2024, 21(2): 0422-0427
https://doi.org/10.21123/bsj.2023.8140
P-ISSN: 2078-8665 - E-ISSN: 2411-7986
Baghdad Science Journal

The Role of Testosterone Level in Women with Osteopenia

Muzahem Mohialdeen Taha [1], ***Ekhlass M. Taha**** [2], ***Suhayla K.Mohammed*** [3]

[1]Kirkuk University, Kirkuk, Iraq: postal codes:36001. Consultant Orthopedic and Spine Surgeon- Erbil International Hospital, Erbil, Iraq.
[2] Department of Chemistry, College of Science for Women, University of Baghdad, Baghdad, Iraq
[3]College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq
*Corresponding Author.

Received 19/11/2022, Revised 21/2/2023, Accepted 23/02/2023, Published Online First 20/07/2023, Published 01/02/2024

Abstract

There is substantial data supporting the importance of both endogenous and exogenous estrogen in maintaining reproductive health and preventing chronic disease, androgens in women's health are rarely discussed. This is one of the first researches to investigate correlates of blood testosterone concentrations in women with osteopenia, in anticipation of the growing interest in the role of androgens in women's health. A 65 volunteer women were enrolled in the current study, they were divided into two groups, 35 postmenopausal women with osteopenia were in the first group, and the second group contained 30 postmenopausal women without osteopenia as a control. Blood samples were collected from all participants and analyzed for testosterone level, also demographic data were collected. The results showed that women with osteopenia have significantly low levels of testosterone as compared to control, the correlation analysis using postmenopausal women with osteopenia as a model showed a significant reversed correlation between testosterone and T score. Cluster analysis results illustrated that T-Score, testosterone and, duration of the postmenopausal were organized in one cluster, which means the three variables were associated with each other in most of the studied cases. The second cluster included t-score, testosterone and, BMI. Whereas the age factor contributed to the third cluster. Testosterone levels were significantly associated with osteopenia, which could indicate the development of osteoporosis in post-menopause women. Testosterone results were organized in one cluster with T-score and, duration of the postmenopausal. So the three variables were associated with each other in most studied cases.

Keywords: Androgen, DXA, Osteopenia, Testosterone, Women.

Introduction

As a result of faster population, aging ,and the tendency for involution of bone and muscle tissues among older persons, the implications of these muscular and bone abnormalities are approaching pandemic status.[1, 2] Osteopenia is a clinical term for a reduction in bone mineral density BMD that is below normal reference levels although not too low to be considered osteoporotic. Dualenergy x-ray absorptiometry DXA bone scans are used to determine BMD. The World Health Organization WHO defines a tscore between 1 and 2.5 as the diagnostic distinction between osteopenia

2024, 21(2): 0422-0427
https://doi.org/10.21123/bsj.2023.8140
P-ISSN: 2078-8665 - E-ISSN: 2411-7986
Baghdad Science Journal

and osteoporosis. Osteoporosis is diagnosed when the value is less than 2.5. BMD declines reflect an underlying change in bone microarchitecture, and osteopenia and osteoporosis are considered quantitative rather than qualitative bone mineralization disorders.[3, 4]. On osteoblasts, androgen receptors can be found. Reduced endogenous androgen levels have been linked to low bone mass and an increased risk of vertebral and hip fractures in both menstruation and postmenopausal women. [5, 6] Higher free testosterone levels in postmenopausal women, on the other hand, have been linked to a decreased incidence of hip fracture. [7] Testosterone is involved in both reproductive and non-reproductive health in women. Age-related testosterone decrease begins before natural menopause [8, 9]. During the late reproductive years, circulating testosterone drops the most [10]. Testosterone treatment enhances BMD and lean body mass while lowering fat mass in postmenopausal women, according to small studies [11, 12]. Furthermore, higher levels of endogenous testosterone in postmenopausal women are linked to a lower incidence of hip fracture [5, 13]. This study aimed to examine total serum testosterone concentrations in relation to osteopenia in Iraqi women.

Materials and Methods

Patients: This study involved 65 females they were divided into two groups, the first group included 35 postmenopausal women with osteopenia, and the second group included 30 postmenopausal women without osteopenia. The age of the cases, as well as the controls, ranged from 50 to 70 years. Patients' blood samples were collected from outpatient clinics in Serdem private hospital, Iraq from June 2018 to August 2019.

