Preliminary Report

The Effects of Weight Bearing Yoga Training on the Bone Resorption Markers of the Postmenopausal Women

Manop Phoosuwan MSc*,
Thanomwong Kritpet PhD*, Pongsak Yuktanandana MD**

** School of Sports Science, Chulalongkorn University, Bangkok, Thailand*
*** Department of Orthopedic, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand*

This study was a preliminary report to investigate the effects of the weight bearing yoga training on both bone resorption marker and the quality of life of the postmenopausal women.

The samples were recruited by the purposive sampling from the female Chulalongkorn University staff aged between 50-60 years. The subjects were divided into two groups: experimental group and control group. The baseline demographic data, the bone resorption marker (□-CrossLaps), the bone formation marker (P1NP) and quality of Life (SF-36) data were collected. The experimental group attended the 12-week weight-bearing yoga training 3 days a week, 50 minutes a day while the control group lived their normal lives. After 12th week, the data collections were repeated in both groups.

The experimental group (19 subjects, the mean age 54.320 yrs) and the control group (14 subjects, the mean age 54.430 yrs) were recruited. The mean ultrasound BMD of both heels in both groups showed no osteopenia or osteoporosis. After the 12-week training, the mean bone resorption marker (□-CrossLaps) of the experimental group reduced from 0.464 to 0.339 ng/ml (-26.939%) whereas the control group reduced from 0.389 to 0.386 ng/ml (-0.771%). There was a significant difference ($p < 0.05$). The mean of the bone formation markers (P1NP) in the experimental group reduced from 55.393 to 42.401 ng/ml (-23.454%) and the bone formation markers (P1NP) in the control group reduced from 61.903 to 44.832 ng/ml (-27.577%). In the area of the life quality measurement of both groups, the data obtained from the medical outcomes study short-form survey (SF-36) showed that there were significant differences at 0.05 levels for the physical functioning, bodily pain, general health, and vitality. The variance of percentage change value of the experimental group increased to +25.299, +16.565, +15.309, and +21.056. The variance of percentage change value of the control group increased to+12.946, -1.221, -9.303 and +2.291.

The weigh-bearing yoga training had a positive effect on bone by slowing down bone resorption which was a very essential indicator for human health because it reduced the osteoporosis risks in the postmenopausal women. Additionally, yoga training promoted better quality of life.

Keywords: *Biological markers, Bone resorption, Post menopause, Quality of life, Weight-bearing, Yoga*

J Med Assoc Thai 2009; 92 (Suppl 5): S102-8
Full text. e-Journal: *http://www.mat.or.th/journal*

When women approach their postmenopausal age, the risk of osteoporosis increases. The multiple risks of the postmenopausal osteoporosis were identified by estrogen deficiency[1], smoking[2], exercise and dietary calcium intake[3], etc. The pathophysiology of bone loss in the menopausal women may result from the increase of bone resorption and the decrease of bone formation. It is very well-accepted that weight-bearing exercises such as weight training, aerobic dance, jogging, walking and tai chi are beneficial for the bone health. However, the successful outcomes really depend on both health limitations of each postmenopausal woman and the kind of exercise she likes to perform.

According to the analysis of the yoga training's positions and movements, there are some

Correspondence to: Phoosuwan M, School of Sports Science, Chulalongkorn University, Bangkok 10330, Thailand. Phone: 0-2218-1002, Fax: 0-2218-1016. E-mail: ph_manop@hotmail.com

positions and movements that weight-bearing through bones and joints positively affect the physical and mental health of the postmenopausal women. Those mentioned positions and movements are: Tree Pose, Downward Facing Dog Pose, Warrior III Pose, Triangle Pose, and Half Moon Pose. Nevertheless, research focusing on weight-bearing yoga training that contributes to the benefit of the bone health has not been widely studied. Therefore, this research is designed to investigate the effects of weight-bearing yoga training not only on both bone resorption and bone formation markers in the postmenopausal women but also on the change of life quality.

Material and Method

Subjects selection and criterion

The research design of this study was a quasi-experimental research. The population of this study was the female Chulalongkorn University staff who volunteered to participate. The inclusion criteria were as follows: healthy postmenopausal women at the age of 50-60 years old, no smoking and no alcoholic drinking, no hormonal replacement therapy (HRT), drinking tea or black coffee not more than 2 standard cups per day (250 cc/cup), doing exercise not more than twice per week, no osteoporosis (BMD not less than -2.5 SD). Subjects would be excluded if they did not continuously join the program or were injured or sick during the experiment. The subjects were categorized into the experimental group or the control group by the purposive selection.

