

The Effects of Baduanjin Qigong in the Prevention of Bone Loss for Middle-Aged Women

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Abstract: This study aimed to assess the efficacy of a 12-week Baduanjin qigong training program in preventing bone loss for middle-aged women. An experimental design was adopted, and subjects were assigned randomly into an experimental group ($n = 44$) and a control group ($n = 43$). The experimental group received a 12-week Baduanjin qigong training program, whereas the control group did not. Interleukin-6 (IL-6) and bone mineral density (BMD) were measured before and after the intervention. The results showed significant differences in IL-6 ($t = -5.19, p < 0.000$) and BMD ($t = 1.99, p = 0.049$) between the groups. Baduanjin reduced IL-6 and maintained BMD in the experimental group. In conclusion, this study demonstrates promising efficacy of Baduanjin in preventing bone loss commonly occurring in middle-aged women. Thus, Baduanjin is valuable for promoting and maintaining the health status of middle-aged women.

Keywords: Baduanjin; Qigong; Middle-Aged Women; Interleukin-6; Bone Mineral Density.

Introduction

With the progress of socioeconomics and medicine, life expectancy for women is continuously increasing, resulting in a growing population of elderly women in many countries of the world. According to a report of the World Health Organization

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(WHO, 1996), the population of menopausal women around the world is predicted to reach 1.2 billion by 2030. Thus, how to slow down the physical aging process and maintain health through old age are important issues for middle-age people. One of the medical conditions most commonly and greatly affecting menopausal women is osteoporosis. According to WHO (2003), more than 40 million women in the US, Japan, and Europe are suffering from osteoporosis. The annual reports of osteoporosis-related hip fracture of women in these regions are up to 1.2 million, of which 20% require long-term care. There is a similar situation in Taiwan. The population of middle-aged women in Taiwan has reached 3.9 million, constituting 17.3% of the entire population of the country (Department of Health [DOH], 2004). DOH (2004) points out that the annual expenditure for osteoporosis and related complications is NT\$ 6 billion. Thus, the deterioration of physical functions and chronic illnesses that most women inevitably face in this stage of life not only substantially impact on family finances and personal lives, but also increase the tremendous financial burden of the nation's medical expenditures and social costs.

One of the main causes of osteoporosis in middle-aged women is estrogen deficiency. The effects of estrogen on bone are mainly mediated by interleukin-6 (IL-6), acting as a strong stimulating factor for the development of osteoclasts (Horowitz, 1993). The decline of estrogen in middle-aged women reduces the inhibitory effect of estrogen on IL-6 activity and consequently causes osteoporosis (Kudo *et al.*, 2003). Thus, IL-6 serves as an index for bone loss. In addition, exercise and bone mineral density (BMD) have distinct efficacy in preventing bone loss (Sinaki, 1989). A regular exercise can enhance BMD, thereby synergistically preventing bone loss due to menopause (Goto *et al.*, 1996; Kemmler *et al.*, 2004), aging (Krolner *et al.*, 1983), and disease (Humphries *et al.*, 2000). Thus, exercise is widely recommended as an effective method to maintain the health status of bone.

In recent years, many studies have demonstrated the beneficial effects of qigong on health maintenance (Li *et al.*, 2005; Li *et al.*, 2004; Liu *et al.*, 2003; Song *et al.*, 2003; Yeh *et al.*, 2006). However, most of these studies focused on the application and efficacy of Tai Chi. Although Tai Chi does provide promising outcomes, the practice of Tai Chi is too complicated and it is difficult for a beginner to learn it well in a short time. Baduanjin, a kind of qigong equally popular as Tai Chi in the Chinese world, is characterized by its simple, slow, and relaxing actions. Baduanjin involves movements and activations of every part of the body, including all the movable joints and voluntary muscles from the head to the feet. Each movement brings certain function-enhancing effects to particular organs or parts of the body. A variety of beneficial effects are associated with Baduanjin, including exercising all movable joints in the whole body, modulating mind and spirit, enhancing respiratory function, and promoting the circulation of blood and qi. Recent reports have collected clear scientific evidence supporting the beneficial effects associated with Baduanjin, such as imposing little work burden on the hearts of middle-aged people and raising estrogen (Huang, 2003). In this study, Baduanjin was delivered to middle-aged women and its efficacy in preventing bone loss was assessed in terms of IL-6 and BMD.

