Original Research Article

Different levels of trace mineral levels in postmenopausal women compared to premenopausal women in Port-Harcourt Metropolis, Nigeria

ABSTRACT:

Aim: The physiological transformation of women from pre- to post-menopause is often accompanied with many changes in biochemical parameters which instigates some physiological alterations in the body system of the women. Research has shown some alterations in trace mineral nutrition and metabolism following attainment of menopause. This study was aimed at investigating the trace mineral status in premenopausal and postmenopausal women in Port-Harcourt metropolis.

Methods: This study was carried out among fifty (50) apparently healthy postmenopausal women aged between 45-65 years and twenty (20) premenopausal women aged between 22-38 years. Five milliliters (5 mL) of venous blood was withdrawn from each participant after an informed consent was obtained. Blood samples were emptied into a plain tube and allowed to clot. Samples were spun and serum separated into separate tubes and stored at -20^0C until analysis. Serum levels of trace mineral magnesium, calcium, zinc and copper were evaluated using Atomic absorption Spectrophotometer ELICO, India, Model No. SL173. Data generated were analyzed using Graph-Pad Prism version 8.0.2 and $p < 0.05$ was considered significant.

Results: Result reveal a significant reduction in serum levels of magnesium in post-menopausal women (0.39± 0.29 mmol/L) when compared with the premenopausal women (1.14 ± 0.54 mmol/L) (P< 0.0001). Similarly, the serum zinc declined in postmenopausal women 6.12 ± 6.42mmol/L compared with the premenopausal women 23.02± 12.25mmol/L (P< 0.0001). However, serum levels of copper and calcium were not statistically different in the two groups (p> 0.05).

Conclusion: The findings in this work suggests a decrease in serum zinc and magnesium levels in postmenopausal women, hence dietary supplements of these trace minerals is advocated for post-menopausal women.

Keywords: Trace mineral, menopause, premenopausal, postmenopausal

1. INTRODUCTION

Menopause is a condition in a woman's life time when she no longer menstruates. It is neither a disease, illness, pathology, nor a state of being not well, but it is just a normal physiological phenomenon of aging among females from transition of reproductive life to loss of reproductive ability. This transition is accompanied by some hormonal changes,

predominantly estrogen leading to menopausal symptoms [1]. The menopausal period is considered the climacterium, the middle adulthood and the age of onset varies among women, between the age 40s to the early 50s [2]. It is the time when steroid hormone deficiency is often accompanied by trace mineral deficiencies, causing or intensifying the clinical symptoms [3].

Trace minerals such as zinc, magnesium, copper and calcium are co-factors for enzymes involved in the synthesis of various bone matrix constituents. They are also involved in the interaction of many enzyme reactions necessary for the transmission of nerve impulses, temperature regulation, detoxification, energy production etc. [4].

Copper (Cu) is an essential co-factor for a number of enzymes involved in metabolic reactions, angiogenesis, oxygen transport and anti-oxidant production including: catalase, superoxide dismutase (SOD) and cytochrome oxidase [5. 6]. Copper induces a low bone turnover by suppression of the osteoblastic and the osteoclastic functions [7]. A decrease in serum copper levels is observed in postmenopausal women which may be due to advanced age [8, 9].

Zinc (Zn) is an essential trace element present in all body tissues and fluids, needed for catalytic, structural and regulatory functions in the body [10]. Zn deficiency appears to be common in older women as a result of low dietary intake or reduced dietary absorption. Increased serum zinc levels may also be observed in postmenopausal women due to increased bone resorption resulting from estrogen deficiency [11].

Magnesium (Mg) is a bivalent intracellular cation and has been recognized as a cofactor for more than 300 metabolic reactions in the body [12]. It is important in maintaining normal nerve and muscle function, blood pressure, bone integrity, cardiac excitability, glucose and insulin metabolism [13]. Magnesium deficiency has been associated with a number of chronic diseases including migraine headaches, hypertension, cardiovascular diseases, osteoporosis which are common amongst postmenopausal women [14].

Calcium (Ca) is most commonly associated with the formation and metabolism of bone. In the circulatory system, extracellular fluid, muscle, and other tissues, Ca is important for mediating vasocontraction and vasodilatation, muscle function, nerve transmission, intracellular signaling, and hormonal secretion. Deficiency of Ca can result in reduced bone strength and osteoporosis, characterized by fragile bones and increased risk of falling [15]. Alteration in the levels of various trace mineral results in altered immune functions, increased oxidative stress, impaired cognitive functions, glucose intolerance, osteoporosis etc. in postmenopausal age group [4].