Instrument

The selection instruments were a subject selection form, a questionnaire about health, and the SAHARA^{R} BMD to measure the heel bone density (BMD).

The experimental instrument was the weight bearing yoga training program that developed the postures (asana) of yoga practice steps purposely for integrating physical and mental fitness along with the movements of the external organs and the breathing rhythms. Each posture had certain effects on pressing weight through the alignment of arms, legs, bones, and joints appropriately.

The testing instruments were the Hitachi Elecsys 2010 automatic hormone analyses machine from Japan, β-CrossLaps and P1NP biochemical testing of Roche Diagnostics (Thailand) Co. Ltd., the adapted medical outcomes study short-form survey (SF-36)[4], and a diary note taking form.

Methods

Before starting the experiment, the biochemical bone markers were tested by using the blood test in order to gain β-CrossLaps (ng/ml) and P1NP (ng/ml) value. The quality of life data were gained from the SF-36 questionnaire. The weight-bearing yoga training programme's validity was verified by 5 experts and its reliability was verified by checking the heart rate of those who were within the criteria but not the experimental group while practicing this weight-bearing yoga training program. Then, the instruments were used to collect the data. Before starting the yoga program, the experimental and control groups had taken the pre-test by using the research instruments. After taking the pre-test, the control group lived their normal lives while the experimental group started taking the weight-bearing yoga training program. The first step of practicing this weight-bearing yoga training, the experimental group stretched their muscles for 10 minutes before and after the training to avoid the injury. Subsequently, they followed 3 times of 6 sets of this developed weight-bearing yoga training program in 25 degree Celsius room temperature, 50 minutes each time, 3 times a week for 12 weeks. The experimental group took either the 16.00-16.50 p.m class or the 17.00-17.50 p.m. class. However, both experimental and control groups had to appropriately control their daily food and drink consumption that may affect on bone such as tea, coffee, and alcohol. In the meantime, they had to write down their diaries for 3 months in order to report thoroughly on their daily behavior. Finally, the subjects took the post-test.

Statistics

The data were computer-analyzed by using the mean scores, standard deviation, percentage of change, and covariance analysis to test the statistical significance at 0.05 levels.

Results

There were thirty-three subjects participating in this study. Nineteen of them preferred to take the weight-bearing yoga training class, *i.e.* the experimental group and fourteen of them decided to live their normal lives, *i.e.* the control group. Table 1 showed the demographic data of the experimental group and the control group. The mean age of both groups was 54 years old and the mean weight was 55 kg. The heel ultrasound BMD of both groups showed no osteopenia or osteoporosis. Table 2 showed the results of β-CrossLaps and P1NP both before and after the training

Table 1. Subject characteristics

	Experimental group (n = 19)	Control group (n = 14)
	The mean ± SD	The mean ± SD
Age (year)	54.320 ± 2.926	54.430 ± 3.610
Weight (kg)	55.415 ± 7.751	55.792 ± 8.983
Height (cm)	154.621 ± 4.896	156.285 ± 4.762
BMD of the right heel	-0.826 ± 0.883	-0.728 ± 0.886
BMD of the left heel	-0.821 ± 0.887	-0.522 ± 0.989

of these two groups. Table 3 showed the quality of life scores by using the SF-36 in both groups.

After the 12-week training, the findings indicated that the mean scores on the bone resorption markers (β-CrossLaps) of the experimental and control groups were significantly different at p = 0.003*. Moreover, the findings indicated that the percentage changes on the bone resorption markers variance of the experiment group reduced to -26.939% and that of the control group also reduced to -0.771%. The quality of life of both groups: Physical Functioning (p = 0.034*), Bodily Pain (p = 0.005*), General Health (p = 0.011*), and Vitality (p = 0.001*) was significantly different at.05 level.

Discussion

Biochemical bone markers

The levels of the biochemical bone marker in both groups especially β-CrossLabs checked after the end of the 12-week yoga involvement rose up to the postmenopausal level as a result of the bone resorption increase. The experimental group's bone resorption β-CrossLaps was at 0.339 ± 0.141 ng/ml; it reduced from the base line to -26.939% (Table 2). This phenomenon implied that the weight-bearing yoga training could reduce the rate of bone resorption in the postmenopausal women. This reduction decreased the risk rate of osteoporosis. This type of yoga program affected on bone because the postures of this weight-bearing yoga training, *i.e.* Tree Pose and Warrior III Pose (Fig. 1, 2), emphasized appropriately on weight-bearing through bones and joints of the postmenopausal women.

