



ORIGINAL ARTICLE

Correlation of Serum Parathyroid Hormone and Calcium Level among Pre- and Post-menopausal Women

Sadia Israt Zaman¹, Humaira Tabassum², Asma Khan³, Umme Shaila⁴

¹Assistant Professor, Department of Physiology, Sir Salimullah Medical College, Dhaka, Bangladesh; ²Associate Professor, Department of Pathology & Microbiology, Pioneer Dental College, Dhaka, Bangladesh; ³Associate Professor, Department of Pharmacology, Shaheed Suhrawardy Medical College, Dhaka, Bangladesh; ⁴Assistant Professor, Department of Biochemistry, Sir Salimullah Medical College, Dhaka, Bangladesh

[Received on: 1 October 2021; Accepted on: 20 December 2021; Published on: 1 January 2022]

Abstract

Background: Postmenopausal women are prone to osteoporosis due to estrogen deficiency. **Objective:** The purpose of the present study was to assess the correlation between serum parathyroid hormone level and serum calcium level among pre- and post-menopausal women. **Methodology:** This cross-sectional study was conducted in the Department of Physiology at Dhaka Medical College, Dhaka, Bangladesh during the period of January 2012 to December 2012. Women were selected from different areas of Dhaka city. Among them, postmenopausal women with age ranging from 50 to 60 years were taken as group A and apparently healthy premenopausal women with age ranging from 20 to 30 years were included as group B for comparison. Serum calcium and parathyroid hormone levels were estimated to assess the hormonal status in both groups. **Results:** A total number of seventy (70) postmenopausal women with age ranging from 50 to 60 years and duration of menopause was more than one year. Thirty (30) apparently healthy premenopausal women with age ranging from 20 to 30 years with regular menstrual cycle. Correlation between parathyroid hormone with serum calcium was analyzed. In group A, serum parathyroid hormone showed negative correlation with serum Calcium ($r = -0.161$, $p = 0.184$) which was statistically non-significant relationship. In group B, serum parathyroid showed positive correlation with serum calcium ($r = +0.232$, $p = 0.218$) which was statistically non-significant relationship. **Conclusion:** In conclusion serum calcium is lower and serum parathyroid hormone is higher in postmenopausal women. [*Journal of Current and Advance Medical Research, January 2022;9(1):16-20*]

Keywords: Correlation; serum parathyroid hormone; calcium level; pre- and post-menopausal women

Correspondence: Dr. Sadia Israt Zaman, Assistant Professor, Department of Physiology, Sir Salimullah Medical College, Dhaka, Bangladesh; **Email:** dr.sadiazmn@gmail.com; **Cell No.:** +8801726321189; **ORCID ID:** <https://orcid.org/0000-0002-7006-6748>

Cite this article as: Zaman SI, Tabassum H, Khan A, Shaila U. Correlation of Serum Parathyroid Hormone and Calcium Level among Pre- and Post-menopausal Women. *J Curr Adv Med Res* 2022;9(1):16-20

Funding: This study has been performed without any funding from outside else.

Conflict of Interest: There was no conflict of interest to any of the authors.

Contributions to authors: All authors involved from protocol preparation up to manuscript writing & revision.

Copyright: ©2022. Zaman et al. Published by Journal of Current and Advance Medical Research. This article is published under the Creative Commons CC BY-NC License (<https://creativecommons.org/licenses/by-nc/4.0/>). This license permits use, distribution and reproduction in any medium, provided the original work is properly cited, and is not used for commercial purposes.

Introduction

Menopause is the period during which the cycle ceases and the female sex hormones diminish to zero¹. When estrogen production falls below a critical value, it no longer inhibits the production of gonadotropins. Thus, FSH and LH production increase in menopause². The menopause usually occurs between the age of 45 to 55 years and the common clinical characteristics of menopause are hot flushes and night sweats³. Moreover, estrogens deficiency during menopause has got remarkable effects on gastrointestinal, skeletal, urogenital, cardiovascular system⁴.