Available data has shown that there is paucity of data on the levels of these trace elements in post-menopausal women in this locality, hence this work was designed to evaluate the trace element nutritional status of pre- and post-menopausal women living in Port Harcourt metropolis

2. MATERIALS AND METHODS

The study was carried out in 50 post-menopausal women (49-65 years) and 20 pre-menopausal women (22-38 years) who written consented to rudiments of the study. Pre-menopausal women were treated as control group. All post-menopausal women have had at least one year of amenorrhea, none were on any hormonal replacement therapy or supportive treatment for menopausal symptoms prior to the time of study. About 5 mL of venous blood was collected aseptically from pre and post-menopausal women into a plain tube and cells allowed to retract. Serum was separated by centrifugation within 2 hours of collection and kept in the refrigerator at −20°C until analysis. The frozen serum samples were thawed and concentration of Zinc, copper, magnesium and calcium were determined using the Atomic absorption Spectrophotometer ELICO, India, Model No. SL173. Data generated were analyzed using Graph pad prism software version 6.00 (GraphPad software Inc. USA. Data was presented as means and standard deviation.

3. RESULTS

Table 1 shows the levels of trace minerals as Mg, Ca, Cu and Zn in both groups. The postmenopausal women (test) have Mg 0.39± 0.29 mmol/L; Ca 0.73± 0.3 mmol/L; Cu 6.06 ± 3.93 mmol/L and Zn 6.12± 6.42 mmol/L , while the postmenopausal women has Mg 1.14± 0.54 mmol/L; Ca 0.85 ± 0.35 mmol/L; Cu 5.89 ± 0.19 mmol/L and Zn 23.02± 12.25 mmol/L. When the values were compared between premenopausal and postmenopausal women, the serum levels of Calcium and Copper levels were not significantly different. However, there was a significant decrease in the serum levels of Magnesium and Zinc in the postmenopausal women (P<0.001).

Table 2 shows the effect of duration of amenorrhea on the studied parameters. In the results obtained, 1-5 years group showed no statistically significant difference when compared to the 6-10years group and >10years group.

Similarly, table 3 shows the effect of exercise on the studied parameters. In the results obtained, there was no significant statistical difference for those who performed exercise regularly when compared to those who performed exercise occasionally and those who do not exercise at all.

Table 1: Comparison of trace elements in Premenopausal & Postmenopausal Women

Parameters	**Test (M ± SD)**	**Control (M ± SD)**	**P-value**	**Inference**
Magnesium (mmol/L)	0.39± 0.29	1.14± 0.54	<0.0001	S
Calcium (mmol/L)	0.73± 0.35	0.85 ± 0.35	0.2265	NS
Copper (µmol/L)	6.06 ± 3.93	5.89 ± 0.19	0.3752	NS
Zinc (µmol/L)	6.12± 6.42	23.02± 12.25	<0.0001	S

Key: S- Significant; NS- Non-significant

Table 2: Effect of Duration of Amenorrhea on Studied Parameters in postmenopausal women

Parameters/ (mmol/L)	1-5 (Years) (M ± SD)	6-10 (Years) (M ± SD)	>10 (Years) (M ± SD)	P-value	F-value	Inference
Magnesium	0.32± 0.23	0.35± 0.14	0.51 ± 0.37	0.1027	2.389	NS
Calcium	0.69 ± 0.42	0.76± 0.23	0.77± 0.32	0.7531	0.7531	NS
Copper	6.51± 4.42	5.19 ± 2.44	5.99± 4.07	0.6856	0.3805	NS
Zinc	6.80± 9.25	4.73± 2.18	5.99± 3.09	0.7071	0.3492	NS

Key: NS - Non-significant

Table 3: Effect of Alcohol Intake on Studied Parameters in postmenopausal women

Parameter (mmol/L)	Regularly (M ± SD)	Occasionally (M ± SD)	No Alcohol (M ± SD)	P-value	F-value	Inference
Magnesium	0.36 ± 0.16	0.32± 0.22	0.43± 0.32	0.4695	0.7684	NS
Calcium	0.59± 0.09	0.76 ± 0.39	0.74± 0.35	0.7049	0.3523	NS
Copper	5.83 ± 10.99	5.51± 2.76	6.36± 4.62	0.7919	0.2345	NS
Zinc	5.07± 3.66	7.30± 10.70	5.68± 3.45	0.6948	0.3669	NS

