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ORIGINAL ARTICLE

Evaluation of Hand Function and Bone Status in Premenopausal Versus Postmenopausal Women

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Abstract

Introduction: Women experience a decline in physical function after menopause. In this study, we aimed to assess the relationship between hand function, grip strength, and bone status in premenopausal versus postmenopausal women.

Methods: Eighty-one premenopausal and 81 postmenopausal women aged 35–65 years who did not have metabolic, endocrine, and neuromuscular problems were evaluated. Grip strength (of dominant hand) was measured using Jamar handheld dynamometer. Grip ability test (GAT) was used to evaluate the hand function. Radius bone mineral density and speed of sound (SOS) were measured using quantitative ultrasonography (Sunlight Omnisense 7000S/8000S).

Results: Postmenopausal women had significantly lower radius T-scores and SOS values, weaker grip strength, and higher GAT scores than premenopausal women. There was a weak negative correlation between GAT scores, radius T-scores, and SOS values and a moderate negative correlation between GAT scores and grip strength in both premenopausal and postmenopausal women. There was a weak positive correlation between grip strength, radius T- and Z-scores, and SOS values in both premenopausal and postmenopausal women ($p<0.05$).

Discussion and Conclusion: Premenopausal women had a better hand function and higher grip strength, radius T- and Z-scores, and SOS values than postmenopausal women.

Keywords: Bone quality; grip strength; hand function; menopause.

Menopause is a critical stage of a woman's life. Women experience a decline in physical function and bone quality after menopause [1]. The increase in the incidence of fragility fractures in older women is attributed to attenuation of both bone strength and neuromuscular function [2]. Whether the decline in physical function and bone quality after menopause is due to aging, hormonal status changes, or other factors is arguable.

At an older age, women tend to exhibit lower physical performance than men, suggesting that gender- or sex-linked dependent factors across life may influence physical performance [3-5]. Hormonal status changes are one of these possible factors because loss of muscle mass and strength starts at an earlier age in women than in men, around the time of menopause [6]. Estrogen could influence the number and force production of cross-bridges in muscles [7].

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Studies have reported a positive correlation between bone mineral density (BMD) and muscle strength. Furthermore, grip strength contributes to the prediction of bone strength [8-10].

Studies assessing the relation between menopausal status and physical function have reported inconsistent results [1, 11]. In this study, we aimed to assess the relationship between hand function, hand grip strength, and bone status in premenopausal versus postmenopausal women.

Materials and Methods

Eighty-one premenopausal and 81 postmenopausal women aged 35–65 (49.0±8.9) years were recruited from the Physical Medicine and Rehabilitation outpatient clinic of an education and research hospital. Women who had metabolic, endocrine, and neuromuscular problems along with any problem in their dominant hand were excluded. Menopausal status was determined using the Stages of Reproductive Aging Workshop staging system [12]. Women were classified according to a self-reported menstruation pattern: premenopausal (regular menses) or postmenopausal (absence of menses for over 1 year).

Grip ability test (GAT) was used to evaluate the hand function. GAT is a simple and rapid test based on activities of daily living [13, 14]. It involves putting a sock over one hand, putting a paper clip on an envelope, and pouring water from a jug. Time needed to perform each task is recorded in seconds, and the recorded times are summed to yield a total GAT score. A GAT score of 20 s is considered normal. Higher scores indicate a decreased hand function. Grip strength (dominant hand) was measured using a calibrated Jamar dynamometer (Smith and Nephewi Irwington, NY 10533, USA). Each subject's arm was positioned according to the American Society of Hand Therapists' recommendations with the shoulder adducted and neutrally rotated, elbow flexed at 90°, and forearm and wrist neutrally positioned with the subject sitting in a straightbacked chair with feet flat on the floor [15, 16]. In all the subjects, the arm was not supported by the examiner or by an armrest. The dynamometer was presented vertically and in line with the forearm to maintain the standard forearm and wrist positions. Subjects were instructed to squeeze the handle as hard as they could and repeat this procedure three times within a 30-s period. The mean score of three trials was recorded.