After menopause, there is loss of bone mass by about 3.0% to 5.0% per year due to deficiency of estrogen⁵. There is a decline in collagenous bone matrix resulting in osteoporotic changes. Bone mass loss and micro architectural deterioration of bone tissue occurs primarily in trabecular & cortical bones. Osteoporosis may lead to back pain, loss of height and kyphosis⁴. Parathyroid hormone is the major circulating factor that regulating extracellular calcium concentration. Its secretion increases by low level of serum calcium ion by stimulating osteoclastic bone resorption and transcellular calcium reabsorption from renal tubules. Parathyroid hormone increases in extracellular calcium concentration⁶⁻⁷.

Globally more than 30 million people are affected by osteoporosis and there are about 1.5 to 2 million osteoporotic fragility fractures occurrence in every year⁸. This includes more than 700000 vertebral fractures and over 300000 hip fractures and the mortality rate following a hip fractures in osteoporotic patients is about 10.0% to 20.0% within first year, and less than 50% of survivors regain their prefracture level of mobility and independence⁴. The risk of fracture increases in postmenopausal women due to acceleration of bone loss. High serum parathyroid hormone concentration is one of the major causes of this bone loss. Moreover, the decreased plasma ionized calcium level stimulates parathyroid hormone secretion⁹. Therefore, the present study has been designed to assess the correlation between serum parathyroid hormone level and serum calcium level among pre- and post-menopausal women.

Methodology

This comparative cross sectional study was conducted in the Department of Physiology at Dhaka Medical College, Dhaka, Bangladesh from January 2012 to December 2012 for a period of one

year. Postmenopausal women with the age ranging from 50 to 60 years and duration of menopause more than one year were considered as group A and apparently healthy premenopausal women with age ranging from 20 to 30 years were included as group B for comparison. They were selected from different areas of Dhaka city. Women with age more than 60 years and less than 20 years, or women with heart, liver, kidney diseases, tuberculosis, malignancy, endocrine disorders like thyroid diseases or women with taking hormone replacement therapy, steroid, anti-hypertensive, anti-diabetic and lipid lowering agents, alcohol user, and smoker were excluded from this study. After selection of the subjects, the objectives, nature, purpose and benefit of the study were explained to the subjects in details. Ethical permission was taken from Institutional Review Board of Dhaka Medical College. Written informed consents were taken from the participants. Detailed medical and menstrual history was taken. Anthropometric measurement of the subjects were taken and recorded in a pre-designed data collection form. Then with all aseptic precautions 5ml of fasting/random blood sample were collected from all the study subjects for estimation of serum calcium and serum parathyroid levels. Estimation of serum PTH was done by Chemiluminescence immunoassay method in Department of Microbiology and Immunology at BSMMU, Dhaka, Bangladesh and serum calcium level was estimated by Biometric endpoint technique in Dimension® clinical chemistry system from the Department of Biochemistry in BSMMU. All the parameters were expressed as mean with SD (standard deviation). Unpaired Student's 't' test was done to compare the all parameters between the groups. Pearson's correlation co-efficient (r) test was done to find out the relationship of serum parathyroid level with serum calcium and serum phosphate. P value of <0.05 was considered as significant. Analysis was performed by using a computer based statistical program SPSS (Statistical Package for Social Science) version 20.0.

Results

A total number of seventy (70) postmenopausal women with age ranging from 50 to 60 years and duration of menopause was more than one year. Thirty (30) apparently healthy premenopausal women with age ranging from 20 to 30 years with regular menstrual cycle. Mean±SD serum calcium level in group A and group B were 8.42±0.50 and 9.36±0.52 (mg/dl) respectively. Mean serum calcium levels in group B were higher than that of group A which was statistically highly significant

($P < 0.001$). Mean (\pm SD) serum parathyroid level in group A and group B were 30.72 ± 10.35 and 18.96 ± 7.58 (mg/dl) respectively. Mean serum phosphate level in group B were higher than that of group A which was statistically highly significant ($P < 0.001$) (Table 1).