When practicing all postures of this program, the yoga doers had to stand still on only one leg for bones and joints of that leg to take on the whole body weight with more leg-muscle contraction to obtain better balanc. The muscle force certainly had an affect on bone and led to stimulate the bone cell working processes in the bone remodeling unit. While performing, for example. Doward Facing Dog Pose and Half Moon Pose (Fig. 3, 4) which the upper part of

Fig. 1 Tree pose

Fig. 2 Warrior III pose

Fig. 3 Doward facingdog pose

Fig. 4 Half moon pose

Table 2. Responses of both bone resorption (β-Crosslaps) and bone formation (P1NP)

	Experimental group (n = 19)		% change	Control group (n = 14)		% change	F	p-value
	Pre-test	Post-test		Pre-test	Post-test			
	The mean ± SD	The mean ± SD		The mean ± SD	The mean ± SD			
Biochemical bone markers								
β-CrossLaps (ng/ml)	0.464 ± 0.129	0.339 ± 0.141	-26.939	0.389 ± 0.191	0.386 ± 0.167	-0.771	10.624	0.003*
P1NP (ng/ml)	55.393 ± 16.084	42.401 ± 17.725	-23.454	61.903 ± 16.667	44.832 ± 13.779	-27.577	1.587	0.217

Note: - sign means the testing result decreased

Table 3. Responses of quality of life (SF-36)

	Experimental group (n = 19)		% change	Control group (n = 14)		% change	F	p-value
	Pre-test	Post-test		Pre-test	Post-test			
	The mean ± SD	The mean ± SD		The mean ± SD	The mean ± SD			
Quality of life (SF-36)								
Physical functioning	67.630 ± 26.790	84.740 ± 20.033	+25.299	60.710 ± 23.027	68.570 ± 22.311	+12.946	4.912	0.034*
Role-physical	82.890 ± 20.921	90.790 ± 14.338	+9.530	75.000 ± 22.063	76.340 ± 30.538	+1.786	2.257	0.143
Bodily pain	65.920 ± 17.916	76.840 ± 14.406	+16.565	58.930 ± 18.649	58.210 ± 17.986	-1.221	9.077	0.005*
General health	60.160 ± 14.222	69.370 ± 13.981	+15.309	56.860 ± 18.777	51.570 ± 23.104	-9.303	7.318	0.011*
Vitality	62.500 ± 15.866	75.660 ± 10.804	+21.056	58.480 ± 12.645	59.820 ± 14.234	2.291	12.384	0.001*
Social functioning	78.950 ± 14.465	86.180 ± 13.107	+9.157	76.790 ± 19.524	75.890 ± 21.068	-1.172	2.751	0.108
Role emotion	81.140 ± 22.880	92.540 ± 11.751	+14.049	79.760 ± 18.407	82.740 ± 22.039	+3.736	2.639	0.115
Mental health	69.470 ± 15.890	79.210 ± 10.174	+14.020	68.930 ± 17.778	72.500 ± 15.659	+5.179	2.186	0.150

Note: - sign means the testing result decreased, + sign means the testing result increased

the body such as the chest, the back, and arms was lower than the thigh, the body weight was pressed on the bones and joints of those parts meanwhile these positions motivated the bone cells working processes. Moreover, when all 6 sets of this training program were continuously and repetitively performed, consequently, the bones and joints were motivated all the time of practices.

The mechanism of bone remodeling unit which consisted of both bone formation and bone resorption processes were controlled by the function of osteocyte and osteoblast in the bone. Weight and force across the bone may be sensed by the osteocyte as a mechano-sensor of the bone. The osteocyte cell had a kind of receptive sensing toward the outer weight pressing down to bones. This procedure could decrease or increase bone mass[5]. The subjects participating in the weight bearing yoga program in this study received the benefit of weight and force through bone that stimulated osteocyte adequately to reduce the rate of bone resorption.