Radius BMD and speed of sound (SOS) were measured using quantitative ultrasonography (QUS) (Sunlight Omnisense 7000S/8000S). QUS has been shown to be a valid tool for the assessment of bone status [17]. It is an inexpensive, portable, and ionizing-radiation-free alternative to dual-energy X-ray absorptiometry. The system has a transducer arrangement designed to eliminate the effects of underlying soft tissues on the bone velocity.

SOS was measured at the distal third of the radius in all the subjects. The probe was aligned along and parallel to the bone, according to the manufacturer's specifications. The arm of the patient was pronated and the probe scanned in a semi arc fashion around the medial radius [18].

Informed consent was obtained from each subject, and all the procedures were performed in accordance with the Helsinki Declaration of 1975 and were approved by the local Institutional Clinical Research Ethics Committee.

Statistical Analysis

Statistical analyses were performed using the SPSS Statistics 22 software package. Descriptive statistics were presented as means±standard deviation and numbers. Distribution of the data was determined using Kolmogorov–Smirnov test. Kruskal–Wallis and Mann–Whitney U tests with Bonferroni correction were used for comparisons between the groups as the parameters were not normally distributed. The between-group differences were evaluated using Student's t-test for parametric variables and Mann–Whitney U test for non-parametric variables. Spearman's correlation coefficient was used to assess the relationships between the parameters. A $p<0.05$ was considered significant.

Results

The characteristics of the study population according to the menopausal status are given in Table 1. As expected, postmenopausal women were older and had higher parity than premenopausal women. Premenopausal women showed higher employment rate than postmenopausal women. Premenopausal women working with their hands had significantly better hand function than premenopausal women who were not employed ($p<0.05$). Among postmenopausal women, those who were employed had significantly higher T-scores and SOS values than those who were not employed ($p<0.05$) (Table 2).

Premenopausal women had lower GAT scores than postmenopausal women, indicating a better hand function. Postmenopausal women had significantly lower radius T-scores, SOS values, and weaker grip strength than premenopausal women ($p<0.05$) (Table 3).

There was a weak negative correlation between GAT scores, radius T-scores, and SOS values in premenopausal women. There was a weak negative correlation between GAT scores,

Table 1. The characteristics of the study population

	Premenopausal	Postmenopausal	p
Age (years) (Mean±SD)	41.81±4.70	56.27±5.80	0.001*
BMI (Mean±SD)	29.34±4.84	30.46±5.60	0.111
Age at menarche (years) (Mean±SD)	13.49±1.23	13.85±1.58	0.173
Parity (Mean±SD)	2.60±1.90	3.77±2.78	0.001*
Exercise (n)			
Never	58	54	0.212
Non-regular	17	17	0.565
Regular	6	10	0.090
None (%)	54 (65.9)	61 (74.4)	0.612
Employment (n/%)			
Employed	21 (25.6)	7 (8.5)	0.008*
Working with hand	7 (8.5)	14 (17.1)	0.081

BMI: body mass index, SD: standard deviation, n: number; *p<0.05.

Table 2. Comparisons according to employment rate among premenopausal and postmenopausal women

Employment	None Mean±SD	Employed Mean±SD	Working with hand Mean±SD	p
Premenopausal				
T-score	-0.98±1.27	-0.87±1.46	-0.61±1.53	0.889
Z-score	-0.88±1.26	-0.77±1.47	-0.56±1.56	0.886
Grip strength (kg)	23.41±5.88	26.06±5.72	24.22±3.79	0.217
GAT	15.87±3.88	14.38±3.57	12.83±2.78	0.047*
SOS (m/s)	4073.72±143.29	4090.05±166.81	4118.17±174.91	0.823
Postmenopausal				
T-score	-2.07±1.55	-0.81±1.40	-2.16±1.39	0.040*
Z-score	-0.75±1.49	0.34±2.01	-1.27±1.44	0.125
Grip strength (kg)	20.24±5.57	20.67±5.97	20.52±6.00	0.883
GAT	18.75±5.85	17.28±4.11	17.21±4.06	0.619
SOS (m/s)	3951.13±176.69	4096.28±156.86	3941.07±159.09	0.048*

GAT: grip ability test, SOS: speed of sound, SD: standard deviation; *p<0.05.

