Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XIV, ISSUE 2 Supplement, 2014, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning, Cabell's Directories

Science, Movement and Health, Vol. XIV, ISSUE 2 Supplement, 2014
September 2014, 14 (2, Supplement): 510-515
Original article

IMPACTS OF AQUATIC TAIJI EXERCISES ON BONE MINERAL DENSITY FOR POSTMENOPAUSAL WOMEN

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Abstract

Purpose. Aquatic Taiji is described as a form of meditation in movement and involves gentle and fluid exercises that focus on the inherent flow of the limbs, arteries and muscles, opening up the meridians of chi so that chi can circulate freely throughout the body. It aims to reduce stress and still the mind, bringing balance, health and rejuvenation. The exercises can be practiced on land or in water and assist with weight loss, stimulate the metabolism, increases energy, improves the skin, massages and tones the muscles and joints, free up and deepen breathing, improves the posture, and develop intuition and insight. The purpose of this study was to investigate the effects of aquatic Taiji exercises on bone mineral density among Postmenopausal women.

*Methods.*The sample consisted of 20 female (54 ± 5.36 years old; 162 ± 5.03 cm height; and 75 ± 7.30 kg weight), from Kurdistan Iraq . Subjects were required to read and complete a health questionnaire and informed consent document; there was no history of coronary heart disease, diabetes or recent surgery.

Results. The major findings from this study were the significant Increases in bone mineral density (hip and backbone) measurements, balance and flexibility in the experimental group, which proved the aquatic Taiji exercises efficacy.

*Conclusions.*The aquatic Taiji exercises improved the balance, flexibility and bone mineral density for hip and backbone but no change in the strength for the sample.

Key words: Aquatic Taiji, Flexibility, Bone Mineral Density, Balance.

Introduction

Osteoporosis is a subject, which should be near and dear to the hearts of most masters' swimmers, but which many choose to ignore. Many swimmers think it will not affect them, either because they feel fine, or because they exercise. They are only partially right, and what they do not know can hurt them. (World Health Organization, 2004).

Osteoporosis is a disorder that affects the entire skeleton. It characterized by a significant loss of bone mass leading to an increased susceptibility to fractures of the hip, spine, and wrist. It affects up to 24 million Americans, of which 80% are women. It estimated that currently 10 million individuals already have osteoporosis, with 14 million more having low bone density (osteopenia). That means that approximately 1 in 4 women and 1 in 8 men over the age of 50 have osteoporosis.

As it is a painless condition, most people are unaware they have osteoporosis. Often the first sign of significant bone loss is a fracture, usually of the hip, forearm, or vertebra. About 32% of women and 17% of men in the United States who live until age 80 experience a hip fracture. The risk of vertebral fractures is even higher. Hip fractures in the elderly are far more than an inconvenience 1 in 4 patients over the age of 50 dies within the year following a hip fracture. (Helena Johansson, 2011).

Although some cases of osteoporosis are due to drugs (i.e., steroids) or the result of a disease (i.e., rheumatoid arthritis), most cases are due to either older age (senile osteoporosis), or to a drop in estrogen (postmenopausal osteoporosis). If one of your parents had a hip, forearm, or vertebral fracture you can pretty much assume that you are at risk for osteoporosis. However, the converse is not necessarily true.

Bones are constantly remodeling. While in space, astronauts' bodies respond to the lack of gravitational stress on the bones by decreasing their bone mass. On the other end of the spectrum, weightlifters experience an increase in bone density due to the stress of the extra weight on the bones. The more stress placed on the bones over a period of time, either through heavy weights and/or by impact, the more the body responds by increasing the bone density.

The process is actually a bit more complex than that. Not only does the body lay down more bone, it actually remodels the structure of the bone along the lines of stress. If you take up running, eventually your body will remodel the structure within the bones in response to the new stress. Stress fractures often caused by running too much, before the body has had a chance to remodel the bones based on the new stresses (Dawson-Hughes, et al. 1997).