Key: NS - Non-significant

4. DISCUSSION

Menopause is associated with numerous physiological and biochemical changes. The present study shows that trace mineral status in postmenopausal women is slightly different from that of premenopausal women. The authors observed that postmenopausal women have significantly lower concentrations of serum Zn, and Mg than premenopausal. This finding of decrease in Zn level is consistent with the report of [3, 16]. The reason for the decline in serum zinc levels may be as a result of decreased intestinal Zn absorption or increased bone Zn buildup. It has been reported that

intestinal absorption of in Zn a rat model is considerably decreased with increasing age [17]. It is possible that similar changes may play out in the human trace element levels. Mg levels were also found to be significantly reduced in postmenopausal women. This finding is in agreement with the report of Naveenta & Khushdeep [18], The reason for the decline in Mg levels is unclear but may be due to the uncoupling of bone formation as a result of loss of the bone mass. It may also be related to renal wasting which is exacerbated by dietary element deprivation and gastrointestinal losses with diarrhea or vomiting as reported by Mutlu *et al,* [19].

As a woman ages, her copper status may alter for several reasons [20], however this report is at variance with our finding. In our study, there was no significant difference in the serum Cu levels after menopause. This is similar to some studies which showed no significant difference in serum copper among postmenopausal women while comparing to premenopausal women [19]. Although copper deficiency appears to be common in older women as a result of low dietary intake or reduced dietary absorption, excess of copper in body may cause depression, irritability, fatigue, nervousness, nausea, vomiting, digestive disorders, joint/muscle and bone pain, jaundice, premature aging, peripheral oedema, dizziness [21]. In older people decreased copper intake and absorption reduces the activity of the copper-dependent enzyme lysyl oxidase, which is required for the maturation of collagen-a key element in the organic matrix of bone. Copper also induces a low bone turnover by suppression of the osteoblastic and osteoclastic function [7,22]. Copper is nutritionally essential element needed for catalytic, structural and regulatory functions for all forms of life [23]. In our study, the serum Ca concentration in the postmenopausal group was not significantly different from that of the premenopausal group of healthy controls. However, some studies have reported significant decrease in serum calcium levels of postmenopausal women [24, 25, 26], while another study in Nigerian menopausal women by Usoro *et al*,[27] reported a significantly higher mean serum calcium levels in the postmenopausal women as compared to the premenopausal women. The differences in these findings could be due to the interplay of genetic and environmental factors, diminished dietary intake of calcium containing foods.

5. CONCLUSION

As postmenopausal women are exposed to higher risk of serum biochemical changes and potential for nutritional disturbances especially traces minerals, the risk of age-related diseases is really very high during this period, these adverse changes in serum trace minerals should be taken into account for the early diagnosis and prevention of menopause-related diseases. In cases where levels are considerably depleted, dietary supplementation may be required.

Consent

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

REFERENCES

1.Afridi I. Psychological and Social Aspects of Menopause. In: J.F Rodriguez-Landa, J. Cueto-Escobedo, (Eds.), A Multidisciplinary Look at Menopause. London: IntechOpen. 2017.

2.Sadock BJ, Sadock VA, Ruiz P, Kaplan & Sadock. (11th Ed.). Synopsis of Psychiatry; Behavioral Sciences/Clinical Psychiatry. Philadelphia: Wolters Kluwer. 2015.

3.Bureau B., Anderson RA, Arnaud J. & Raysiguier Y. Trace mineral status in post-menopausal women: impact of hormonal replacement therapy. Journal of Trace Elements in Medicine and Biology. 2002; 16(1): 9-13.

4.Kirk D. & Fish SA. Medical management of osteoporosis. American Journal on Managed Care. 2004; 10: 39-43.

5.Stern BR. Essentiality and Toxicity in Copper Health Risk Assessment: Overview, Update and Regulatory Considerations. Journal of Toxicology and Environmental Health.2010;73: 114-127.

6.Stern BR. Copper and Health: Biochemistry, Genetics, Human, and Strategies for Modeling Dose-Response Relationships. Journal of Toxicology and Environmental Health. Part B. 2007;10: 157-222.

7.Gur A, Colpan L. & Nas K.The role of trace minerals in the pathogenesis of postmenopausal osteoporosis and a new effect of calcitonon. Journal of Bone and Mineral Metabolism. 2002; 2(20): 39-43.

8.Bednarek - Tupikowska G, Jodkowska, A. & Antonowicz – Juchiniewicz J. Zinc, Copper, Manganese and selenium status in pre and post-menopausal women during

sex hormone therapy. Advances in Clinical and Experimental Medicine. 2010; 19(3): 337- 345.