Table 3. Comparison of GAT, grip strength, T- and Z-sores, and SOS values between premenopausal and postmenopausal women

	Premenopausal Mean±SD	Postmenopausal Mean±SD	p
T-score	-0.92±1.33	-1.97±1.54	0.001*
Z-score	-0.83±1.32	-0.74±1.56	0.173
SOS (m/s)	4081.24±150.43	3961.93±175.29	0.001*
Grip strength (kg)	24.15±5.77	20.32±5.60	0.001*
GAT	15.25±3.81	18.35±5.44	0.001*

GAT: grip ability test, SOS: speed of sound, SD: standard deviation; *p<0.05.

radius T- and Z-scores, and SOS values in postmenopausal women. There was a moderate negative correlation between GAT scores and grip strength in both premenopausal and postmenopausal women (p<0.05) (Table 4).

There was a weak positive correlation between grip strength, radius T- and Z-scores, and SOS values in both premenopausal and postmenopausal women. Furthermore, there was a moderate negative correlation between grip strength and GAT scores in both premenopausal and postmenopausal women (p<0.05) (Table 5).

Table 4. Correlations according to GAT sores among premenopausal and postmenopausal women

	GAT	
	r	p
Premenopausal		
T-score	-0.242	0.030*
Z-score	-0.253	0.022*
SOS (m/s)	-0.256	0.021*
Grip strength (kg)	-0.499	0.001*
Postmenopausal		
T-score	-0.259	0.019*
Z-score	-0.101	0.368
SOS (m/s)	-0.252	0.023*
Grip strength (kg)	-0.508	0.001*

GAT: grip ability test, SOS: speed of sound; *p<0.05.

Table 5. Correlations according to grip strength among premenopausal and postmenopausal women

	Grip strength (kg)	
	r	p
Premenopausal		
T score	0.246	0.027*
Z score	0.262	0.018*
SOS (m/s)	0.246	0.027*
GAT	-0.499	0.001*
Postmenopausal		
T score	0.390	0.001*
Z score	0.307	0.005*
SOS (m/s)	0.378	0.001*
GAT	-0.508	0.001*

GAT: grip ability test, SOS: speed of sound; *p<0.05.

Regarding the postmenopausal women, there was a weak negative correlation of menopause duration with radius T-scores and SOS values (p<0.05). As menopause duration increased, T-scores and SOS values decreased.

Discussion

We investigated the relationship between grip strength, hand function, and bone status in premenopausal versus postmenopausal women in this study. We found that premenopausal women had a better hand function and higher grip strength, radius T- and Z-scores, and SOS values than postmenopausal women. There was a weak positive correlation between grip strength, radius T-scores, and SOS values. Also, women who had higher grip strength, radius T-scores, and SOS values had a better hand function.

A correlation between grip strength, BMD, and fractures has frequently been reported [19, 20]. Di Monaco et al.[9] found a positive correlation between distal radius BMD and grip strength among postmenopausal women. We also found a positive correlation between grip strength, radius T-scores, and SOS values, suggesting that bone quality is related with muscle strength.

The results of our study are consistent with the hypothesis that changes in hormonal status from pre- to postmenopause contribute to a decline in physical function [1, 21]. Decreased estrogen levels during menopausal transition have been considered as the most important determinant of bone loss leading to osteoporosis among women [20, 22]. Menopausal transition also deteriorates muscle tissue and function through estrogen-dependent pathways. Estrogen could influence the number and force production of cross-bridges in muscles [7, 23]. It is well known that decreased estrogen levels are a major contributing factor to not only bone loss and increased skeletal fragility but also muscle weakening and decline in optimal physical performance among women [24]. Thus, postmenopausal women are at an increased risk of falling, hip fracture, and mortality, and they should be encouraged to improve their overall muscle strength for prevention of bone loss.