Table 1: Mean Values of Study Parameters of Different Groups (Mean \pm SD)

Serum	Groups		P value
	Group A	Group B	
Calcium (mg/dL)	8.42 ± 0.50 (7.60-9.80)	9.36 ± 0.52 (8.50-10.70)	0.0001
PTH (pg/ml)	30.72 ± 10.35 (10.50-68.40)	18.96 ± 7.58 (8.27-36.00)	0.0001

Group A=Post-menopause women; Group B=Pre-menopause women; parathyroid hormone=PTH; Unpaired Student's 't' test was performed to compare between groups. The test of significance was calculated and p values < 0.05 was accepted as level of significance.

Correlation between parathyroid hormone with serum calcium was analyzed. In group A, serum parathyroid hormone showed negative correlation with serum Calcium ($r = -0.161$, $p = 0.184$) which was statistically non-significant relationship.

Table 2: Correlation of Serum Parathyroid Hormone with Serum Calcium Level

Groups	r coefficient	P value
Group A	-0.161	0.184
Group B	+0.232	0.218

Pearson's correlation-coefficient (r) test was performed to compare relationship between parameters. The test of significance was calculated and p value < 0.05 was accepted as level of significance.

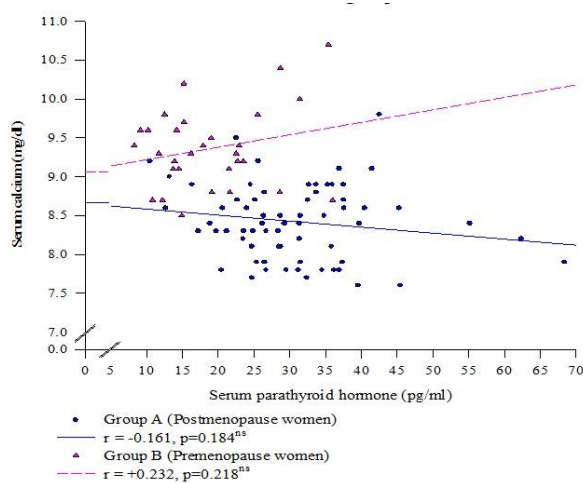


Figure I: Scatterplot showing the correlation between the serum PTH and serum calcium level among study population

In group B, serum parathyroid showed positive correlation with serum calcium ($r = +0.232$, $p = 0.218$) which was statistically non-significant relationship (Table 2).

Discussion

The present study has been undertaken to observe serum calcium and parathyroid levels in postmenopausal women. For this purpose, 100 women were selected, of them 70 were postmenopausal women with age ranging from 50 to 60 years and 30 were premenopausal women with age ranging from 20 to 30 years. Unpaired Student's 't' test was done to compare the all parameters between the study and control groups. Pearson's correlation co-efficient (r) test was done to find out the relationship of serum parathyroid hormone with serum calcium level.

In the present study, findings of serum calcium, phosphate were lower and serum parathyroid was higher in postmenopausal women than in premenopausal women. Similar study were observed by other investigators from different countries¹⁰⁻¹⁴.

In the present study, serum calcium level were significantly ($p < 0.001$) lower in postmenopausal women than that of premenopausal women. These findings were in agreement with study of many researchers^{10-11,15}. Again, some workers found lower calcium level in postmenopausal women than premenopausal women and result was also statistically significant^{11,15-16}. Need et al⁹ did not find any significant correlation between serum calcium and serum parathyroid hormone level.

In this study, serum parathyroid level in postmenopausal women is significantly ($p < 0.001$) higher than that of premenopausal women. This finding is in agreement with those of different researchers of different countries^{9,11,17}. Similar observations are also made by other workers Cerda et al⁷ but they have found that menopausal status is not associated with increased serum parathyroid level.