It has become important for the treatment of any pathology consider the repercussions of disease on

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Received 12.04.2014 / Accepted 30.05.2014

the quality of life of individuals. Exercise, calcium and vitamin D supplementation can help protect women from bone loss. By engaging in regular weight-bearing exercise, women lose less bone than those who are sedentary (Puntila, et al.2001). Supplementing a woman's diet with at least 1200 mg of calcium daily can help protect her from menopausal bone loss. Adequate vitamin D levels are also crucial for calcium homeostasis. Cholecalciferol (vitamin D3) 1000 IU or more should be taken daily to assure adequate vitamin D stores. This is particularly important for women who do not have sufficient sunlight exposure (at least 15 minutes per day to non-sun screened skin) and women over 60 years of age (Harush, &Rotstein, 2004).

Oriental medicine believes that the balance of Yin and Yang is fundamental for quality of life. Aquatic Taiji is a good foundation for creating balance for both body and mind, as well as feeling the smooth movement of life energy. Through Clinical Aquatic Taiji (EASY), we will consciously connect with the universal energy of Yin and Yang by inviting it into our bodies and minds (Konno, 1997).

The method Aquatic Taiji (AT) was created by Jun Konno in Japan in 1996 from the combination of Tai-Chi and Qi Gong concepts with Watsu techniques, and is performed standing in shoulder-depth warm water using a combination of deep breathing and slow, broad movements of the arms, legs, and torso (Márcia, et al. 2010).

AT is a physical activity performed in the water that originated for health, self-defense and spiritual growth. Graceful movements, slow tempo, relaxed yet dynamic in beautiful natural postures. It is recommended as a perfect activity for the elderly due to its low or moderate intensity, its health benefits, its calm and non-competitive character, the fact that it does not require specific equipment and its enormous flexibility with regard to time devoted to practice and where it can be performed (Ruth Sova, 2004).

Aquatic Taiji is a water-based total body strengthening and relaxation progression that bridges East and West philosophies, and integrates mental, physical, and spiritual energy. It is believed that the physiologic and therapeutic effects provided an Aquatic Taiji method would allow an improved metabolism and blood circulation, increasing oxygen consumption, which will benefit these patients, calming the mind and reducing stress and insomnia, provided- them a better quality of life (Alonso, et al. 2007).

Chinese physicians have long prescribed Aquatic Taiji as physical therapy as "gymnastic medicine," in combination with herbs, acupuncture, and acupressure to provide a holistic treatment for disease. The often-amazing results of proper practice suggest that, in some way not fully known to Western science, Aquatic Taiji can indeed relieve many chronic ailments and impart longevity (Chang, et al. 2008).

The purpose of this study was to investigate the effects of aquatic Taiji exercises on bone mineral density among Postmenopausal women

Methods

Experimental approach to the Problem

Two groups (experimental and control), performed a pre and post-training designed intervention in flexibility, balance, strength tests and bone mineral density (BMD) recorded. The experimental group (EG) (10 women) trained 1 hour per day 2 times a week on Aquatic Taiji training for eight-weeks. The control group (CG) (10 women) continued their daily life, while the experimental group completed the Aquatic Taiji training program to see whether this type of training modality would have a positive or negative or no effect on flexibility, balance, strength and bone mineral density.

Participants

The sample consisted of 20 female (54 ± 5.36 years old; 162 ± 5.03 cm height; and 75 ± 7.30 kg weight), from Kurdistan Iraq . Subjects were required to read and complete a health questionnaire and informed consent document; there was no history of coronary heart disease, diabetes or recent surgery.

Training Protocol

The eight-weeks training program consisted of Aquatic Taiji (AT).

Procedures

Subjects assessed before and after the eight-week training program. All measurements taken one week before and after training at the same time of day. Tests followed a general warm-up that consisted of running, calisthenics, and stretching.

Training Protocol

1) Special Considerations for Aquatic Taiji practice

- Maintain adequate core temperature of participants. Water movements performed approximately 4 times faster than comparable land movements.
- Position in mid-rib cage to chest depth water to allow for stabilization.
- Optional wearing of water shoes for improved traction, footing, grounding and protection.

2) Movements Techniques for Aquatic Taiji

- Works with spring loaded joints
- Uses only the amount of energy needed to execute movements, adds the quality of relaxation.
- Works from a lower center of gravity, softening knees.
- Creates circular movements to work intrinsic muscles, gently expanding the range of motion.
- Shift and transfer body weight as you move to integrate leg power.
- Develops coordination of arm and hand motions to the whole body, moving as if your spine was a third arm.
- Moves from the center, using the abdominal muscles. The center is the energy source.

