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Original article

Effects of yoga on stress and inflammatory factors in patients with chronic low back pain: A non-randomized controlled study

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Abstract

Introduction: Yoga is known to reduce stress and inflammation which are related to chronic low back pain (CLBP). However, very few studies investigated the effect of yoga on stress and inflammation in patients with CLBP. We aimed to evaluate effects of the 12-week yoga program on back-related function, stress, and inflammatory factors in patients with CLBP.
Methods: We conducted a non-randomized controlled study. Premenopausal women with CLBP were recruited with a local flyer and allocated to Hatha yoga and untreated control groups. Before and after 12 weeks, CLBP by Roland–Morris Disability Questionnaire (RMDQ), back flexibility, stress by Symptoms of Stress Inventory (SOSI), and serum cortisol, tumor necrosis factor-alpha (TNF-α), and C-reactive protein (CRP) were evaluated. Effects of yoga were assessed with per-protocol and intention-to-treat analyses.
Results: By the per-protocol analysis, RMDQ ($p < 0.05$) and back flexibility ($p < 0.001$) significantly improved in the yoga group ($n = 14$), whereas there were no significant differences in the control group ($n = 11$). Serum cortisol level and total SOSI score significantly decreased in the yoga group (both $p < 0.05$). TNF-α maintained in the yoga group whereas TNF-α significantly increased in the control group ($p < 0.01$). CRP did not changed significantly in both groups. The findings from the intention-to-treat analysis were consistent with those of the per-protocol analysis.
Conclusions: The present results suggest that yoga may be an effective treatment for CLBP and stress although the results should be confirmed with a large-scale randomized controlled trial.

Keywords: Yoga; Back pain; Stress; Cortisol; Inflammatory factors

Introduction

Yoga originated in ancient India and has been practiced for over 4000 years to promote physical and mental health [1,2]. Yoga is one of the most common complementary and alternative medicine (CAM) therapies used in Western society [3,4]. Among various types of yoga, Hatha yoga is a popular style of yoga emphasizing both physical and mental training, and typically consists of yoga poses, breathing, and meditation [1,2].

Back pain is becoming a more common health problem in recent years [5,6]. Since it is generally difficult to identify a single specific cause of back pain, diverse non-pharmacologic therapies including CAM therapies have been practiced to relieve chronic back pain [5,7]. Yoga is one CAM therapy that appears to be promising for relieving chronic back pain [8–10]. Previous studies reported that 12- and 24-week yoga interventions resulted in improvement in pain intensity measured by a numerical rating scale and a visual analog scale and pain-associated disability assessed using the Roland–Morris disability questionnaire (RMDQ) and the Oswestry disability questionnaire in patients with chronic low back pain [8–10].

Previously it has been reported that yoga not only increased physical fitness [11,12] but also reduced heart rate [13], inflammatory markers such as tumor necrosis factor-alpha (TNF-α), interleukin-6 and C-reactive protein (CRP) [14,15], and stress [15,16]. Based on these results, improvements in physical fitness, sympathetic nervous system activity, inflammation, and stress have been proposed as physiological mechanisms for beneficial effects of yoga on chronic pain [17].

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Stress and inflammation have been known to be related to chronic back pain and suggested to mediate effects of therapeutic interventions on chronic back pain [18,19]. Yoga is known to improve the signs and symptoms of stress in healthy adults and patients with chronic diseases [15,16,20,21]. However, very few studies investigated the effect of yoga on stress in patients with chronic back pain [22,23]. Moreover, the effect of yoga on inflammation in patients with chronic back pain has not been investigated although it has been reported that yoga reduced inflammation in patients with chronic inflammatory diseases and heart failure [14,15].

As mentioned above, there may be a possible connection between chronic pain and stress/inflammation [18,19]. Accordingly, in this study, we aimed to investigate the effects of the 12-week yoga program on back-related function, stress, and inflammatory factors in premenopausal women with chronic low back pain.

