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Trace Mineral Levels in Postmenopausal Women Compared to Premenopausal Women Living Within Port Harcourt Metropolis

Onwuli, Donatus Onukwufor [a], Waribo, Helen Anthony [a*], Anyalebechi, Eberechukwu Okwuchi [a], Maduelosi, Ngozi Jane [b] and Maduelosi, Emmanuella [a]

[a] Department of Medical Laboratory Science, River State University, P.M.B. 5080, Port Harcourt, Rivers State, Nigeria.
[b] Department of Chemistry, River State University, P.M.B. 5080, Port Harcourt, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Author ODO designed the study and wrote the first draft of the manuscript with the protocol. Authors ME and AEO performed the experiments and statistical analysis. Authors WHA and MNJ managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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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 Five milliliters (5 mL) of venous blood was withdrawn from each participant after an informed consent was obtained.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^{0}C until analysis. Serum levels of trace mineral magnesium, calcium, zinc and copper were evaluated using Atomic

**Corresponding author: E-mail: helen.waribo1@ust.edu.ng, helywary@yahoo.com;*

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 not being well, but it is 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] to mention but a few. 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 potentially as a result of oestrogen deficiency [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 estrogen deficiency [11] which may lead to higher amount of zinc absorbed.

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 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 orally 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 (Graph Pad 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.

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

Similarly, Table 3 shows the effect of alcohol consumption on the studied parameters. In the results obtained, there was no significant statistical difference for those who performed regularly consumed alcohol when compared to those who consumes alcohol occasionally.

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 diarrhoea or vomiting as reported by Mutlu et al. [19].

As a woman ages, her copper status may alter for several reasons as reported by [20], However that report of Ferdous and colleagues [20] 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 [24-26], 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 greater risk of serum biochemical changes and possibility of nutritional disturbances particularly trace minerals, the risk of age-related diseases is very high during this period, these adverse changes in serum trace minerals should be taken into consideration for early diagnosis and prevention of menopause related diseases. Dietary supplementation may be necessary especially where levels are significantly reduced.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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