The postmenopausal women exercise program was conducted in many researches[1, 6-9]. Their findings were that most of their work outs were Tai chi[6-8], walking[1] and water weight bearing exercise[9] which showed the positive effect on bone, but there still was no clear explanation on the bone resorption reduction mechanism. Similarly, it was difficult for this study to use its findings to support the research assumption of weight-bearing yoga on the inhibition of the bone resoption mechanism as a matter of fact that there were several elements of limitations, *e.g.* work out models of the samples, duration of experiment, research instruments, and age span of the samples. Nevertheless, this research found that the effects of the weight-bearing yoga training program could prolong the bone resorption of the postmenopausal women. P1NP was not significantly different, but both P1NP of the sample groups decreased. This could be explained that the process of bone remodeling mechanism had a coupling effect. Coupling means that the bone formation is linked to the bone resorption[10].

Quality of life (SF-36)

The weight-bearing yoga training program in this research provided the statistical significance of having better Physical Functioning, Bodily Pain, General Health and Vitality of the postmenopausal women (Table 3). It could be implied that this program controlled mentality, breathing, and physical posture while practicing this yoga type: weight-bearing. Most of the postures focused on the positions of balancing the doers' body that really needed their concentration which was of great benefit to physical and mental health. This finding was congruent with the 'Hatha' yoga position for adults that statistically increased health and life quality significantly[11]. Yoga was one of the instruments helping people who suffered from liver diseases; it also had a statistically significance of better life quality[12]. When considering the percentage change of all 8 life quality elements in this study, the experimental group had higher and better percentage than the control group.

In conclusion, the weight-bearing yoga training not only had the positive effect on slowing down the bone resorption but also promoted better quality of life. In addition, it reduced osteoporosis risks in postmenopausal women.

Acknowledgments

This research was funded by Graduate School and School of Sports Science, Chulalongkorn University. The authors thank the subjects who volunteered for this study, including Faculty of Education, Chulalongkorn University; Soison Sakolrak PhD, Vachiraporn Achariyakosol PhD, Surapee Rujopakarn PhD, Siripaarn Suwanmonkha PhD. We also thank Faculty of Medicine, Chulalongkorn University for providing the laboratory service and expertise. The authors gratefully thank Narong Bunyaratavej MD for the valuably consultative discussions.

References

1. Yamazaki S, Ichimura S, Iwamoto J, Takeda T, Toyama Y. Effect of walking exercise on bone metabolism in postmenopausal women with osteopenia/osteoporosis. J Bone Miner Metab 2004; 22: 500-8.
2. Hla MM, Davis JW, Ross PD, Yates AJ, Wasnich RD. The relation between lifestyle factors and biochemical markers of bone turnover among early postmenopausal women. Calcif Tissue Int 2001; 68: 291-6.
3. Munoz MT, de la Piedra C, Barrios V, Garrido G, Argente J. Changes in bone density and bone markers in rhythmic gymnasts and ballet dancers: implications for puberty and leptin levels. Eur J Endocrinol 2004; 151: 491-6.
4. Jirarattanaphochai K, Jung S, Sumananont C, Saengnipanthkul S. Reliability of the medical outcomes study short-form survey version 2.0

(Thai version) for the evaluation of low back pain patients. J Med Assoc Thai 2005; 88: 1355-61.
5. Songpattanasilp T. Progress in bone biology: the reviews and new insights. In: Narong B, editor. Bone forum. Bangkok: Concept Medical; 2007: 4 (Thai version).
6. Chan K, Qin L, Lau M, Woo J, Au S, Choy W, et al. A randomized, prospective study of the effects of Tai Chi Chun exercise on bone mineral density in postmenopausal women. Arch Phys Med Rehabil 2004; 85: 717-22.
7. Qin L, Au S, Choy W, Leung P, Neff M, Lee K, et al. Regular Tai Chi Chuan exercise may retard bone loss in postmenopausal women: A case-control study. Arch Phys Med Rehabil 2002; 83: 1355-9.
8. Wayne PM, Kiel DP, Krebs DE, Davis RB, Savetsky-German J, Connelly M, et al. The effects of Tai Chi on bone mineral density in postmenopausal women: a systematic review. Arch Phys Med Rehabil 2007; 88: 673-80.
9. Bravo G, Gauthier P, Roy PM, Payette H, Gaulin P. A weight-bearing, water-based exercise program for osteopenic women: its impact on bone, functional fitness, and well-being. Arch Phys Med Rehabil 1997; 78: 1375-80.
10. Watts NB. Clinical utility of biochemical markers of bone remodeling. Clin Chem 1999; 45: 1359-68.
11. Hadi N, Hadi N. Effects of hatha yoga on well-being in healthy adults in Shiraz, Islamic Republic of Iran. East Mediterr Health J 2007; 13: 829-37.
12. Sareen S, Kumari V, Gajebasia KS, Gajebasia NK. Yoga: a tool for improving the quality of life in chronic pancreatitis. World J Gastroenterol 2007; 13: 391-7.