Collection of the samples: Blood was drawn from the cubital veins of the arms of both patients and healthy controls while they were fasting. by 10 ml syringe after centrifugation performed, serum was sent to the laboratory after being transferred to a separate tube for processing and performance of the biochemical tests. Blood samples are processed in two steps: first, they are centrifuged at 3000 x g for five minutes, and second, the level is determined using specialized chemical tests.

Selectivity of blood samples: Patients with parathyroid illness, liver disease, kidney disease, cigarette smoking, alcohol consumption, or those who had any overlapping doses were eliminated when blood samples were collected.

The quantitative measurement of testosterone was done using the sandwich technique and the enzyme-linked immunosorbent assay (ELISA). This technique works by coupling an antibody or antigen to an enzyme used in the assay. The T-score percentage was calculated by DEXA.

Statistical analysis: Statistical analysis program (SPSS 25) was used for analyzing the results. The general descriptive statistic was used to describe the main findings; independent T-test and Mann whitney test was used with an alpha level of 0.05 to compare groups, the correlation is done by using Spearman correlation, cluster analysis of multivariate have been used.

Results and Discussion

The results of BMI and Age for the studied groups were normally distributed so it described as mean ± SE Table. 1, whereas Testosterone level was non normal distributed so it discussed as mean ranks Table. 2.

Table 1. Statistical distribution of BMI, Age, and T-Score in studied population

	Groups	N	Mean ± Std. Error	Sig.
BMI	Osteopenia	35	30.5281 ± 1.15306	0.57
	control	30	34.9422 ± 1.73937	
Age	Osteopenia	35	55.1714 ± 1.13573	0.4
	control	30	53.6842 ± 1.28658	
T- Score	Osteopenia	35	1.3057 ± 0.33766	0.013
	control	30	0.0947 ± 0.14679	

Student T-test was used with alpha level of 0.05

2024, 21(2): 0422-0427
https://doi.org/10.21123/bsj.2023.8140
P-ISSN: 2078-8665 - E-ISSN: 2411-7986
Baghdad Science Journal

Table 2. Statistical distribution of Testosterone in studied population Ranks, and Descriptive Statistics

	Groups	N	Mean Rank	Mean	Minimum	Maximum	Median	Sig.
Testosterone (nmol/l)	Osteopenia	35	21.94	0.29	0.05	1.18	0.21	0.00
	control	30	37.74	0.54	0.2	1.34	0.52	

Mann whitney test was used with alpha level of 0.05

The authors have matched presented demographic factors age and DMI to study the real alteration on testosterone level in the studied population. The results showed that women with osteopenia have significantly low levels of testosterone as compared to control Table. 2. The current study disagrees with Arpaci et. al[14], the last study failed to demonstrate a statistically significant relationship between testosterone and BMD. Also, Wang et. al[15] found that total testosterone concentration below 500 ng/dl may have no effect on bone mineral density. Several factors are involved in the alteration of chemical parameters when making the case-control study. In the current study, the duration of menopause was analyzed in relation to testosterone level. The results showed no significant difference among the study group post-menopause. The decrement in testosterone levels could be due to declining adrenal function and ovarian within aging. Further classification of the studied population has been made according to the duration of menopause, the results are presented in Table. 3. There are no significant alterations in testosterone level when compared all groups one another. The subjects were divided into three groups with duration 1-5, 5-10, 10-15 for both Osteopenia and control subjects.

Table 3. Effect of duration of post-menopausal on testosterone level

Ranks					
Subjects	Parameter	duration	N	Mean Rank	Sig
Osteopenia	Testosterone	1-5	12	7.7	0.2
		5-10	12	3.3	
		10-15	11	7.4	
Control	Testosterone	1-5	10	5.6	0.4
		5-10	10	6	
		10-15	10	8.6	

kruskal wallis test and Mann whitney test were used with alpha level of 0.05

Low testosterone levels have nothing to do with the duration of postmenopausal as shown in the present study. Other researchers said that testosterone has nothing to do with sexual dysfunction postmenopausal [16]. Both findings are in the same line.

Correlation analysis using postmenopausal women with osteopenia as a model showed a significant reversed correlation between testosterone and T Score Table. 4.

Table 4. Correlation study among the studied variables using postmenopausal women with Osteopenia as a model.

