ORIGINAL ARTICLE

The efficacy of selected *tai chi* movements and hand exercise for people with rheumatoid arthritis

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

Jie Du [1,2ABCDE], **Chao Liang** [3BCE], **Caixia Guo** [4ACD]

[1] School of Physical Education, Shanxi University, Taiyuan, China
[2] Institute of Biomedicine and Health, Shanxi University, Taiyuan, China
[3] School of Health Sciences, Wuhan Sports University, Wuhan, China
[4] School of Life Science, Shanxi University, Taiyuan, China

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Abstract

Background and Study Aim: Rheumatoid arthritis (RA) has been known to a chronic, inflammatory and systemic disease which causes chronic pain and long-term disability to their sufferers. Tai chi has beneficial health effects on patients with RA, but the effects are limited. Sometimes, a complete set of tai chi exercises is too difficult to perform. Choosing suitable movements to improve compliance and relieve disease conditions is needed. Meanwhile, hand exercise shows positive effects on hand joint protection as part of self-management. The aim of the research is to answer the question: whether selected tai chi movements in alliance with hand exercise is effective on joint pain, disease activity, quality of life, depression and anxiety in people with RA.

Material and Methods: Twenty people with RA were participated in the research. They were divided into experimental and control groups of 10 persons each. Participants in experimental group engaged in a special 12-week training program with selected tai chi movements and hand exercise. All participants were assessed at baseline and at 12 weeks for disease activity. This activity was evaluated by the Disease Activity Score in 28 joints (DAS28), which was calculated from morning stiffness (MS); tender joint count (TJC), swollen joint count (SJC), serum rheumatoid factor (RF), C-reactive protein (CRP) erythrocyte sedimentation rate (ESR), and global health assessment.

Results: After 12 weeks of selected tai chi movements and hand exercise, DAS28, TJC, MS, ESR, CRP, and indicators of the Health Assessment Questionnaire (HAQ), the Self-Rating Depression Scale (SDS) and the Self-Rating Anxiety Scale (SAS) in the experimental group exhibited significant improvement compared to the control group ($p<0.05$). DAS28 was strongly positively correlated with TJC ($r = 0.890$, $p = 0.000$), SJC ($r = 0.784$, $p = 0.000$) and CRP ($r = 0.802$, $p=0.000$). CRP had a positive correlation with TJC ($r = 0.683$, $p = 0.001$) and SJC ($r = 0.463$, $p = 0.04$). Additionally, there was a strong positive correlation ($r = 0.608$, $p = 0.004$) between the RF and ESR. We also observed that there was a significant positive correlation between changes in DAS 28 and HAQ ($r = 0.491$, $p = 0.028$), SAS ($r = 0.805$, $p = 0.000$) and SDS ($r = 0.651$, $p = 0.003$).

Conclusions: The selected tai chi movements and hand exercise is an effective treatment for RA that improves joint pain, disease activity, quality of life, depression and anxiety.

Keywords: anxiety • depression • disease activity • hand exercise • quality of life

Conflict of interest: Authors have declared that no competing interest exists

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Tutorial Video: https://archbudo.journalstube.com/page/display/id/2027/tai-chi-movements-hand-exercise

Author's address: Jie Du, School of Physical Education, Shanxi University, Wucheng Street No. 92, Taiyuan, China; e-mail: sdwushu@sxu.edu.cn

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic and systemic autoimmune disease that affects the multiple joints including should, knee hip and hand. The common symptoms of RA are joint inflammation, pain and fatigue that lead to detrimental effects on the functional ability and quality of life for RA patients [1, 2]. It affects approximately 1% of the general population worldwide and has become a key public health problem. The disease adversely affects in several ways: pain, functional disability, inconvenience of life, poor quality of life, etc. The better management of RA includes maintenance of physical function, control of disease activity and improvement of quality life [3]. It has been proposed that physical activity is a good way to reduce the risk of RA disease, and no harmful side effect from physical activity was observed [4, 5]. Aerobic and resistant exercise are currently recommended as the routine management of patients with RA [6]. However, many patients have difficulties to undertake these exhaustive exercise programs, because of pain and deformities. Therefore, new approaches are needed that patients can embrace to reduce disease activity and improve their quality of life.

