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Original Article

Effect of Tai Ji Quan training on self-reported sleep quality in elderly Chinese women with knee osteoarthritis: a randomized controlled trail

Jiaojiao Lü, Lingyan Huang, Xie Wu, Weijie Fu, Yu Liu*

Key Laboratory of Exercise and Health Sciences of Ministry of Education, Shanghai University of Sport, Shanghai, 200438, China

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ABSTRACT

Objective: The purpose of this study was to explore the effects of a 24-week Tai Ji Quan training program on sleep quality, quality of life, and physical performance among elderly Chinese women with knee osteoarthritis (OA).

Methods: A 24-week randomized, controlled trial of 46 elderly women with knee OA. Participants were randomly assigned to either a Tai Ji Quan group ($n = 23$) or a control group ($n = 23$). Participants in the Tai Ji Quan group completed training sessions three times per week, while those in the control group had bi-weekly educational classes. The primary outcome was total score of the Pittsburgh Sleep Quality of Index (PSQI). Secondary outcomes were: seven subscales of the PSQI; sleep latency; total sleep time; sleep efficiency; physical component summary (PCS) and mental component summary (MCS) of the 36-item Short Form Health Survey (SF-36); Berg Balance Scale (BBS); and Timed Up and Go (TUG).

Results: Compared with the control group, participants in the Tai Ji Quan group had significantly improved primary outcome (global PSQI score, $p = 0.006$) and secondary outcomes, including three PSQI sub-scores (sleep latency, $p = 0.031$; sleep duration, $p = 0.043$; daytime dysfunction, $p = 0.007$), total sleep time ($p = 0.033$), and SF-36 PCS ($p = 0.006$). The Tai Ji Quan group also had significant improvements compared with baseline in three PSQI sub-scores (sleep latency, $p = 0.031$; habitual sleep efficiency, $p = 0.049$; sleep disturbance, $p = 0.016$), sleep latency ($p = 0.003$), BBS ($p = 0.001$), and TUG ($p = 0.006$).

Conclusion: Tai Ji Quan training is an effective treatment approach to improve sleep quality and quality of life in elderly Chinese women with knee OA.

Trial registration: Chinese Clinical Trial Registry (June 16, 2013): ChiCTR-TRC-13003264.

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1. Introduction

Knee osteoarthritis (OA) is the most common joint disorder and a leading cause of chronic pain, functional limitation and physical disability; it affects women more frequently than men [1]. The prevalence of symptomatic knee OA is higher in China than in Western countries [2], especially in women (40% higher in Beijing than in Framingham, USA) [3]. Sleep complaints are more common in people with OA because of chronic pain and poor physical function [4,5]. Sleep disturbances occur in more than two-thirds of OA patients, leading to augmentation of pain severity, and poor quality of life and mental health [6]. Therefore, sleep quality is an important outcome relevant to the treatment efficacy of OA [7].

Non-pharmacological interventions, such as exercise, play an important role in the treatment of knee OA [1], and can have beneficial effects on pain, physical function, sleep quality, and quality of life [8–10]. Tai Ji Quan is a traditional Chinese exercise that has the potential to improve muscular strength, joint stability and flexibility, and reduce pain, depression and physical disability [11,12]. It has been shown that Tai Ji Quan is effective in improving the sleep quality among different populations, including college students [13], middle-aged adults [14], older adults [15–17], and cancer survivors [18]. Subjects participating in Tai Ji Quan have improved self-reported sleep quality, increased sleep duration, and reduced sleep-onset latency and sleep disturbances [15,17]. Moreover, there is evidence that this kind of range of motion and low-

* Corresponding author. Fax: +86 21 51253242.
E-mail address: yuliu@sus.edu.cn (Y. Liu).

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impact physical activity is associated with improvements in arthritic symptoms and physical function in patients with OA [19]. However, most of these prior studies have dealt mainly with pain and physical function, with relatively little attention being paid to other outcome measures, such as sleep quality and quality of life, which reflect the real impact of knee OA on patients.

The primary purpose of this study was therefore to determine the effect of a 24-week Tai Ji Quan training program on self-reported sleep quality among elderly Chinese women with knee OA. A secondary purpose was to examine the effects of Tai Ji Quan on quality of life and physical performance. It was hypothesized that Tai Ji Quan training would lead to improvement in sleep quality, quality of life, and physical performance outcome measures.

2. Methods

2.1. Study design and participants

The study was designed as a randomized, controlled intervention trial with two groups. Participants were randomly assigned into either a Tai Ji Quan training or health education control group. The study protocol has been described in detail elsewhere [20] and was approved by the ethics committee of Shanghai University of Sport. Written informed consent was obtained from all participants.