3) Aquatic Taiji Exercises

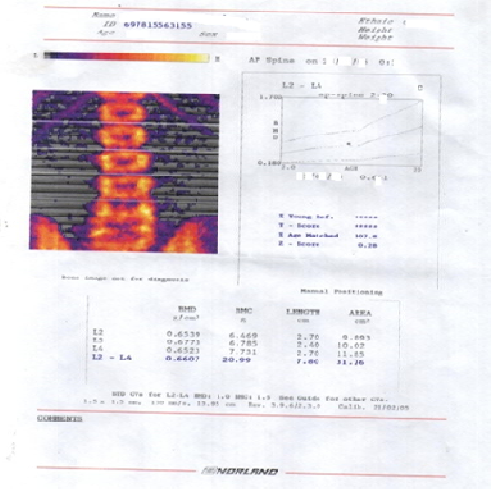
- Brush Knee Push
- Part the Wild Horses Mane
- Double Cloud Waving Hands
- Single Cloud Waving Hand
- Five Animal Qigong
- Five Element Qigong
- Lifting Pressing Water
- Single Whip
- Sweep The Sea

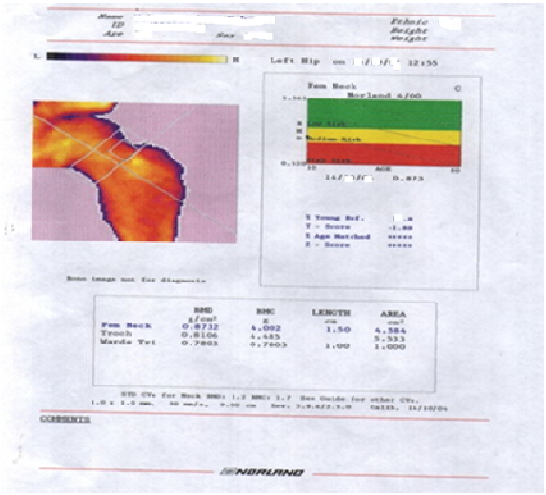
Testing Procedures

Subjects assessed before and after an 8-week training program Tests followed a general warm-up that consisted of running, calisthenics, and stretching.

BMD measurement.

Regional BMD was measured by a bone densitometer (QDR-1000®, Hologic Inc., Waltham, Massachusetts, USA) using dual-energy x-ray absorptiometry. DXA scans used primarily to evaluate bone mineral density. Also **use DXA** scans to measure total body composition and fat content with a high degree of accuracy comparable to hydrostatic weighing with a few important caveats. However, it suggested that, while very accurately measuring minerals and lean soft tissue (LST), DXA might provide skewed results because of its method of indirectly calculating fat mass by subtracting it from the LST and/or body cell mass (BCM) that DXA actually measures. The measured regions where lumbar spine (L2, L3, L4) and the femoral regions of the left leg, neck (NECK), trochanter (TROCH), ward's triangle (WARDS). The region "lumbar spine" (L2-L4) is defined by the mean value of L2, L3 and L4; the coefficient of variation was < 1.5percentage.





Sit and Reach Flexibility Test (SRFT).

This test involves sitting on the floor with legs stretched out straight ahead. Shoes should remove. The soles of the feet placed flat against the box. Both knees should locked and pressed flat to the floor - the tester may assist by holding them down. With the palms facing downwards, and the hands on top of each other or side by side, the subject reaches forward along the measuring line as far as possible. Ensure that the hands remain at the same level, not one reaching further forward than the other. After some practice reaches, the subject reaches out and holds that position for one-two seconds while the distance recorded. No jerky movements. The score recorded to the nearest centimeter at the distance reached by the hand.

Star Excursion Balance Test (SEBT).

The Star Excursion Balance Test (SEBT) is a dynamic test that requires strength, flexibility, and proprioception. It is a measure of dynamic balance that provides a significant challenge to athletes and people who are physically active. The test can used to assess physical performance but can also use to screen deficits in dynamic postural control due to musculoskeletal injuries like chronic ankle instability. It could use to identify athletes at greater risk for lower extremity injury. It is also possible to use the test during the rehabilitation of orthopedic injuries in healthy, physically active adults.