Methods

Study participants

Initially, we designed two independent studies using the same study participants: the present study was focused on stress and inflammation and the other was focused on pain-related neuromodulators [24]. Premenopausal women with chronic low back pain were recruited with a local flyer posted in the yoga studios. Twenty-three women in a yoga group and 20 women in a control group who were screened based on self-reported low back pain, medical history and lifestyle were finally enrolled in the matched controlled study. Age and body mass index (BMI) were matched in two groups since serum concentrations of CRP and TNF-α are age- and obesity-dependent [25–27].

Inclusion criteria for study participation were non-obese premenopausal women having low back pain more than 12 weeks without radiating pain; currently not on the medication or treatment related to back pain; not participating in regular exercise. We excluded subjects diagnosed with pregnancy, rheumatoid arthritis, infectious disease, diabetes, cardiovascular disease, spondylolisthesis, spondylitis, osteoporosis, cancer or neurological disease. All participants provided their written informed consent before participating study.

Calculation of sample size was based on the minimally clinically important change (MCIC) of 1–2 points on the RMDQ scores for patients with low baseline scores reported in previous studies [28,29]. Our planned sample size of 16 had 80% power to detect the MCIC of 1.5 point on the RMDQ assuming a two-sided $\alpha = 0.05$, 1 standard deviation.

Study procedures

The Hatha yoga program was performed three times a week for 12 weeks in a yoga group. Participants in a control group were untreated and asked not to change their usual lifestyles over 12 weeks. Before and after 12 weeks, back-related function was assessed with RMDQ and back flexibility during extension. CRP and TNF-α levels were measured as serum inflammatory markers. In addition, stress levels were evaluated using the Symptoms of Stress Inventory (SOSI) and serum cortisol. Data collection and analysis were done in a blinded manner. Data collection and analysis were conducted by different members of our research team. The blood samples were analyzed by clinical laboratory technologists who were blinded to clinical information of participants.

Table 1
Yoga protocol.

Warm-up (10 min)	Breathing and total body stretch
Yoga poses (40 min)[a]	Paschimottanasana (Seated forward bend) Ardha Matsyendrasana (Half spinal twist pose) Gomukhasana (Cow face pose) Bhujangasana (Cobra pose) Krauncasana (Heron pose) Vrksasana (Tree pose) Matsyasana (Fish pose) Marjariasana (Cat and cow pose) Uttanasana (Standing forward bend) Utthita Trikonasana (Triangle pose) Salabhasana (Locust pose) Baddha Konasana (Butterfly pose) Ardha Chandrasana (Half moon pose) Jathara Parivartanasana (Knee together twist) Adho Mukha Svanasana (Downward-facing dog) Dhanurasana (Bow pose) Setu Bandhasana (Bridge pose) Halasana (Plow pose) Parighasana (Gate pose) Ustrasana (Camel pose) Upavistha Konasana (Wide seated forward bend pose) Virabhadrasana (Warrior pose) Supta Matsyendrasana (supine spinal twist) Sarvangasana (Shoulder-stand pose)
Relaxation and meditation (10 min)	Breathing, relaxation-meditation, yoga nidra (yogic sleep)

[a] Each yoga session included 12 poses.

Yoga protocol

Twelve-week group-based yoga program was performed in a yoga studio affiliated with the Korea Yoga Association. All yoga classes were taught by one yoga instructor who has been certified with the Korea Yoga Association and had 18 years of teaching experiences. As shown in Table 1, the 60-min Hatha yoga class consisted of warming-up, yoga poses, and relaxation. Participants were encouraged to practice their yoga poses as much as they can without increasing pain. Each yoga session included 12 poses and yoga poses increased in difficulty. Participants did not practice yoga at home.

Back-related function

Physical disability due to back pain was assessed by the Korean version of RMDQ which measures the number of activities of daily living limited due to back pain [30–32]. The RMDQ has been previously translated in Korean and found to be valid and reliable [31,33].