Chinese women, who have a higher risk of both OA and age-related sleep problems than men [1,21], were recruited from two community centers in Shanghai between January 2013 and March 2013. Detailed descriptions of inclusion criteria, recruitment and adherence have already been presented by Zhu et al. [20]. Briefly: individuals were eligible if they had a clinical diagnosis of knee OA, an age of 60–70 years, stable medication use, and willingness to engage in the study and to be assigned to any of the two interventions. Forty-six participants who qualified according to the eligibility criteria were randomized to the Tai Ji Quan training group (Tai Ji Quan, $n = 23$) and the health education control group (control, $n = 23$) [20]. Of these, six participants dropped out due to time conflict and health-related issues (two in the intervention group and four in the control group).

2.2. Intervention

Individuals in the Tai Ji Quan group participated in a 60-min session three times a week for 24 weeks. Considering the symptoms of knee OA and avoiding strenuous activities on joints, the Tai Ji Quan program was designed to be more suitable for patients with knee OA, and followed an easy-to-difficult progression, focusing on reducing sustained unilateral weight bearing, dynamic rotational weight shifting at the knee joints and excessive knee flexion. The training program included eight Tai Ji Quan forms adapted primarily from the 24-form practice routine [22]: (1) “withdraw and push”; (2) “fan through the back”; (3) “wave hands like clouds”; (4) “life hand”; (5) “brush knee and twist steps”; (6) “step back to repulse monkey”; (7) “fair lady works at shuttles” and (8) “golden pheasant stands with one leg (right and left)”. Each exercise session included a 5-min warm-up, 50 min of Tai Ji Quan, and 5-minute cool down, all of which took place in the morning (at approximately 08:00–09:00). For more details of the Tai Ji Quan intervention, please refer to Zhu et al. [20]. Mean attendance at Tai Ji Quan sessions (total of 72) was 87% over 24 weeks (SD 5%; median [IQR] 88% [83–91%]).

During the 24-week study period, participants in the control group received 60-min bi-weekly wellness education classes regarding health promotion. Health education participants attended 78% of scheduled sessions (SD 16%; median [IQR] 77% [67–92%]).

2.3. Outcome measures

All outcome measures were assessed at baseline (before intervention) and the end of the study (after intervention), and included demographic and clinical profiles, anthropometric measures, study primary outcome measures and secondary outcome measures. All assessments were completed in a research laboratory at Shanghai University of Sport, and study assessors who conducted outcome assessments were blinded to the participants' group allocation.

2.3.1. Primary outcome measures

The Pittsburgh Sleep Quality Index (PSQI, Chinese version [23]) was used as a outcome measure for assessing sleep quality and disturbances over a one-month time interval, with higher scores indicating poorer sleep quality [24]. The PSQI is a 19-item self-report scale with seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction. The global PSQI score is the sum of the seven components, ranging from 0 to 21. The global PSQI score was the primary outcome and the subscale scores were secondary outcomes in this study. This scale has a high degree of internal consistency (Cronbach's alpha = 0.83) with good sensitive (89.6%) and specificity (86.5%) [24].

2.3.2. Secondary outcome measure

Secondary outcome measures included: (1) sleep latency (minutes), total sleep time (hours) and sleep efficiency (%), and seven subscales of PSQI (range score: 0–3) [24], (2) physical component summary (PCS) and mental component summary (MCS) of the 36-item Short Form Health Survey (SF-36) used as measures of quality of life, with a range of 0–100 [25], (3) Berg Balance Scale (BBS) assessing balance, which consisted of 14 items, including simple mobility tasks (eg, transfers, standing unsupported, sit-to-stand) and more difficult tasks (eg, tandem standing, turning 360°, single-leg stance) [26], (4) Timed Up and Go test (TUG) assessing mobility in which the participant was asked to stand up from a chair, walk 3 m, turn around, return to the chair and sit down [27].

2.4. Statistical analysis

All analyses were conducted on an intent-to-treat basis so that all participants were included and analyzed regardless of adherence or dropout status. The incomplete data resulting from dropouts were handled through the method of “last observation carried forward” [28]. Baseline characteristics of the study participants were analyzed using analysis of variance for continuous variables and Chi-squared test or Mann–Whitney U test for categorical variables. Differences in each group before and after intervention were analyzed by paired t-test for normally distributed data and Wilcoxon signed-rank test for non-parametric data. Mean changes from baseline were compared between groups using repeated measure analysis of variance. For the variables that were significantly different between groups at baseline, mean changes between groups were analyzed using analysis of covariance (ANCOVA) adjusting for baseline levels of the dependent variables. Relationships between changes in sleep quality, knee pain, quality of life and physical performance were evaluated using Pearson correlation analysis. An alpha level of 0.05 was considered as statistical significance. Data analyses were performed using SPSS software (version 20.0, IBM Corporation, Armonk, NY, USA).

This randomized, controlled trial was originally powered to examine effects on gait kinematics [20], which determined the

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