In the present study, Pearson' correlation co-efficient (r) test is performed to observe the relationship of serum calcium with the serum parathyroid level in postmenopausal women. Serum parathyroid level in postmenopausal women has shown negative correlation with serum calcium level but in premenopausal women showed positive correlation with serum calcium level and both

results are statistically not-significant. It has been suggested that, in menopausal osteoporosis there are increased bone resorption and decreased bone formation. Postmenopausal women have rapid bone loss due to estrogen deficiency¹⁸. Some research workers have stated that, lower levels of serum calcium are due to reduced intestinal calcium absorption. This decline could be associated with either decrease in active calcium transport or diffusion component of absorption system¹⁰. It is also possible that, postmenopausal women have significantly lower serum calcium levels due to their increased bone turnover^{11,15}. In addition, some researchers have suggested that, postmenopausal osteoporosis is a common health problem due to osteoporotic bone fracture. Many factors such as estrogen deficiency, low calcium intake, vitamin D insufficiency and secondary hyperparathyroidism are causes for postmenopausal osteoporosis¹⁹.

Some researchers have suggested that the extracellular calcium concentration is regulated by parathyroid hormone which is secreted by parathyroid gland. Low serum calcium concentration stimulates the parathyroid gland to cause increase secretions of parathyroid hormone. The parathyroid hormone stimulates osteoclastic bone resorption which causes calcium release from bone. PTH also stimulates transcellular calcium reabsorption from renal tubules. It also stimulates 12 kidneys to produce 1, 25-dihydroxyvitamin D which acts on the intestine to increase calcium absorption²⁰.

It has been suggested that serum parathormone level (PTH) rises in postmenopausal which cause bone resorption and release of calcium from the bone⁹. Again, in menopause, the incidence of osteoporosis increases due to decrease in ovarian estrogen. This decrease accelerates bone loss and increases bone remodeling. In hypocalcaemia, there is increase in PTH secretion. This PTH restores the serum calcium by increasing calcium efflux from bone, renal reabsorption of calcium and renal phosphorus excretion²⁰. Low circulating serum calcium concentration stimulates parathyroid hormone secretion, which mobilizes calcium from bones by osteoclastic stimulation¹¹.

In the present study, impairment of serum calcium has observed in postmenopausal women. The higher value of serum parathyroid hormone in postmenopausal women compare to premenopausal due to bone turnover is more prominent in study group. Again, negative correlation of serum calcium with serum parathyroid hormone indicates the role of these hormones on bone remodeling. In addition,

increased bone turnover in postmenopausal was due to estrogen withdrawal effect and calcium homeostasis.

Conclusion

The present study has revealed that the serum calcium is lower and parathyroid hormone level is higher in postmenopausal women than premenopausal women. These changes may increase the risk of bone loss and osteoporosis in postmenopausal women. The values are considered as biochemical markers of bone turnover. They provide valuable information for diagnosis and monitoring of bone formation and bone resorption. Osteoporotic fractures can be avoided, if preventive measures are taken prior to the onset of excessive bone loss in postmenopausal women.