The SEBT could use to compare balance ability among different sports and to assess physical performance. Research have suggested use the SEBT as a screening tool for sport participation on the one hand and as a post-rehabilitation test to ensure dynamic functional symmetry on the other hand. It is also been showed that the performance of SEBT improves after training. It is important, that the test capture the greatest amount of information of instability in the shortest amount of time.

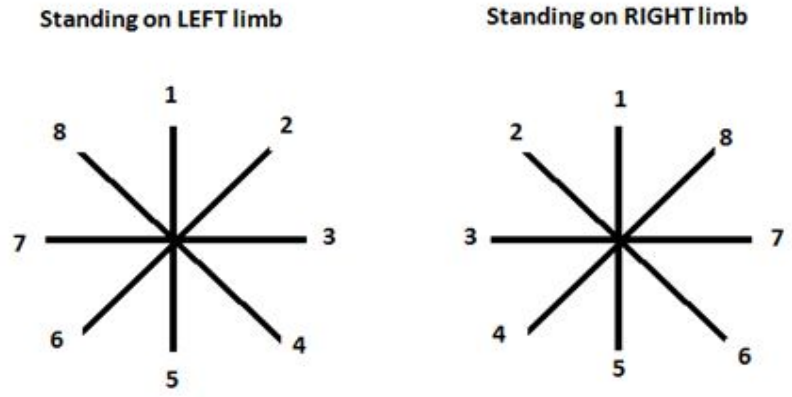


Fig 2 explain the Star Excursion Balance Test

Statistical Analysis

All statistical analyses calculated by the SPSS statistical package. The results reported as means and standard deviations (SD). Differences between two groups are reported as mean difference ± 95% confidence intervals (mean diff ± 95% CI).Student's t-tests for independent samples were used to determine the differences in physical variables between the two groups. A P-value <0.05 was considered statistically significant.

Results

Table 1. Age and Anthropometric Characteristics of the Groups (Mean ± SD)

Group	N	Age [years]	Weight [kg]	Height [cm]	BMI [kg/m2]	Menstruation status
Experimental	10	55 ± 3.2	82 ± 8.9	166 ± 7.1	29.76 ± 2.46	8.23± 2.8
Control	10	54 ± 4.9	85 ± 7.1	161 ± 5.2	32.81 ± 2.55	7.89± 3.1

Baseline measurements showed homogeneity in age, anthropometric variables, and menstruation status between the Experimental and control groups.

Table 2. Mean ±SD for BMI, BMD measurements, Back flexibility, Leg flexibility and Dynamic balance in the experimental group.

Variables	Experimental			T SIGN
	pre	post	change%	
BMI	29.76 ± 2.46	28.11 ± 1.55	6.02	Sign
BMD of Fem Neck	0.421 ± 0.016	0.425 ±0.011	0.950	Not sign
BMD of Troch	0.389 ± 0.018	0.392 ±0.017	0.771	Not sign
BMD of L2-L4	0.402 ± 0.019	0.409 0.010	1.49	sign
Back flexibility	13.12±0.93	14.99±0.63	14.25	Sign
Leg flexibility	42.55±1.89	44.67±1.25	4.98	Sign
Star Excursion Balance Test (SEBT)	15.35±2.58	11.91±2.63	23.90	Sign

Table 2. Showed significant differences between pre-and post-training scores for all variables in the experimental group (P≥ 0.05) in L2-L4 BMD, SRFT and SEBT. In addition, no significant differences shown in the other variables. And the highest improvement in Dynamic balance Test (SEBT) 23.90%

Table 3. Mean ±SD for BMI, BMD measurements, Back flexibility, Leg flexibility and Dynamic balance in the control group.

