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 hand-held 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.
Studies have reported a positive correlation between bone mineral density (BMD) and muscle strength. Furthermore, grip strength contributes to the prediction of bone strength \cite{8-10}.

Studies assessing the relation between menopausal status and physical function have reported inconsistent results \cite{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 \cite{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 \cite{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 Nephew 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 \cite{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 \cite{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 \cite{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 postmenopausal 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,
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).
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 post-menopause 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

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

<table>
<thead>
<tr>
<th></th>
<th>GAT</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Premenopausal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-score</td>
<td>-0.242</td>
<td>0.030*</td>
</tr>
<tr>
<td>Z-score</td>
<td>-0.253</td>
<td>0.022*</td>
</tr>
<tr>
<td>SOS (m/s)</td>
<td>-0.256</td>
<td>0.021*</td>
</tr>
<tr>
<td>Grip strength (kg)</td>
<td>-0.499</td>
<td>0.001*</td>
</tr>
<tr>
<td><strong>Postmenopausal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-score</td>
<td>-0.259</td>
<td>0.019*</td>
</tr>
<tr>
<td>Z-score</td>
<td>-0.101</td>
<td>0.368</td>
</tr>
<tr>
<td>SOS (m/s)</td>
<td>-0.252</td>
<td>0.023*</td>
</tr>
<tr>
<td>Grip strength (kg)</td>
<td>-0.508</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th></th>
<th>Grip strength (kg)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Premenopausal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T score</td>
<td>0.246</td>
<td>0.027*</td>
</tr>
<tr>
<td>Z score</td>
<td>0.262</td>
<td>0.018*</td>
</tr>
<tr>
<td>SOS (m/s)</td>
<td>0.246</td>
<td>0.027*</td>
</tr>
<tr>
<td>GAT</td>
<td>-0.499</td>
<td>0.001*</td>
</tr>
<tr>
<td><strong>Postmenopausal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T score</td>
<td>0.390</td>
<td>0.001*</td>
</tr>
<tr>
<td>Z score</td>
<td>0.307</td>
<td>0.005*</td>
</tr>
<tr>
<td>SOS (m/s)</td>
<td>0.378</td>
<td>0.001*</td>
</tr>
<tr>
<td>GAT</td>
<td>-0.508</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

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

**Ethics Committee Approval:** The approval of the local Ethics Committee was obtained. (27.09.2009 - 59/I)

**Peer-review:** Externally peer-reviewed.


**Conflict of Interest:** None declared.

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**References**

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 [DHl]). Arthritis & Rheumatism 2003;559–66. [CrossRef]