References

1. Barrett KE, Brooks HL, Boitano S, Barman SM. Ganong's Review of medical physiology, 23rd edn, McGraw-Hill companies, New York, 2010
2. Guyton, AC & Hall, JE. Text book of medical physiology, 11th edn, 2010, Elsevier Inc, UK.
3. Hafeez F, Zulfiqar S, Hasan S, Khurshid R. An assessment of osteoporosis and low bone density in postmenopausal women. Pakistan Journal of Physiology. 2009;5(1):41-44
4. Dutta DC, Konar H. Textbook of Gynaecology, 5th edn, N C Book Agency, Kolkata, 2008
5. Indumati V, Patil VS, Jailkhani R. Hospital based preliminary study on osteoporosis in postmenopausal women. Indian Journal of clinical biochemistry. 2007;22(2):96-100
6. El-Shabrawy EM, Gabal KMA, Nassar SF. Hormonal role in osteoporosis among post-menopausal uremic women, J Am Scien 2010;6(10):284-291
7. Cerdà D, Peris P, Monegal A, Albaladejo C, Martínez de Osaba MJ, Surís X, Guañabens N. Increase of PTH in postmenopausal osteoporosis. Revista Clinica Espanola. 2011;211(7):338-43
8. Eastell R, Yergey AL, Vieira NE, Cedel SL, Kumar R, Riggs BL. Interrelationship among vitamin D metabolism, true calcium absorption, parathyroid function, and age in women: Evidence of an age-related intestinal resistance to 1, 25-dihydroxyvitamin D action. Journal of Bone and Mineral Research. 1991;6(2):125-32
9. Need AG, O'Loughlin PD, Morris HA, Horowitz M, Nordin BC. The effects of age and other variables on serum parathyroid hormone in postmenopausal women attending an osteoporosis center. The Journal of Clinical Endocrinology & Metabolism. 2004;89(4):1646-9
10. Nordin BC, Need AG, Morris HA, O'Loughlin PD, Horowitz M. Effect of age on calcium absorption in postmenopausal women. The American Journal of Clinical Nutrition. 2004;80(4):998-1002
11. Qureshi HJ, Hussain G, Jafary ZA, Bashir MU, Latif N, Riaz Z. Calcium status in premenopausal and postmenopausal women. Journal of Ayub Medical College Abbottabad. 2010;22(2):143-5
12. Datta NS. Osteoporotic fracture and parathyroid hormone. World journal of orthopedics. 2011;2(8):67-74
13. Palmer SC, Hayen A, Macaskill P, Pellegrini F, Craig JC, Elder GJ, Strippoli GF. Serum levels of phosphorus,

parathyroid hormone, and calcium and risks of death and cardiovascular disease in individuals with chronic kidney disease: a systematic review and meta-analysis. *JAMA* 2011;305(11):1119-27

14. Jenkins, DK 2001, 'Bone alkaline phosphate, a serum bone turnover assay: usefulness in managing postmenopausal women receiving therapy to prevent or treat osteoporosis', Review Series, Viewed: 20 February 2012, Website: <http://www.quidel.com/libraries/wp/BH/usefulness>.

15. Suchetha Kumari N, Smitha Rosario B, Damodara Gowda KM. Altered liver function and the status of calcium in postmenopausal women in and around mangalore. *Al Ameen J Med Sci*. 2010;3(2):115-9.

16. Neer RM, Arnaud CD, Zanchetta JR, Prince R, Gaich GA, Reginster JY, et al. Effect of parathyroid hormone (1-34) on fractures and bone mineral density in postmenopausal women with osteoporosis. *New England journal of medicine*. 2001 May 10;344(19):1434-41

17. Varma M, Paneri S, Badi P. Correlative study of bone related biochemical parameters in normal postmenopausal women and hyperglycemic postmenopausal women. *Biomedical Research*. 2005;16(2):129-32

18. Sarmidi S, Setiyohadi B, Anggoro S. Vitamin D Status and Hyperparathyroidism in Postmenopausal Osteoporotic Patient In Cipto Mangunkusumo Hospital Jakarta. *Indones J Intern Med*. 2008;5:35-42.

19. Felsenfeld AJ, Rodriguez M. Phosphorus, regulation of plasma calcium, and secondary hyperparathyroidism: a hypothesis to integrate a historical and modern perspective. *Journal of the American Society of Nephrology*. 1999;10(4):878-90.

20. Vučeljić M, Ilić-Stojanović O, Lazović M, Grajić M. Vitamin D and parathyroid hormone in relation to bone mineral density in postmenopausal women. *Vojnosanitetski pregled*. 2012;69(3):243-8.