Correlations						
		Testosterone	duration	Tscore	Age	BMI
Testosterone	r	1.000	.004	-.663**	.022	.303
	p	.	.991	.000	.899	.125
duration	r		1.000	.496	.849**	.000
	p		.	.101	.000	1.000
Tscore	r			1.000	.143	-.181
	p			.	.411	.366
Age	r				1.000	-.323
	p				.	.100
BMI	r					1.000
	p					.

r: Spearman correlation
p: Significant level at 0.05

2024, 21(2): 0422-0427
https://doi.org/10.21123/bsj.2023.8140
P-ISSN: 2078-8665 - E-ISSN: 2411-7986
Baghdad Science Journal

To confirm the association among the studied variables Cluster analysis has been used. T-Score, testosterone and, duration of the postmenopausal were organized in one cluster, which means the three variables were associated with each other in most of the studied cases. The second cluster included t-score, testosterone and, BMI. Whereas the Age factor was contributed to the third cluster, the latter included t-score, testosterone, BMI, and Age (Fig. 1). During ageing, total and free testosterone levels decline[17]. There was no link between serum testosterone and age, according to Akatsu. In both premenopausal and postmenopausal women, age has a negative relationship with serum testosterone levels [18]. Current study do not showed any correlation to age with testosterone.

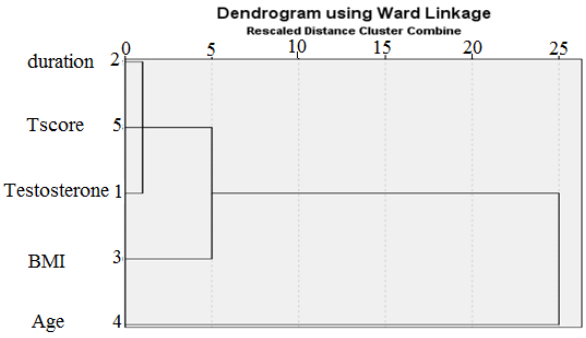

Figure 1. Cluster analysis of variables used in the current study using osteopenia patients as a model.

Correlation analysis using postmenopausal women without osteopenia as a model showed a significant reversed correlation between Age and T score only Table. 5.

Table 5. Correlation study among the studied parameters using control subjects as a model

		Testosterone	BMI	Age	Tscore	duration
Testosterone	r	1.000	-.494	.091	-.005	.320
	p	.	.177	.712	.983	.310
BMI	r		1.000	.538	.570	.
	p		.	.135	.109	.
Age	r			1.000	-.592**	.159
	p			.	.008	.621
Tscore	r				1.000	.242
	p				.	.448
duration	r					1.000
	p					

r: Spermancorolation
p: Significant level at 0.05

Cluster analysis showed that T-Score, testosterone and, duration of the postmenopausal were organized in one cluster, the three variables were associated with each other in most of the studied cases with or without osteopenia even though it was not correlated to each other in control subjects. The second cluster included t-score, and, BMI. Whereas the Age factor was contributed to the third cluster, the latter included BMI and Age Fig. 2.

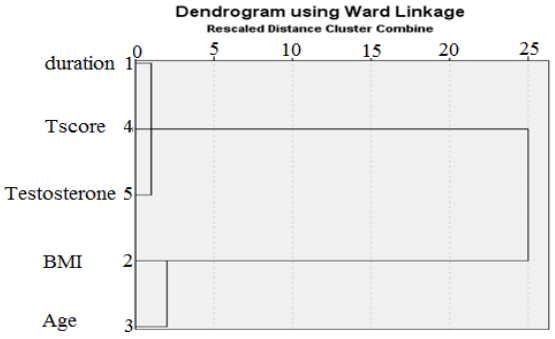

Figure 2. Cluster analysis of variables used in the current study using control as a model

Conclusion

Testosterone levels were significantly associated with osteopenia, which could indicate the development of osteoporosis in post-menopause women. testosterone results were organized in one cluster with T-score and, duration of the

postmenopausal. So the three variables were associated with each other in most studied cases.

Acknowledgment

The cooperation of medical staff at Serdem private hospital is appreciated.

Author's Declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been included with the necessary permission for re-publication, which is attached to the manuscript.
- Authors sign on ethical consideration's approval
- Ethical Clearance: The project was approved by the local ethical committee in University of Baghdad.
- Ethical approval: This research has been approved by University of Baghdad Committee, College of Science for Women, Department of Chemistry, session7, number387 at 24/1/2022

Author's Contribution Statement

This work was carried out in collaboration between all authors. M.M.T diagnosed the cases, collected the samples and did the tests. E.M.T wrote and edited the manuscript with revision. S.K.M and E.M.T did the analysis of the data and the revision. All authors read and approved the final manuscript.