Materials and Methods

Research Design and Subjects

This study designed with two groups. The experimental group received a Baduanjin qigong training program, whereas the control group did not. The number for each group was estimated to be at least 35 by using SSIZE package. Subjects were healthy middle-aged women between the ages of 35 to 60 with BMD T scores ≥ -2.5 . However, women with histories of uterine/ovarian diseases or surgery, hormonal therapy, steroid or diuretic medication, or other diseases potentially affecting BMD and those doing regular exercise before the study were excluded. Ethical approval was obtained from the hospital where the study was held and informed consent was obtained from all subjects. All subjects were also made aware that data collected would be confidential, and that they would be free to withdraw from the study at any time. IL-6 and BMD were measured before and after Baduanjin.

Baduanjin Qigong Training Program

The experimental subjects at first learned Baduanjin for 2 weeks, and the performance of each participant was then ensured to be correct by the authors. After that, the subjects started to join a 12-week Baduanjin qigong training program, in which they practiced Baduanjin with the authors 3 days/week. The entire set of Baduanjin includes 8 sections, each of which is composed of graceful movements. 1st section: (1) stand normally and hold palms facing upward; (2) inhale and raise hands to the chest level, exhale while palms are turned downward and lowered, and return to (1); (3) inhale and raise hands to the eye level, turn palms forward and raise hands up to the head, and raise heels slightly and maintain 3~5 seconds; (4) exhale and lower hands from each side, and return to (1). 2nd section: (1) stand normally with feet shoulder-width apart; (2) inhale and raise fists to the chest level, exhale while the body is lowered straight back and the left fist is pushed out horizontally to the left side of the body; (3) inhale and withdraw the left fist; and (4) exhale and stand up straight back to (1). 3rd section: (1) stand naturally and hold palms facing upward; (2) inhale and raise hands to the chest level, exhale while palms are turned downward and lowered; (3) inhale and raise hands to the chest level; (4) raise the right hand to the top of head and push the left hand straight down; (5) exhale and return to (1). 4th section: (1) stand naturally and hold palms facing upward; (2) inhale and raise hands to the chest level, and exhale and push down hands; (3) turn the head to face backward from the left side to see the left heel and return to (1). 5th section: (1) stand naturally and place palms on the thighs; (2) bend the right knee and shift body weight onto the right leg, and turn the face to the right; (3) inhale, move the body from the left to the front side, and distribute body weight evenly on the legs; (4) exhale and return to (1). 6th section: (1) stand normally raising heels; (2) turn palms downward and stand straight for 5 seconds; (3) relax the body suddenly and exhale with bent knees, allowing heels to fall to the ground; (4) inhale and return to (1). 7th section: (1) stand normally with feet shoulder-width apart; (2) hold fists

on the waist of each side with bent knees; (3) punch the right fist forward; (4) withdraw the right fist and return to (1). 8th section: (1) stand naturally; (2) inhale and raise hands to the top of the head; (3) exhale and bend the body to reach the ground with hands; (4) inhale and return to (1); (5) exhale and arch the back; and (6) inhale and return to (1).

Measuring IL-6 and BMD

The level of serum IL-6 was determined by Enzyme-link immunosorbent assay (ELISA) using IL-6 kit and an ELISA reader (Alpha Diagnostic International, Inc., USA). BMD was measured by a DTX-200 DEXACARE osteometer (MediTech Inc., USA). The equipment had been certified in accordance with ISO 9001/EN/EEC.

Statistical Analysis

The chi-square and t tests were used to evaluate statistical differences between data of the two groups. $p < 0.05$ was considered as statistically significant.

Results

Demographic Analysis

Ninety subjects were assigned randomly to the experimental or control group. There were 44 subjects in the experimental group and 43 in the control group completing the study, with drop out rate of 3%. The average age was 45.7 ± 6.08 years for the experimental group and 44.6 ± 5.47 for the control group. The demographic characteristics are summarized in Table 1. There were no significant differences in age, body weight, body height, and menopause status between the two groups ($p > 0.05$). Homogeneity between the two groups was demonstrated.

Table 1. Demographic Characteristics of Subjects

Items	Experimental Group	Control Group	t*	p†
	M ± SD	M ± SD		
Age	45.7 ± 6.08	44.6 ± 5.47	0.885	0.38
Body weight	58.9 ± 8.97	59.3 ± 7.79	-0.279	0.78
Body height	156.1 ± 5.17	156.6 ± 5.44	-0.451	0.653
Menopause status	n (%)	n (%)	χ^2 †	p
Yes	32 (72.7%)	35 (81.4%)	-0.923	0.337
No	12 (27.3%)	8 (18.6%)		

*The t-test was used to examine the homogeneity.

†The chi-square test was used to examine the homogeneity.