Tai chi is a type of traditional Chinese physical exercise, which has practiced for many centuries in China for body and mind fitness [7]. It is a low intensity exercise consisted with a series of relaxation, meditation, deep breathing and slow, continuous movements, and equal to mild athletic exercise or walking at the speed of 6 km/h [8]. Numbers of researches have provided growing evidence that Tai chi has beneficial health effects on patients with RA [9, 10]. However, it was difficult for all RA patients to practice a set of Tai chi movements. Generally speaking, Tai chi movements can be practiced individually or in groups, and the therapeutic effects are also different. For patients with RA, choosing simple, easy to learn and suitable movements to improve compliance and relieve disease conditions is needed. Besides, 90% of RA patients, joints of the hand are affected resulting in problems performing activities of daily living [11]. Effective use of the hand requires anatomical integrity, sensation, mobility, muscle strength and the lack of pain [12]. The effect of Tai chi on the improvement of hand functions has not been reported. Some researchers reported that hand strengthening and stretching exercise at home were found to be beneficial effect for RA patients to relieve hand problems as part of self-management [13]. Hence, it is hypothesized that addition of hand exercise may improve the outcome of patients with RA, through enhancement of hand function.

The aim of the research is to answer the question: whether selected *tai chi* movements in alliance with hand exercise is effective on joint pain, disease activity, quality of life, depression and anxiety in people with RA.

Tai chi – *noun* a type of traditional Chinese physical exercise, which is a low intensity exercise consisted with a series of relaxation, meditation, deep breathing and slow, continuous movements [5].

Hand exercise – *noun* a kind of exercise for fingers, palms, wrists and joints.

Rheumatoid arthritis (RA) – *noun* a chronic autoimmune inflammatory disease, typically presenting as symmetrical polyarthritis of proximal small and other synovial joints [2].

Disease Activity – *noun* refers to the state of the disease (remission/low activity/moderate activity/high activity), which usually evaluated by the degree of joint swelling and pain, ESR and C-reactive protein levels, imaging data, and the patient's joint functional status [2].

Quality of life – *noun* refers to the state assessment of the individual's physical, psychological and social functions [8].

MATERIAL AND METHODS

Subjects

The subjects were recruited from the rheumatology of Shanxi Traditional Chinese Medicine Hospital and Shanxi Provincial People`s Hospital (China). Inclusion criteria were: 1) age between 30-65 years; 2) a diagnosis of RA using the American College of Rheumatology (ACR)/European League Against Rheumatism (EULAR) 2010 classification criteria [14]; 3) low-to-moderate Disease Activity Score in 28 joints (2.6<DAS28<5.1); 4) stable medical treatment (no alternative medical treatments during study period); 5) no participation in structured exercise for the preceding 3 months. The subjects with heart or kidney disease and other preexisting medical conditions that might prevent participation in the exercise program, were excluded from the study. All participants were asked to maintain their usual diet.

The study was carried out from January to December 2019 and approved by the research

ethics committee of Shanxi University (No. SXULL2019061). All subjects signed a written, informed consent before participation in the study.

Study Design

Twenty subjects entered in a 12-week program and were randomly assigned in a 1:1 ratio using a computer-generated blocked randomization to either experimental group (n = 10) or control group (n = 10). Professional coaches, outcome assessors, and study assistants were blinded to the treatment assignments throughout the duration of the study.

The intervention of exercise group consisted of *tai chi* session and hand exercise, which was customized for RA patients according to disease symptoms. The *tai chi* session included 10 minutes of warm-up exercise, 20 minutes of *tai chi* walking, and 20 minutes of *tai chi* motions. Warm-up exercises included breathing, centering, shifting and swing of arm, wrists, neck, legs, shoulders, hips, spine, waist and knees. The *tai chi* walking focus on releasing tension in the physical body, incorporating mindfulness and imagery into movement, increasing awareness of breathing, and promoting overall relaxation of body and mind. Three movements extracted from the 24 simple forms of *tai chi* were selected as the main motions, including "wave hands like clouds", "part the wild horse`s mane" and "withdraw and push". After *tai chi* session, the subjects were asked to participate in a hand exercise. A short stick with six ridges, which is made of wood from mountain Wutai (Shanxi, China), was used in this study to perform the hand exercise including 10 minutes of twisting and 10 minutes of revolving around the fingers (Figure 1).