Studies examining the association between menopause and physical performance have reported that peri- and postmenopausal women have worse physical function than premenopausal women [3, 5, 25, 26]. The results of our study are consistent with those of these studies. Saionara et al.[5] in a population of Latin-American women showed that menopausal transition is associated with physical performance. They found that peri- and postmenopausal women have a weaker grip strength than premenopausal women. The association between grip strength and menopausal status was maintained after extensive adjustments, including for age as well as socioeconomic and reproductive factors. We did not use regression models to determine the relative effect of age, body mass index, parity, etc. This was a limitation of our study. Furthermore, we found a weak negative correlation between menopause duration, radius T-scores, and SOS values in postmenopausal women, but we could not find any correlation between menopause duration, grip strength, and GAT scores. Longitudinal studies are needed to confirm these results.

The hand is an essential organ that performs critical functions in daily activities and may have an enormous impact on activities of daily living in a woman. We found a weak negative correlation between GAT scores, radius T-scores, and SOS values and a moderate negative correlation between GAT scores and grip strength in both premenopausal

and postmenopausal women. Premenopausal women had a better hand function than postmenopausal women; thus, we concluded that menopause seems to be related with the musculoskeletal system. We suggest that postmenopausal women should improve their muscle strength for prevention of bone loss.

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References

1. Kurina LM, Gulati M, Everson-Rose SA, Chung PJ, Karavolos K, Cohen NJ, et al. The effect of menopause on grip and pinch strength: results from the Chicago, Illinois, site of the Study of Women's Health Across the Nation. Am J Epidemiol 2004;160:484–91. [CrossRef]
2. Ikegami S, Uchiyama S, Nakamura Y, Mukaiyama K, Hirabayashi H, Kamimura M, et al. Factors that characterize bone health with aging in healthy postmenopausal women. J Bone Miner Metab 2015;33:440–7. [CrossRef]
3. Cooper R, Mishra G, Clennell S, Guralnik J, Kuh D. Menopausal status and physical performance in midlife: findings from a British birth cohort study. Menopause 2008;15:1079–85. [CrossRef]
4. El Khoudary SR, McClure CK, VoPham T, Karvonen-Gutierrez CA, Sternfeld B, Cauley JA, et al. Longitudinal assessment of the menopausal transition, endogenous sex hormones, and perception of physical functioning: the Study of Women's Health Across the Nation. J Gerontol A Biol Sci Med Sci 2014;69:1011–7. [CrossRef]
5. da Câmara SM, Zunzunegui MV, Pirkle C, Moreira MA, Maciel ÁC. Menopausal status and physical performance in middle aged women: a cross-sectional community-based study in Northeast Brazil. PLoS One 2015;10:e0119480. [CrossRef]
6. Maltais ML, Desroches J, Dionne IJ. Changes in muscle mass and strength after menopause. J Musculoskelet Neuronal Interact 2009;9:186–97.
7. Phillips SK, Woledge RC. A comparison of isometric force, maximum power and isometric heat rate as a function of sarcomere length in mouse skeletal muscle. Pflugers Arch 1992;420:578–83. [CrossRef]
8. Cipriani C, Romagnoli E, Carnevale V, Raso I, Scarpiello A, Angelozzi M, et al. Muscle strength and bone in healthy women: effect of age and gonadal status. Hormones (Athens) 2012;11:325–32. [CrossRef]