Variables	Control			T SIGN
	pre	post	change%	
BMI	32.81 ± 2.55	32.15 ± 1.88	0.09	Not sign
BMD of Fem Neck	0.422± 0.011	0.420 ±	0.474	Not sign

BMD of Troch	0.391 ± 0.017	0.392 ± 0.017	±	0.767	Not sign
BMD of L2-L4	0.407 ± 0.018	0.402 ± 0.010	±	1.25	Not sign
Back flexibility	13.36±0.74	13.33±0.74		0.22	Not sign
Leg flexibility	42.41±2.02	42.36±2.11		0.12	Not sign
Star Excursion Balance Test (SEBT)	15.22±2.49	15.12±2.70		0.66	Not sign

Table 3. Showed No significant differences between pre-and post-training scores for all variables in the control group ($P \geq 0.05$).

Table 4. Mean ±SD for BMI, BMD measurements, Back flexibility, Leg flexibility and Dynamic balance in the control and experimental groups

Variables	Control	Experimental	T SIGN
	post	post	
BMI	32.15 ± 1.88	28.11 ± 1.55	Sign
BMD of Fem Neck	0.420 ± 0.017	0.425 ± 0.011	Not sign
BMD of Troch	0.392 ± 0.017	0.392 ± 0.017	Not sign
BMD of L2-L4	0.402 ± 0.010	0.409 ± 0.010	sign
Back flexibility	13.33±0.74	14.99±0.63	Sign
Leg flexibility	42.36±2.11	44.67±1.25	Sign
Star Excursion Balance Test (SEBT	15.12±2.70	11.91±2.63	Sign

Table 4. Showed a significant difference between pre-and post-training scores for all variables ($P \leq 0.05$) except Fem Neck and Troch for the experimental group.

Discussion

The main findings from this study were the significant Increases in BMD measurements, (SRFT) and (BBT) in the experimental group, which proved the Aquatic Taiji-exercises efficacy.

There are a number of potential explanations for these findings.

Exercise is not just important to general health, it helps build bone mass in youth and slows down bone loss in adults. Exercise is also a factor in helping to reduce the risk of falls as it strengthens muscles, increases flexibility, and improves coordination and balance. During physical activity, bones receive messages that they need to work and be strong. When there is a lack of exercise, bones do not receive these messages and lower bone mass can result. Regular physical activity on a long-term basis maintains the benefits for bone health (Dawson-Hughes, et al. 1997).

Aquatic Taiji-exercises are a low-impact activity; it is a good exercise for older people who may have joint degeneration and other physical problems. In addition, it practiced in the water that in fact produces weight-bearing force and thus helps maintain and often increase bone density (Márcia, et al. 2010). Moreover, it recommended for anyone who has difficulty with land-based exercise. According to Harush, and Rotstein, (2004) the water exercise could effect on bone density among Postmenopausal Women.

Ruth Sova, (2012) indicated that Aquatic Taiji was created to help aquatic practitioners (including aquatic exercise instructors, personal trainers, and aquatic therapy and rehabilitation practitioners) and students enjoy the water in a flowing yet powerful progression. An efficient exercise program increase oxygen and caloric consumption through correct form and positioning in the water, a perfect relaxation technique for highly stressed, over-challenged clients, and is ideal for creating improved range of motion and mobility (Konno, 1997).

In addition, Flexibility and core (abdominal) strength are the benefits most mentioned by aquatic exercise instructors. The trunk stabilization/balance and pain management benefits of the program are the two most frequently cited by aquatic therapists. Clients' comments include "a soothing experience," "mind and body relaxation," and "a symphony for my body." Such benefits increase with practice (Devereux, et al. 2005). As a person becomes more familiar with the program, relaxation will improved, with a focus on the smallest movement of the hand, wrist, or eyes, and improved mental alertness. Water lessens edema in the joints, which allows clients to improve range of motion and mobility. (Howe, et al. 2007).The soft, round flowing motions strengthen core muscles while providing a soothing experience, and the circular movements create harmony, based on a principle of yielding to, rather than resisting the natural flow. The flowing movements of Aquatic Taiji can increase metabolism and blood circulation. Studies show that simply breathing while submersed to the shoulder in the water can increase oxygen consumption from seven to 25 percent. This, in turn, increases caloric consumption. (Takeshima, et al. 2002)

Practical Applications

Two months of Aquatic Taiji technique improved the balance, flexibility and bone mineral density for hip and backbone in the elderly independent.

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