared with premenopausal women. In effect, Qureshi²⁴, Bhale⁸, and Patwa⁹ showed a significant decrease in serum calcium in postmenopausal as compared with premenopausal women, and this deficiency was due to estrogen decline which leads to decrease intestinal absorption of calcium, decrease renal reabsorption and increase calcium excretion by the gut.

Our results show a significant decrease in vitamin D in postmenopausal women in relation to premenopausal women. These results agree with Pérez-López¹⁰, Asadi²⁵, and Singh²⁶ who mentioned that there is a significant decrease in vitamin D in postmenopausal as compared with premenopausal women.

The levels of serum estrogen noted a significant decrease in postmenopausal women as compared with premenopausal women due to the discontinued endocrinological activity of the ovaries resulting in several systemic processes occurring in the women's body causing the undesirable symptoms reported by women during this period²⁷. In accordance, Minicucci⁶ and Buencamino⁷ also mentioned there was a significant decrease in serum estrogen in postmenopausal women, and this decline was due to the aging of ovaries which are responsible for the secretion of estrogen and progesterone.

Serum cortisol levels were significantly increased in postmenopausal women in relation to premenopausal women. Agha-Hosseini¹⁸ and Al-Kholy²⁸ have noted that the level of salivary cortisol was significantly increased in postmenopausal women as compared with premenopausal women. The salivary concentration of cortisol is a reliable indicator of serum cortisol concentration. The cortisol may affect and decrease the level of serum calcium by the effect of the parathyroid hormone, decrease intestinal absorption of calcium, and decrease renal reabsorption.

All the above changes are also noted in postmenopausal women with dental problems as compared with postmenopausal women which are without dental problems. Buencamino⁷ and Bhat⁸ demonstrated that dental problems will increase during the menopausal period due mainly to the decline of estrogen which leads to calcium and vitamin D decrease and happens of osteoporosis and periodontitis, decreases in the density of the alveolar bone in the mandible, dental caries, and tooth loss.

All these hormonal changes (decrease of estrogen and vitamin D and increase of cortisol) explain the significant positive correlation between calcium and both estrogen and vitamin D, and a significant negative correlation between calcium with cortisol.

C reactive protein (CRP) is one of the most proinflammatory mediators produced by the monocytes of the tissue factor which initiates the coagulation process²⁹⁻³⁰.

Conclusion and recommendations:

A significant association was found between serum calcium, vitamin D, cortisol, estrogen, and dental caries in postmenopausal women. The study supports the significance of preventive dentistry upsurges with aging in females. Such studies will help to devise culturally appropriate public health programs for menopausal and postmenopausal women to ensure a healthy post-reproductive life for them.

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