9.Ansar S, Alhefdhi T. & Allem AM. Status of trace elements and antioxidants in premenopausal and post-menopausal phase of life: A comparative Study. International Journal of Clinical and Experimental Medicine. 2015; 8(10): 19486-19490.

10.Hambidge M. Human zinc deficiency. Journal of Nutrition. 2000; 130(5): 1344-1349.

11.Kogirima M, Kurasawa R, Kubori S, Sarukura N, Nakamori M. & Okada S. Ratio of low serum zinc levels in elderly Japanese people living in the central part of Japanese. Journal of Clinical Nutrition.2007; 61: 375-381.

12.Takaya J, Higashino H. & Kobayashi Y. Intracellular magnesium and insulin resistance. Magnesium Research. 2004;17: 126–136.

13.Guerrero-Romero F. & Rodríguez-Morán M. Low serum magnesium levels and metabolic syndrome. Acta Diabetologica.2002; 39: 209–213.

14.Kupetsky-Rincon EA, Li Q. & Uitto J. Magnesium reduces carotid intima- media thickness in a mouse model of pseudoxanthoma elasticum: a novel treatment biomarker. Clinical and Translation Science. 2012; 5: 259–264.

15.Weaver CM & Heaney RP. Calcium. In: A. C. Ross, B. Caballero, RJ. Cousins, KL. Tucker, TR. Ziegler, (Eds.), Modern Nutrition in Health and Disease (11th Ed). Baltimore, MD: Lippincott Williams & Wilkins. 2014.

16.Taylor A, Nichols JA. & Morgan J. Zink metabolism in postmenopausal women receiving hormone replacement therapy. Trace Elements and Electrolytes. 1995; 12: 47–51.

17.Coudray C, Feillet-Coudray C, Rambeau M, Tressol JC, Gueux E, Mazur A. & Rayssiguier Y. The effect of aging on intestinal absorption and status of calcium, magnesium, zinc, and copper in rats : a stable isotope study. Journal of Trace Elements in Medicine and Biology. 2006 ; 20(2) : 73–81.

18.Naveenta G & Khushdeep SA. The Status of Trace Elements after Menopause: a comparative study. Journal of Clinical and Diagnostic Research. 2011; 5(4): 795-797.

19.Mutlu M, Argun M, Kilic E, Saraymen R. & Yazar S. Magnesium, zinc and copper status in osteoporotic Anwer Khan Modern Medical College Journal, osteopenic and normal postmenopausal women. Journal of International Medical Research. 2007; 35: 692-695.

20. Ferdous N, Mishu FA, Shamsunna H, Haque SM, Anmar K & Siddique S. Estimation of Serum Copper in Post-menopausal Women Attending in a tertiary Care

Hospital, Bangladesh. Anwer Khan Modern Medical College Journal. 2019 ; 10(2): 110-113.

21.Spinazzi M, De Lazzari F & Tavolato B. Myelo-optico-neuropathy in copper deficiency occurring after partial gastrectomy. Do small bowel bacterial overgrowth syndrome and occult zinc ingestion tip the balance? Journal of Neurology. 2007; 254: 1012-1017.

22.Rowin J & Lewis SL. Copper deficiency myeloneuropathy and pancytopenia secondary to overuse of zinc supplementation. Journal of Neurology, Neurosurgery and Psychiatry. 2005; 76(5): 750-751.

23.Nedrow A, Miller J, Walker M & Nygren P. Complementary and alternative therapies for the management of menopause-related symptoms: a systematic evidence review". Archives of Internal Medicine. 2006; 166(14): 1453-1465.

24.Achie LN, A Mohammed A, Lawal YZ, Igashi J & Olorunshola KV. Serum calcium levels of premenopausal, perimenopausal and postmenopausal rural women of Zuturung District, Kaduna State, Nigeria. Journal of African Association of Physiological Sciences. 2020; 8(2): 133-139.

25.Bhattarai T, Bhattacharya K, Chaudhuri P & Sengupta P. Correlation of Common Biochemical Markers for Bone Turnover, Serum Calcium, and Alkaline Phosphatase in Post- Menopausal Women. Malaysian Journal of Medical Science. 2014 ; 21(1) : 58–61.

26.Kalita N & Choudhury BD. A cross sectional study evaluating the association of serum calcium, serum magnesium, and body mass index in premenopausal and postmenopausal women. International Journal of Research in Medical Sciences. 2017 ; 5(5) : 1953-1958.

27.Usoro CDO, Onyeukwu CU & Nsonwu AC. Biochemical Bone Turnover Markers in Postmenopausal Women in Calabar Municipality. Asian Journal of Biochemistry. 2007; 2(2): 130 – 135.