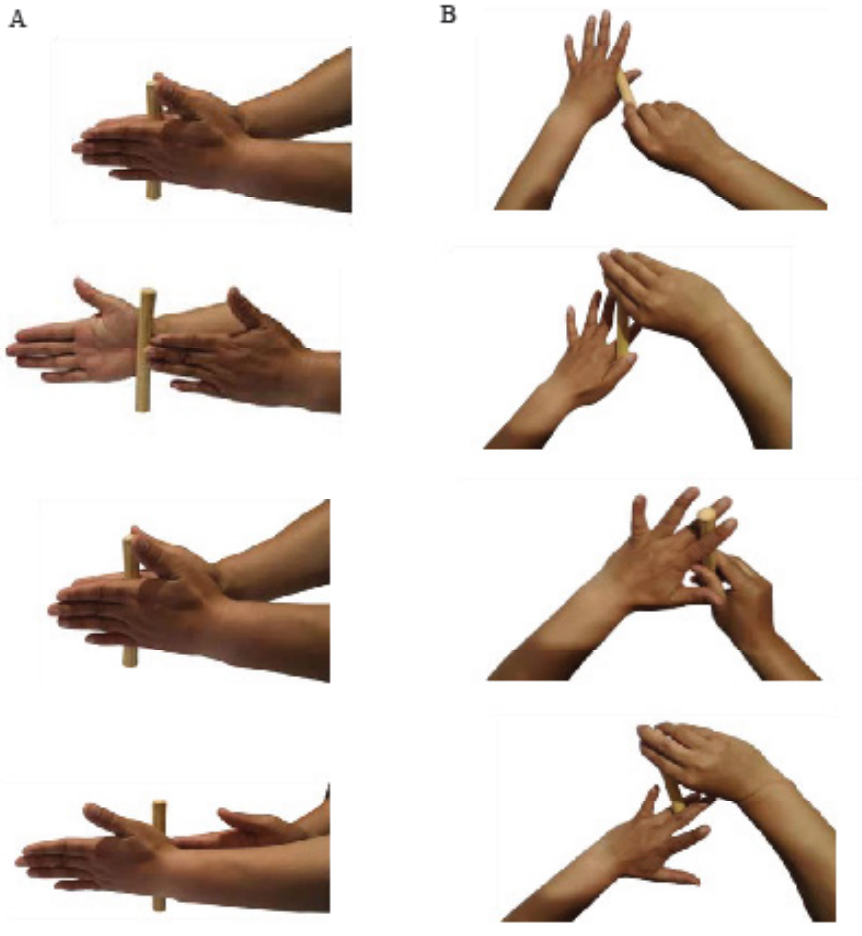

Figure 1. Hand exercise including 10 minutes of twisting (A) and 10 minutes of revolving around the fingers (B).

Before the intervention, a professional *tai chi* instructor introduced the whole program consisting of *tai chi* principles, demonstration of Tai chi movements and hand exercise, and description of class format. The professional *tai chi* instructor taught the *tai chi* movements and hand exercise step by step and repeatedly, until the participants felt comfortable enough to perform them correctly. Chinese traditional folk music was accompanied to help participants move gracefully. During the intervention period, one session was held in class with a professional *tai chi* instructor weekly, and the participants were instructed to continue the exercise at home every day. The class attendance and the frequency and duration of home *tai chi* practice were monitored by daily WeChat log. Participants assigned to control group maintained their original life.

Outcome measurements

Demographic information was collected by using a self-completed patient questionnaire, included age, gender, disease history, physical activity, education, etc. All outcome measures were assessed at baseline and the end of intervention. Morning stiffness (MS), tender joint count (TJC) and swollen joint count (SJC) for RA subjects were analyzed by a rheumatoid clinician, and a visual analogue scale score for global health was completed. Laboratory data to identify characteristics of RA were examined. The levels of serum rheumatoid factor (RF) and C-reactive protein (CRP) were determined by latex particle enhanced immuneturbidimetric assay. The level of erythrocyte sedimentation rate (ESR) in blood sample was examined using an ESR processor (BD Sedi-15, Becton, Dickinson and Company). The disease activity was evaluated by the Disease Activity Score in 28 joints (DAS28), which was calculated from TJC, SJC, CRP and global health assessment.

