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RESEARCH LETTER

Effects of *T'ai Chi* on Chronic Systemic Inflammation

Tongjian You, PhD, and Elisa F. Ogawa, PhD

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Introduction

Chronic systemic inflammation plays an important role in the pathophysiology of a number of clinical diseases and conditions. Lifestyle modifications have been advocated for the treatment of chronic inflammation. Effects of diet and exercise on chronic inflammation have been summarized in several review articles. The purpose of this research letter is to review current evidence of potential effects of a popular mind–body exercise, *t'ai chi*, on chronic inflammation and to provide guidance for future research.

Methods

A literature search was performed using PubMed, Web of Science, and PsycINFO. The keywords were *t'ai chi* OR Tai Ji AND inflammation OR C-reactive protein OR cytokine OR interleukin 6 OR tumor necrosis factor α. Inclusion criteria were randomized controlled studies or quasiexperimental studies; written in English; middle-aged or older adults as sample participants. The literature search was conducted from inception to April 3, 2019.

The authors reviewed 175 articles and then assessed 26 articles for eligibility. Among 26 articles, 13 articles met the inclusion criteria.[1–13] There were two sets of articles that describe the same studies.[3,4,7,8] The authors combined the two articles for one study,[3,4] and included one article for the other study.[8] Among the 11 studies, 9 studies were randomized controlled studies[1–6,8–11] and 2 studies were quasiexperimental studies.[12,13]

Results

Current randomized controlled studies on *t'ai chi* and chronic inflammation are summarized in Table 1.[1–6,8–11] Among these 9 studies, 3 were conducted in middle-aged or older cancer survivors,[3,4,6,9] 4 studies were conducted in other subgroups of older adults (healthy older adults, and older adults with insomnia, depression, or mild cognitive impairment),[2,5,8,11] 1 study was conducted in HIV-infected adults,[1] and 1 study was conducted in women with elevated cardiovascular disease risk.[10] All studies, except for 1,[10] included an active control group that received health education, cognitive behavioral therapy, or other interventions. The terms ranged from 3 weeks to 6 months, and the doses varied as the duration ranged from 1 to 2 h and the frequency ranged from one time per week to three times per week.

Findings from these studies do not strongly support that short- to medium-term *t'ai chi* could reduce chronic inflammation in these special populations. Only one study indicated that compared with waitlist (nonactive) controls, 8 weeks of *t'ai chi* intervention lowered levels of proinflammatory cytokines in women with an elevated cardiovascular disease risk.[10] Three studies with active controls only showed a marginally significant effect of *t'ai chi* in lowering circulating levels of inflammatory markers and cytokines,[2,5,8] although the anti-inflammatory effect of *t'ai chi* was more significant at the cellular level as indicated by the decreased cytokine release levels by circulating mononuclear cells.[6,8] Six studies with active controls did not show a significant effect of *t'ai chi* on circulating levels of inflammatory markers and cytokines.[1,3,4,6,9,11]

Two quasiexperimental studies were conducted by the same research group.[12,13] Compared with noncontact controls, 6-month *t'ai chi* practice did not alter circulating levels of inflammatory markers in older adults with periodontal disease,[12] and only lowered levels of one, but not other proinflammatory cytokines in older adults with metabolic disease.[13] These findings are consistent with those from the randomized controlled studies.

Discussion

Current randomized controlled studies do not support a definite anti-inflammatory effect of *t'ai chi* in various special populations. The effectiveness of *t'ai chi* intervention is likely influenced by the baseline levels of inflammatory markers/cytokines, and the components, intensity, duration, and term of the *t'ai chi* program. Specifically, the forms/movements of

Department of Exercise and Health Sciences, College of Nursing and Health Sciences, University of Massachusetts Boston, Boston, MA.