References

1. Colón CJ, Molina-Vicenty IL, Frontera-Rodríguez M, García-Ferré A, Rivera BP, Cintrón-Vélez G, Frontera-Rodríguez S. Muscle and Bone Mass Loss in the Elderly Population: Advances in diagnosis and treatment. J Biomed (Sydney, NSW). 2018; 3: 40. https://dx.doi.org/10.7150/jbm.23390.
2. Confortin SC, Ono LM, Marques LP, Ceolin G, d'Orsi E, Barbosa AR. Osteopenia/Osteoporosis and Its Association with Sarcopenia: EpiFloripa Aging Study 2013/2014. Port. J Public Health. 2020; 38(1): 15-22. https://dx.doi.org/10.1159/000508924
3. Farhan LO, Taha EM, Farhan AM. A Case control study to determine Macrophage migration inhibitor, and N-telopeptides of type I bone collagen Levels in the sera of osteoporosis patients. Baghdad Sci J. 2022; 19(4): 848-854 https://doi.org/10.21123/bsj.2022.19.4.0848
4. Barnsley J, Buckland G, Chan PE, Ong A, Ramos AS, Baxter M, et al. Pathophysiology and treatment of osteoporosis: challenges for clinical practice in older people. Aging Clin Exp Res. 2021 Apr; 33(4): 759-73. https://doi.org/10.1007/s40520-021-01817-y
5. Smith T, Batur P. Prescribing testosterone and DHEA: The role of androgens in women. Cleve Clin J Med. 2021 Dec 31; 88(1): 35-43. https://doi.org/10.3949/ccjm.88a.20030
6. Chen JF, Lin PW, Tsai YR, Yang YC, Kang HY. Androgens and androgen receptor actions on bone health and disease: from androgen deficiency to androgen therapy. Cells. 2019 Oct 25; 8(11): 1318. https://doi.org/10.3390/cells8111318.
7. Lee JS, LaCroix AZ, Wu L, Cauley JA, Jackson RD, Kooperberg C, et al. Associations of serum sex hormonebinding globulin and sex hormone concentrations with hip fracture risk in postmenopausal women. J Clin Endocrinol Metab. 2008; 93(5): 1796–1803. https://doi.org/10.1210/jc.2007-2358
8. Davison SL, Bell R, Donath S, Montalto JG, Davis SR. Androgen levels in adult females: changes with age, menopause, and oophorectomy. *J Clin Endocrinol Metab*. 2005 Jul 1; 90(7): 3847-53. https://doi.org/10.1210/jc.2005-0212
9. Scott A, Newson L. Should we be prescribing testosterone to perimenopausal and menopausal women? A guide to prescribing testosterone for women in primary care. Br J Gen Pract. 2020 Apr 1; 70(693): 203-4. https://doi.org/10.3399/bjgp20X709265
10. Islam RM, Bell RJ, Green S, Davis SR. Effects of testosterone therapy for women: a systematic review and meta-analysis protocol. Syst Rev. 2019 Dec; 8(1): 1-5. https://doi.org/10.1186/s13643-019-0941-8 .
11. Ng Tang Fui M, Hoermann R, Bracken K, Handelsman DJ, Inder WJ, Stuckey BG, et al. Effect of testosterone treatment on bone microarchitecture and bone mineral density in men: a 2-year RCT. *J*

2024, 21(2): 0422-0427
https://doi.org/10.21123/bsj.2023.8140
P-ISSN: 2078-8665 - E-ISSN: 2411-7986
Baghdad Science Journal

Clin Endocrinol Metab. 2021 Aug; 106(8): e3143-58. , https://doi.org/10.1210/clinem/dgab149