The Health Assessment Questionnaire (HAQ) was used to assess physical functional disabilities, including eight aspects (dressing, grooming, eating, arising, hygiene, walking, griping, reaching and activities) with a score from 0 to 3. Higher scores of HAQ indicate worsening physical function [15]. The Self-Rating Depression Scale (SDS) and the Self-Rating Anxiety Scale (SAS) were used to assess depression and anxiety. Both SDS and

Table1. Baseline characteristics of the study subjects (mean and standard deviation).

Variable	Control group (n = 10)	Experimental group (n = 10)	*p* value
Sex, female (%)	80%	80%	--
Age (years)	52.40 ±3.35	43.80 ±3.57	0.096
Weight (kg)	59.00 ±1.87	58.05 ±2.35	0.393
Height (cm)	160.90 ±1.39	164. 5±2.04	0.161
BMI (kg/m^2)	22.74 ±0.39	21.39 ±0.54	0.089
Disease duration (years)	3.50 ±0.91	3.00 ±0.86	0.436
SBP (mmHg)	126.74 ±1.89	126.94 ±0.69	0.922
DBP (mmHg)	78.86 ±1.05	79.57 ±0.71	0.578
MS (min)	9.50 ±1.38	7.50 ±1.53	0.393
TJC (0~28 joints)	7.60 ±0.40	7.00 ±0.80	0.631
SJC (0~28 joints)	5.80 ±0.36	4.00 ±0.67	0.063
DAS28	4.25 ±0.10	3.96 ±0.24	0.276
RF (IU/mL)	157.04 ±34.14	203.33 ±50.77	0.459
ESR (mm/h)	32.30 ±6.59	27.41 ±7.32	0.626
CRP (mg/L)	4.60 ±0.69	10.96 ±6.39	0.912
HAQ	1.18 ±0.07	0.90 ±0.09	0.028*
SDS	57.70 ±2.56	58.00 ±3.19	0.684
SAS	54.40 ±2.46	58.90 ±2.88	0.250

SBP systolic blood pressure; **DBP** diastolic blood pressure; * (p<0.05); ** (p<0.01)

SAS survey scales contain 20 items score respectively, and depression or anxiety could be divided into mild (scores 50–60), moderate (scores 61-70) and severe (scores >70) [16].

Statistical analysis

Descriptive statistics are presented as mean and standard deviation (SD or ±), and the normality of data distribution was explored by using Shapiro-Wilk test. We use the independent t-test or Mann-Whitney U test to compare the difference between two groups at baseline. The paired t-test or Wilcoxon signed-rank test was used to analyze the differences in each group before and after intervention, and the differences among groups after intervention were evaluated by using analysis of covariate (ANCOVA) adjusting for baseline levels of the dependent variables. All data analyses were processed using IBM SPSS software (version 23.0, IBM Corp., Armonk, NY, USA). The level of significance was set at $p<0.05$ (*) or $p<0.01$ (**).

RESULTS

All subjects with RA (n = 20) completed the 12 weeks exercise program with no adverse events. No significant differences were observed between the two groups, with the exception of HAQ level ($p = 0.028$) (Table 1).

Compared with the baseline, 12 weeks of selected *tai chi* movements and hand exercise exhibited significant decrease in DAS28 (3.96 ±0.24 *vs* 3.51 ±0.18, $p = 0.000$), TJC (7.00 ±0.80 *vs* 5.10 ±0.53, $p = 0.020$), MS (7.50 ±1.53 *vs* 5.20 ±1.26, $p = 0.011$), ESR (27.41 ±7.32 *vs* 14.80 ±3.99, $p = 0.005$) and CRP (10.96 ±6.39 *vs* 5.48 ±3.15, $p = 0.005$), while no significant changes of these indicators was shown in the control group. The ANCOVA analyses showed that those RA-related indicators in exercise group also presented significantly improvements compared with the control group after 12 weeks intervention (Table 2).

Table 2. Changes in RA-related indicators after 12 weeks of selected *tai chi* movements and hand exercise (mean and standard deviation).