9. Di Monaco M, Di Monaco R, Manca M, Cavanna A. Handgrip strength is an independent predictor of distal radius bone mineral density in postmenopausal women. Clin Rheumatol 2000;19:473–6. [CrossRef]
10. Frank AW, Lorbergs AL, Chilibeck PD, Farthing JP, Kontulainen SA. Muscle cross sectional area and grip torque contraction types are similarly related to pQCT derived bone strength indices in the radii of older healthy adults. J Musculoskelet Neuronal Interact 2010;10:136–41.
11. Bassey EJ, Mockett SP, Fentem PH. Lack of variation in muscle strength with menstrual status in healthy women aged 45-54 years: data from a national survey. Eur J Appl Physiol Occup Physiol 1996;73:382–6. [CrossRef]
12. Harlow SD, Gass M, Hall JE, Lobo R, Maki P, Rebar RW, et al. Executive summary of the Stages of Reproductive Aging Workshop + 10: addressing the unfinished agenda of staging reproductive aging. J Clin Endocrinol Metab 2012;97:1159–68.
13. Dellhag B, Bjelle A. A Grip Ability Test for use in rheumatology practice. J Rheumatol 1995;22:1559–65.
14. Poole JL. Measures of adult hand function: Arthritis Hand Function Test (AHFT), Grip Ability Test (GAT), Jebsen Test of Hand Function, and The Rheumatoid Hand Functional Disability Scale (The Duruöz Hand Index [DHI]). Arthritis & Rheumatism 2003;S59–66. [CrossRef]
15. Fess EE, Moran CA. Clinical assessment recommendations. American Society of Hand Therapists: 1992.
16. Mathiowetz V, Rennells C, Donahoe L. Effect of elbow position on grip and key pinch strength. J Hand Surg Am 1985;10:694–7. [CrossRef]
17. Njeh CF, Saeed I, Grigorian M, Kendler DL, Fan B, Shepherd J, et al. Assessment of bone status using speed of sound at multiple anatomical sites. Ultrasound Med Biol 2001;27:1337–45.
18. Barkmann R, Kantorovich E, Singal C, Hans D, Genant HK, Heller M, et al. A new method for quantitative ultrasound measurements at multiple skeletal sites: first results of precision and fracture discrimination. J Clin Densitom 2000;3:1–7.
19. Dixon WG, Lunt M, Pye SR, Reeve J, Felsenberg D, Silman AJ, et al; European Prospective Osteoporosis Study Group. Low grip strength is associated with bone mineral density and vertebral fracture in women. Rheumatology (Oxford) 2005;44:642–6. [CrossRef]
20. Sirola J, Tuppurainen M, Honkanen R, Jurvelin JS, Kröger H. Associations between grip strength change and axial postmenopausal bone loss-a 10-year population-based follow-up study. Osteoporos Int 2005;16:1841–8. [CrossRef]
21. Ranganathan VK, Siemionow V, Sahgal V, Yue GH. Effects of aging on hand function. J Am Geriatr Soc 2001;49:1478–84.
22. Sirola J, Kröger H, Honkanen R, Jurvelin JS, Sandini L, Tuppurainen MT, et al; OSTPRE Study Group. Factors affecting bone loss around menopause in women without HRT: a prospective study. Maturitas 2003;45:159–67. [CrossRef]
23. Samson MM, Meeuwsen IB, Crowe A, Dessens JA, Duursma SA, Verhaar HJ. Relationships between physical performance measures, age, height and body weight in healthy adults. Age Ageing 2000;29:235–42. [CrossRef]
24. Horstman AM, Dillon EL, Urban RJ, Sheffield-Moore M. The role of androgens and estrogens on healthy aging and longevity. J Gerontol A Biol Sci Med Sci 2012;67:1140–52. [CrossRef]
25. Sowers M, Pope S, Welch G, Sternfeld B, Albrecht G. The association of menopause and physical functioning in women at midlife. J Am Geriatr Soc 2001;49:1485–92. [CrossRef]
26. Cheng MH, Wang SJ, Yang FY, Wang PH, Fuh JL. Menopause and physical performance-a community-based cross-sectional study. Menopause 2009;16:892–6. [CrossRef]