12. Rariy CM, Ratcliffe SJ, Weinstein R, Bhasin S, Blackman MR, Cauley JA, et al. Higher serum free testosterone concentration in older women is associated with greater bone mineral density, lean body mass, and total fat mass: the cardiovascular health study. J Clin Endocrinol Metab. 2011 Apr 1; 96(4): 989-96. https://doi.org/10.1210/jc.2010-0926. Epub 2011 Feb 2 .
13. Lee JS, LaCroix AZ, Wu L, Cauley JA, Jackson RD, Kooperberg C, et al. Associations of serum sex hormone-binding globulin and sex hormone concentrations with hip fracture risk in postmenopausal women. *J Clin Endocrinol Metab*. 2008 May 1; 93(5): 1796-803. https://doi.org/10.1210/jc.2007-2358
14. Arpaci D, Saglam F, Cuhaci FN, Ozdemir D, Ersoy R, Cakir B. Serum testosterone does not affect bone mineral density in postmenopausal women. Arch Endocrinol 2015; 59: 292-6. https://doi.org/10.1590/2359-3997000000085 .
15. Wang N, Wang L, Huang C. Association of total testosterone status with bone mineral density in adults aged 40–60 years. J Orthop Surg. 2021 Dec; 16(1): 1-7. https://doi.org/10.1186/s13018-021-02714-w
16. Slomski A. Which Postmenopausal Women Should Use Testosterone for Low Sexual Desire? J Am Med Assoc. 2020; 323(6): 493–495. https://doi.org/10.1001/jama.2019.22070
17. Hasan BF, Al-karawi IN, Abd Jassim N. Determination of Testosterone level as predictor for insulin resistance in young men with family history of type2 diabetes and hypertension. Baghdad Sci J. 2013; 10(3): 945-953. https://doi.org/10.21123/bsj.2013.10.3.945-953.
18. Akatsu T. Sex steroids, bone turnover and bone mineral density in pre-, peri-, and postmenopausal woman. Environ Health Prev Med. 1998; 3: 123-9 https://doi.org/10.1007/BF02931702 .

دور مستوى هرمون التستوستيرون لدى النساء المصابات بهشاشة العظام

مزاحم محي الدين طه [1] ، اخلاص محمد طه [2] ، سهيلة خالد محمد [3]

[1] جامعة كركوك، كركوك، العراق: الرموز البريدية: 36001. استشاري جراحة العظام والعمود الفقري - مستشفى أربيل الدولي، أربيل، العراق.
[2]جامعة بغداد كلية العلوم للبنات قسم الكيمياء الجادرية، بغداد، العراق: الرموز البريدية: 10071.
[3] كلية علوم الهندسة الزراعية، جامعة بغداد ، الجادرية، بغداد، العراق.

الخلاصة

أن هناك أدلة وافرة على أهمية الاستروجين الداخلي والخارجي في الصحة الإنجابية والأمراض المزمنة ، فإن الأندروجينات في صحة المرأة لا تحظى باهتمام كبير. تحسبًا للاهتمام المتزايد بوظيفة الأندروجينات في صحة المرأة ، تعد هذه واحدة من أولى الدراسات التي تبحث في ارتباط تركيزات هرمون التستوستيرون في الدم لدى النساء المصابات بهشاشة العظام. تم تسجيل 65 امرأة متطوعة في الدراسة الحالية، تم تقسيمهن إلى مجموعتين ، المجموعة الأولى ضمت 35 امرأة بعد سن اليأس مصابات بهشاشة العظام ، المجموعة الثانية ضمت 30 امرأة بعد سن اليأس بدون هشاشة. تم جمع عينات الدم من جميع المشاركين وتحليلها لمعرفة مستوى هرمون التستوستيرون ، كما تم جمع البيانات الديموغرافية.أظهرت النتائج أن النساء المصابات بهشاشة العظام لديهن مستويات منخفضة بشكل ملحوظ من هرمون التستوستيرون مقارنة بمجموعة التحكم ، وأظهر تحليل الارتباط باستخدام النساء بعد سن اليأس المصابات بهشاشة العظام كنموذج ارتباطًا عكسيًا معنويًا بين هرمون التستوستيرون ودرجة التستوستيرون. أظهرت نتائج التحليل العنقودي أن T-Score وهرمون التستوستيرون ومدة ما بعد انقطاع الطمث تم تنظيمها في مجموعة واحدة ، مما يعني أن المتغيرات الثلاثة كانت مرتبطة ببعضها البعض في معظم الحالات المدروسة. تضمنت المجموعة الثانية درجة t ، وهرمون التستوستيرون، ومؤشر كتلة الجسم. في حين أن عامل العمر قد ساهم في المجموعة الثالثة ارتبطت مستويات هرمون التستوستيرون بشكل كبير مع هشاشة العظام، والتي يمكن الإشارة إليها لتطور هشاشة العظام لدى النساء بعد انقطاع الطمث

الكلمات المفتاحية: الأندروجين ، DXA ,هشاشة العظام ، التستوستيرون, النساء.