ผลของการฝึกโยคะแบบลงน้ำหนักที่มีต่อการสลายมวลกระดูกของสตรีวัยหมดประจำเดือน

มานพ ภู่สุวรรณ์, ถนอมวงศ์ กฤษณ์เพ็ชร์, พงศ์ศักดิ์ ยุกตะนันทน์

***วัตถุประสงค์**: เพื่อศึกษาผลของการฝึกโยคะแบบลงน้ำหนักที่มีต่อการสลายมวลกระดูก และคุณภาพชีวิตของสตรีวัยหมดประจำเดือน*

***วัสดุและวิธีการ**: เลือกกลุ่มตัวอย่างแบบเจาะคือบุคลากรในจุฬาลงกรณ์มหาวิทยาลัย มีอายุระหว่าง 50-60 ปี ที่ผ่านเกณฑ์ การคัดเข้าโดยแบ่งออกเป็นกลุ่มฝึกโยคะแบบลงน้ำหนัก และกลุ่มใช้ชีวิตประจำวันตามปกติ ด้วยความสมัครใจ จากนั้นมีการทดสอบทั้งก่อนและหลังการทดลองคือ การสลายและการสร้างมวลกระดูกด้วยขบวนการทางชีวเคมี และคุณภาพชีวิตจากแบบสอบถามมาตรฐานเอสเอฟ 36 โดยมีระยะเวลาการทดลองเป็นเวลานาน 12 สัปดาห์ ๆ ละ 3 วัน ๆ ละ 50 นาที*

***ผลการศึกษา**: กลุ่มฝึกโยคะแบบลงน้ำหนักจำนวน 19 คน มีอายุเฉลี่ย 54.320 ปี และกลุ่มใช้ชีวิตประจำวันตามปกติ จำนวน 14 คน มีอายุเฉลี่ย 54.430 ปี ซึ่งทั้งสองกลุ่มไม่พบผู้ที่มีค่าความหนาแน่นมวลกระดูกที่สันเท้าต่ำกว่า -2.5 SD และหลังการทดลอง 12 สัปดาห์ พบว่าค่าการสลายมวลกระดูกมีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ โดยเปอร์เซ็นต์การเปลี่ยนแปลงค่าการสลายมวลกระดูกของกลุ่มฝึกโยคะแบบลงน้ำหนักลดลง 26.939 เปอร์เซ็นต์ ส่วนกลุ่มใช้ชีวิตประจำวันตามปกติมีเปอร์เซ็นต์การเปลี่ยนแปลงลดลงเพียง 0.771 เปอร์เซ็นต์และค่าการสร้างมวลกระดูกไม่พบความแตกต่างกัน สำหรับคุณภาพชีวิต พบว่ามีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติที่ระดับ 0.05 ในด้านของกิจกรรมทางกาย อาการปวดเมื่อยตามร่างกาย สุขภาพทั่วไป และความสดชื่นมีชีวิตชีวา โดยเปอร์เซ็นต์การเปลี่ยนแปลงของกลุ่มฝึกโยคะแบบลงน้ำหนักมีค่าเพิ่มขึ้น คือ +25.299, +16.565, +15.309 และ +21.056 เปอร์เซ็นต์ตามลำดับ ส่วนเปอร์เซ็นต์การเปลี่ยนแปลงของกลุ่มใช้ชีวิตประจำวันตามปกติมีค่า +12.946, -1.221, -9.303 และ +2.291 เปอร์เซ็นต์ตามลำดับ*

***สรุป**: การฝึกโยคะแบบลงน้ำหนักมีผลต่อการชะลอการสลายมวลกระดูกและสามารถลดปัจจัยเสี่ยงของการเกิดโรคกระดูกพรุนของสตรีวัยหมดประจำเดือนได้ นอกจากนั้นยังช่วยส่งเสริมให้มีคุณภาพชีวิตที่ดีเพิ่มขึ้นอีกด้วย*