

Original article

Bone turnover increases during supervised treadmill walking in Thai postmenopausal women

Wisaneeya Siwapituk^a, Wasuwat Kitisomprayoonkul^{b,*}

^a Department of Physiology, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand

^b Department of Rehabilitation Medicine, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand

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Abstract

Introduction: Treadmill walking is a cheap and attainable form of exercise, which carries a low injury risk and confers other health benefit. The aim of this study is to investigate the effects of 3-month treadmill walking on biochemical bone markers in Thai postmenopausal women.

Material and methods: Thai postmenopausal women participated in a 3-month supervised treadmill walking program. The program consisted of treadmill walking, the intensity of which was 55–70% of maximal heart rate, with duration of 30 min per day, at a frequency of 3 days a week. Crosslinked C-terminal telopeptides of type I collagen (CTX-I) and N-terminal propeptides of type I procollagen (PINP) level were measured at baseline and at 1 week after 3-month training.

Results: Eighteen women completed the training program. The average age of patients was 59.39 ± 4.18 years. The average period after menopause was 9.28 ± 6.52 years. CTX-I and PINP levels at baseline were 0.43 ± 0.14 and 52.15 ± 13.43 ng/ml. CTX-I and PINP levels after 3-month training were 0.80 ± 0.26 and 66.77 ± 22.82 ng/ml. Bone resorption and formation markers were significantly increased after treadmill walking ($p < 0.01$).

Conclusion: Bone turnover increases after 3-month supervised treadmill walking in Thai postmenopausal women.

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Keywords: Bone marker; Menopause; Treadmill walking

1. Introduction

Twenty percent of Thai postmenopausal women were diagnosed as osteoporosis [1]. Weight-bearing exercise is the most important exercise in osteoporosis. Walking is a cheap and attainable form of weight-bearing exercise, which carries a low injury risk and confers other health benefit. It may be an ideal intervention which could prevent further bone loss after menopause. However, the benefit of walking on bone health in postmenopausal women is controversial.

In previous studies, aerobic walking did not prevent bone loss in postmenopausal women [2–4]. On the other hand, high intensity aerobic walking or anaerobic walking preserved bone mineral density in postmenopausal women [5–7]. In a meta-analysis study, regular walking could not preserve bone mineral density at the lumbar spine in postmenopausal women. Although bone mineral density at femur was increased, prevalence of hip fracture in this group was not reduced [8]. A 1 year outdoor aerobic walking could reduce bone turnover marker in postmenopausal women with osteoporosis/osteopenia [9]. Bone turnover also decreased after a 3-month treadmill walking in Thai women [10]. However, only 9 subjects in that study are postmenopausal.

Thai physicians usually advise postmenopausal women to perform aerobic walking exercise. We hypothesize that treadmill walking program may decrease bone resorption and

* Corresponding author. Department of Rehabilitation Medicine, Faculty of Medicine, King Chulalongkorn Memorial Hospital, Chulalongkorn University, Rama IV Road, Prathumwan, Bangkok 10330, Thailand.

E-mail address: wkitisom@yahoo.co.th (W. Kitisomprayoonkul).

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increase bone formation markers in postmenopausal women. The aim of this study is to investigate the effects of 3-month treadmill walking with moderate intensity on biochemical bone markers in Thai postmenopausal women.

2. Materials and methods

Thai postmenopausal women were recruited from nearby community and from personnel of our hospital. This study was approved by the institutional ethical committee (IRB no. 95/52, COA 323/2009). Written informed consent was obtained from all participants. Subjects were postmenopausal women who did not perform any exercise more than 3 days per week, body mass index (BMI) within normal range between 18.5 and 25 kg/m² [11], no history of fracture for at least 1 year prior to participation and did not taking agents affecting bone metabolism, such as hormonal replacement; bisphosphonate; corticosteroid; anticonvulsants; vitamin K antagonist; thiazide diuretics and GnRH agonist for at least 6 months before participation [12]. Exclusion criteria included women who had a history of falls and balance problem that precluded safety during treadmill walking, who had metabolic bone diseases such as Paget's disease; hyper- or hypoparathyroidism; thyrotoxicosis; Cushing's disease; multiple myeloma; bone metastasis [12,13], who had chronic diseases affecting bone turnover such as chronic kidney disease and rheumatoid arthritis, who had diseases prohibiting treadmill walking such as knee osteoarthritis with a visual analog scale (VAS) more than 4 cm; low back pain with symptoms aggravated during walking; uncontrolled hypertension; heart disease with American Heart Association functional class C or D. Participants who could not participate at least 80% of exercise session was dropped out.