Table 2. Paired t-test in IL-6 and BMD

Group	Pre-test – Post-test		t	p
	M ± SD			
IL-6				
Experimental	–38.02 ± 58.55		4.307	0.000
Control	25.83 ± 56.05		–3.022	0.000
BMD				
Experimental	0.05 ± 0.36		0.823	0.415
Control	–0.13 ± 0.49		1.864	0.069

Effects of Baduanjin on IL-6

The mean baseline of IL-6 was 138.66 ± 78.63 ng/ml (range, 42~488) in the experimental group and 114.72 ± 37.81 ng/ml (range, 71~239) in the control group. At the post-test, IL-6 was 100.64 ± 47.35 ng/ml (range, 19~255) in the experimental group and 140.56 ± 56.27 ng/ml (range, 60~270) in the control group. As shown in Table 2, IL-6 in the experimental group significantly decreased 27% at the post-test ($t = 4.307$, $p < 0.000$), whereas in the control group it significantly increased 23% ($t = -3.022$, $p < 0.000$). The difference in change of IL-6 between the two groups was significant ($t = -5.19$, $p < 0.000$).

Effects of Baduanjin on BMD

The mean baseline of BMD was -0.35 ± 0.91 ng/ml (range, -2.3~1.4) in the experimental group and -0.16 ± 0.72 ng/ml (range, -1.9~1.4) in the control group. At the post-test, BMD was -0.30 ± 0.99 ng/ml (range, -2.4 ~ 1.6) in the experimental group and -0.30 ± 0.77 ng/ml (range, -2.1~1.5) in the control group. As shown in Table 2, neither the increase in the experimental group ($t = 0.823$, $p = 0.415$) nor the decrease in the control group ($t = 1.864$, $p = 0.069$) at the post-test was statistically significant. However, the difference in changes of BMD between the two groups was significant ($t = 1.99$, $p = 0.049$).

Discussion

The experimental subjects receiving the 12-week Baduanjin qigong training program displayed a significant decrease in IL-6, while the control subjects, who did not receive the program, had a significant increase in IL-6 at the post-test. These are different from the results of Jones (2001) and Pedersen *et al.* (2003) that demonstrated that exercise could elevate IL-6. The different styles of exercises used in their studies can potentially explain the disagreement. Baduanjin is a soothing and relaxing qigong. When practicing, an individual has to relax muscles of the whole body. Each movement must be performed gently and slowly in obedience to the key points of qigong: tightening in relaxing and forbidding inflexible strength or rash force (Li and Yeh, 2005; Yeh and Chen, 2003). In

addition, the mind should be kept in tranquility, and thoughts should be conducted to dan-tian where qi assembles. Concentration of thoughts at dan-tian can facilitate the formation of abdominal respiration, qi and blood circulation in the abdomen, and acquisition of better posture balance for aging people by helping to descend their body weight downward (Yeh and Chen, 2003). Baduanjin has been reported to raise estrogen level (Huang, 2003). Thus, the inhibitory effects of estrogen on IL-6, enhanced by Baduanjin, might be the underlying mechanism whereby IL-6 is reduced in the experimental group. The increased IL-6 observed in the control group simply reflected the inverse correlation between IL-6 and estrogen, the latter of which gradually declines in women about menopause.

The control subjects who did not receive Baduanjin had a decrease in BMD. In contrast, the experimental subjects demonstrated an increase in BMD. A similar result was found in Kemmler *et al.* (2004). In the control group, BMD at the post-test had decreased to an alarming level, indicating severe bone loss. We suspect that the lower BMD level may be associated with IL-6 which was significantly increased at the post-test in the control group. IL-6 is reported not only to stimulate bone resorption (Horowitz, 1993), but also to enhance osteoclast development, in turn accelerating bone resorption and resulting in bone loss (Kudo *et al.*, 2003). Our findings suggest that to prevent osteoporosis effectively, middle-aged women need to delay and slow down the onset and process of bone loss before the fluctuation of hormone levels occurs in menopause by regularly doing exercise, such as Baduanjin.

In conclusions, a 12-week Baduanjin qigong training program demonstrated efficacy in lowering IL-6 and maintaining BMD in a group of middle-aged women. Thus, Baduanjin was helpful to a certain degree in preventing of bone loss common in middle-aged women. Baduanjin is simple, easy to learn, and easy to remember. It is not strenuous and does not require any equipment or spacious places to be performed. Thus, this style of qigong is a health-maintaining exercise suitable for middle-aged women. The application and usefulness of Baduanjin requires and is worthy of further study. The subjects enrolled for this study were 35- to 60-year-old women in one region, thus the data are not sufficient for analyzing the effect of Baduanjin for all age groups. We suggest that future studies investigating the effect of Baduanjin should increase sample size and widen the age range of samples. Through exploring the beneficial effects in all age groups, the efficacy of Baduanjin in osteoporosis prevention will be further elucidated.

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