TABLE 1. EFFECTS OF *T'AI CHI* ON CHRONIC INFLAMMATION: CURRENT RANDOMIZED CONTROLLED STUDIES

Study	*Research population*	*Intervention*	*Training procedure*	*Results*[a]
McCain et al.[1]	Adults with HIV infection (mean age = 42 years; 40% women)	*T'ai chi* (8-form, $n = 62$) vs. cognitive behavioral relaxation training ($n = 65$) vs. spiritual growth ($n = 68$) vs. waitlisted control ($n = 57$)	90 min/time, 1 time/week, 10 weeks	*T'ai chi* vs. all Mononuclear cell fraction = TNF-α, -γ = IL-2,-4,-6,-10
Lavretsky et al.[2]	Older adults with major depression (mean age = 71 years; 62% women)	*T'ai chi* Chih (the stone forms) + esCIT ($n = 36$) vs. health education control + esCIT ($n = 37$)	2 h/time, 1 time/week, 10 weeks	*T'ai chi* vs. control ↓ CRP ($p = 0.10$) *T'ai chi* (pre vs. post) ↓ CRP ($p = 0.05$)[b]
Janelsins et al.[3] and Sprod et al.[4]	Breast cancer survivors (mean age = 53 years, 100% women)	*T'ai chi* Chuan (15-form, $n = 9$) vs. psychosocial therapy ($n = 10$)	60 min/time, 3 times/week, 12 weeks	*T'ai chi* vs. control = IL-2, -6, -8 = IFN-γ
Irwin and Olmstead[5]	Healthy older adults (mean age = 70 years; 82% women)	*T'ai chi* Chih (the stone forms, $n = 46$) vs. health education control ($n = 37$)	40 min/time, 3 times/week, 16 weeks	*T'ai chi* vs. control ↓ IL-6 ($p = 0.06$) = IL-18 = CRP = sIL-1RA = sIL-6R ↓ sICAM ($p = 0.10$)
Irwin et al.[6]	Breast cancer survivors with insomnia (mean age = 60 years; 100% women)	*T'ai chi* Chih (the stone forms, $n = 45$) vs. cognitive behavior therapy ($n = 45$)	2 h/time, 1 time/week, 3 months	*T'ai chi* vs. cognitive behavior therapy Systemic inflammation = CRP Cellular inflammation ↓ % monocytes producing IL-6 ($p = 0.07$) ↓ % monocytes producing TNF ($p < 0.05$) ↓ % monocytes coproducing TNF and IL-6 ($p < 0.02$)
Irwin et al.[8]	Older adults with insomnia (mean age = 65 years; 72% women)	*T'ai chi* Chih (the stone forms, $n = 40$) vs. cognitive behavior therapy ($n = 50$) vs. sleep seminar education control ($n = 25$)	2 h/time, 1 time/week, 4 months	*T'ai chi* vs. control Systemic inflammation ↓ CRP ($n = 0.06$) *T'ai chi* vs. all Cellular inflammation ↓ % monocytes producing IL-6 ($p < 0.01$) ↓ % monocytes producing TNF ($p < 0.01$) ↓ % monocytes coproducing TNF and IL-6 ($p < 0.01$) at different time points
Campo et al.[9]	Senior female cancer survivors (mean age = 67 years; 100% women)	*T'ai chi* Chih (19 movements, $n = 29$) vs. health education control ($n = 25$)	60 min/time, 3 times/week, 12 weeks	*T'ai chi* vs. control = IL-4, -6, -10, -12 = TNF-α
Robins et al.[10]	Women at increased risk for cardiovascular disease	*T'ai chi* (short form, $n = 31$) vs. waitlisted control ($n = 32$)	60 min/time, 1 time/week, 8 weeks	*T'ai chi* vs. control 2 months postintervention ↓ IFN-γ ($p = 0.002$) ↓ TNF-α ($p = 0.002$) ↓ IL-8 ($p = 0.026$) ↓ IL-4 ($p = 0.001$) ↓ GCSF ($p = 0.087$)
Sungkarat et al.[11]	Older adults with mild cognitive impairment (mean age = 68 years; 86% women)	*T'ai chi* (10-form, $n = 29$) in-class and at home video vs. educational control, in-class presentations, and discussion and at home educational booklet and phone call ($n = 27$)	*T'ai chi* In-class 3 times/week, 3 weeks *At home (video)* 50 min/time, 3 times/week, 6 months Control *In-class* 1 h/time *At home* 1 time/week, 6 months	*T'ai chi* vs. control = TNF-α = IL-10

[a]Significant and marginal differences.
[b]Both groups received escitalopram (esCIT) 4 weeks before and during intervention.
CRP, C-reactive protein; GCSF, granulocyte colony stimulating factor; IFN, interferon; IL, interleukin; sICAM, soluble intercellular adhesion molecule; sIL-1RA, secretary interleukin-1 receptor agonist; sIL-6R, soluble IL-6 receptor; TNF, tumor necrosis factor.

the *t'ai chi* program varied, so it is difficult to evaluate the ''doses'' of the cognitive inputs and physical movements of these *t'ai chi* programs. Also, most *t'ai chi* programs were designed to last for <6 months, and it is unlikely to see changes in inflammatory markers over a relatively short-term lifestyle intervention. Future longer-term intervention studies are needed to identify a definite effect of *t'ai chi* on systemic and cellular levels of inflammation, and its role in the prevention and treatment of clinical diseases and conditions.

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Author Disclosure Statement

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Address correspondence to:
Tongjian You, PhD
Department of Exercise and Health Sciences
College of Nursing and Health Sciences
University of Massachusetts Boston
Boston, MA 02125

E-mail: tongjian.you@umb.edu