Treadmill training and physical performance test were set up in the exercise training room of the Department of Physiology, Faculty of Medicine, Chulalongkorn University. The program consisted of 3-month treadmill walking (Nautilus T916 Sport Series LC Display, USA), the intensity of which was 55–70% of maximal heart rate [14], with duration of 30 min per day, at a frequency of 3 days a week. The exercise session included a 5-min warm up, 20-min treadmill walking and a 5-min cool down. All participants were supervised during exercise program. Blood pressure was measured before and after exercise. Heart rate was measured throughout the exercise session using a heart rate monitoring device (Polar, Finland). Participants who had trauma or any complications that prohibited exercise were discharged from the program and were referred to a physician.

Blood samples were collected between 8 and 9 a.m. Subjects were asked to fast overnight and refrain from exercise at least 24 h before blood collection [12]. Biochemical bone markers were analyzed using immunoassay methods with Elecsys kits for Crosslinked C-terminal telopeptides of type I collagen (CTX-I) and N-terminal propeptides of type I procollagen (PINP) (Roche Diagnostics, USA). Bone biochemical marker levels were measured at baseline and after 3-month training. Baseline levels were measured 1 week

before starting the treadmill walking program. Post-training levels were measured at 1 week after the last training session to avoid an acute effect of exercise. Effects of acute exercise on biochemical bone markers persisted as long as 72 h after exercise [15]. Injury according to exercise was recorded throughout the study.

Physical performance test included sit and reach test [16], chair stand test [17] and step test [18]. We assessed the physical performance at 1 week before starting the treadmill walking program and 1 week after the last training session. Sit and reach test was used for measure flexibility of the lower back and the hamstrings. Each subject was tested 2 times. The average value was used for analysis. Greater reach distance determines more flexibility. Chair stand test was used for assess lower limb strength and endurance. The number of repetitions within 30 s was recorded. More repetitions determine better strength and endurance of lower limb muscles. Step test was used for assess cardiovascular fitness. Number of step cycle repetitions in 3 min was recorded and converted to VO₂ (mL/kg/min) [19]. The higher the VO₂ value determines better cardiovascular fitness.

SPSS for Windows version 15.0 was used for statistical analysis with significant level at $p < 0.05$. Demographic data, biochemical bone markers and the physical performance test were reported by mean and standard deviation. The paired *t*-test was used to compare the different of biochemical bone markers and physical performance at baseline and after treadmill walking.

3. Results

Twenty-six postmenopausal women were enrolled. Six participants who had diseases prohibiting treadmill walking were excluded. Two participants were dropped out. One could not participate at least 80% of exercise. One lost follows up. Eighteen women completed the 3-month program. The average age was 59.39 years. The average period after menopause was 9.28 years. The average BMI was 21.99 kg/m². The demographic data of the participants are shown in Table 1.

Baseline CTX-I and PINP levels were 0.43 and 52.15 ng/ml. After 3-month treadmill walking, CTX-I and PINP levels were significantly increased. Biochemical bone markers are shown in Table 2.

At baseline, sit and reach test, chair stand test and step test (convert to VO₂) were 8.58 inches, 17.61 repetitions and 23.10 ml/kg/min, respectively. After 3 months treadmill walking, sit and reach test, chair stand test and step test were 10.06 inches, 20.11 repetitions and 23.47 ml/kg/min. The chair

Table 1
Demographic data of the participants

Age (mean ± SD, year)	59.39 ± 4.18
Height (mean ± SD, cm)	153.78 ± 6.91
Weight (mean ± SD, kg)	52.34 ± 6.55
BMI (mean ± SD, kg/m ²)	21.99 ± 2.32
Duration after menopause (mean ± SD, year)	9.28 ± 6.52

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