Variable	Control group (n = 10)			Experimental group (n = 10)			Group difference after intervention (*p* value)
	Baseline	after 12 weeks	*p* value	Baseline	after 12 weeks	*p* value	
DAS28	4.25 ±0.10	4.22 ±0.11	0.452	3.96 ±0.24	3.51 ±0.18	**0.000****	**0.000****
TJC (0~28 joints)	7.60 ±0.40	7.40 ±0.40	0.577	7.00 ±0.80	5.10 ±0.53	**0.002****	**0.000****
SJC (0~28 joints)	5.80 ±0.36	5.70 ±0.47	0.785	4.00 ±0.67	3.60 ±0.58	0.168	0.225
MS (min)	9.50 ±1.38	8.40 ±1.01	0.129	7.50 ±1.53	5.20 ±1.26	**0.011***	**0.035***
RF (IU/mL)	157.04 ±34.14	119.72 ±22.51	0.114	203.33 ±50.77	181.02 ±44.75	0.099	0.795
ESR (mm/h)	32.30 ±6.59	34.80 ±6.14	0.389	27.41 ±7.32	14.80 ±3.99	**0.005****	**0.001****
CRP (mg/L)	4.60 ±0.69	5.21 ±0.94	0.234	10.96 ±6.39	5.48 ±3.15	**0.005****	**0.001****

* ($p<0.05$); ** ($p<0.01$)

Table 3. Changes in quality of life, depression and anxiety indicators after 12 weeks of selected *tai chi* movements and hand exercise (mean and standard deviation).

Variable	Control group (n = 10)			Experimental group (n = 10)			Group difference after intervention (*p* value)
	Baseline	after 12 weeks	*p* value	baseline	after 12 weeks	*p* value	
HAQ	1.18 ±0.07	1.26 ±0.12	0.307	0.90 ±0.09	0.69 ±0.07	**0.000****	**0.006****
SDS	57.70 ±2.56	60.70 ±2.09	0.175	58.00 ±3.19	50.60 ±2.71	**0.043***	**0.000****
SAS	54.40 ±2.46	59.40 ±2.66	0.015*	58.90 ±2.88	49.40 ±3.00	**0.001****	**0.000****

* ($p<0.05$); ** ($p<0.01$)The results of DAS28 was strongly positively correlated with TJC (r = 0.890, p = 0.000), SJC (r = 0.784, p = 0.000) and CRP (r = 0.802, p = 0.000). CRP had a positive correlation with TJC (r=0.683, p=0.001) and SJC (r = 0.463, p = 0.040). Additionally, there was a strong positive correlation (r = 0.608, p = 0.004) between the RF and ESR. We also observed that there was a significant positive correlation between changes in DAS 28 and HAQ (r = 0.491, p = 0.028), SAS (r = 0.805, p = 0.000) and SDS (r = 0.651, p = 0.003) (Figure 2).

Compared with the baseline, HAQ (0.90 ±0.09 *vs* 0.69±0.07, p = 0.000), SDS (58.00 ±3.19 *vs* 50.60 ±2.71, p = 0.043) and SAS (58.90 ±2.88 *vs* 49.40 ±3.00, p = 0.001) in exercise group were improved after 12 weeks of selected *tai chi* movements and hand exercise. At 12 weeks, it was obvious that HAQ, SDS and SAS scores were significant different between exercise group and control group (Table 3).

DISCUSSION

Recently, multiple studies reported that increase of physical activity was encouraged for patients with RA, and low-intensity exercise is recommended [17, 18]. Tai chi, as a Chinese martial art, is consisted with slow, gentle and graceful movements accompanying with deep breathing and relaxation [19]. Previous research reported that Tai chi was a safe program for RA [20, 9, 21]. In the present study, 12 weeks of selected Tai chi movements and hand exercise was performed to the subjects with RA, and a positive effect on arthritis-related symptoms and health quality was observed with no adverse effects.

For RA patients, the increase joint pain and disability associated with RA could have direct impact on the subjects` lives, such as disease status, quality of life, stress and anxiety [22]. In this study, improvements of morning stiffness (MS), tender joint count (TJC) and swollen joint count (SJC) among participants joined in experimental

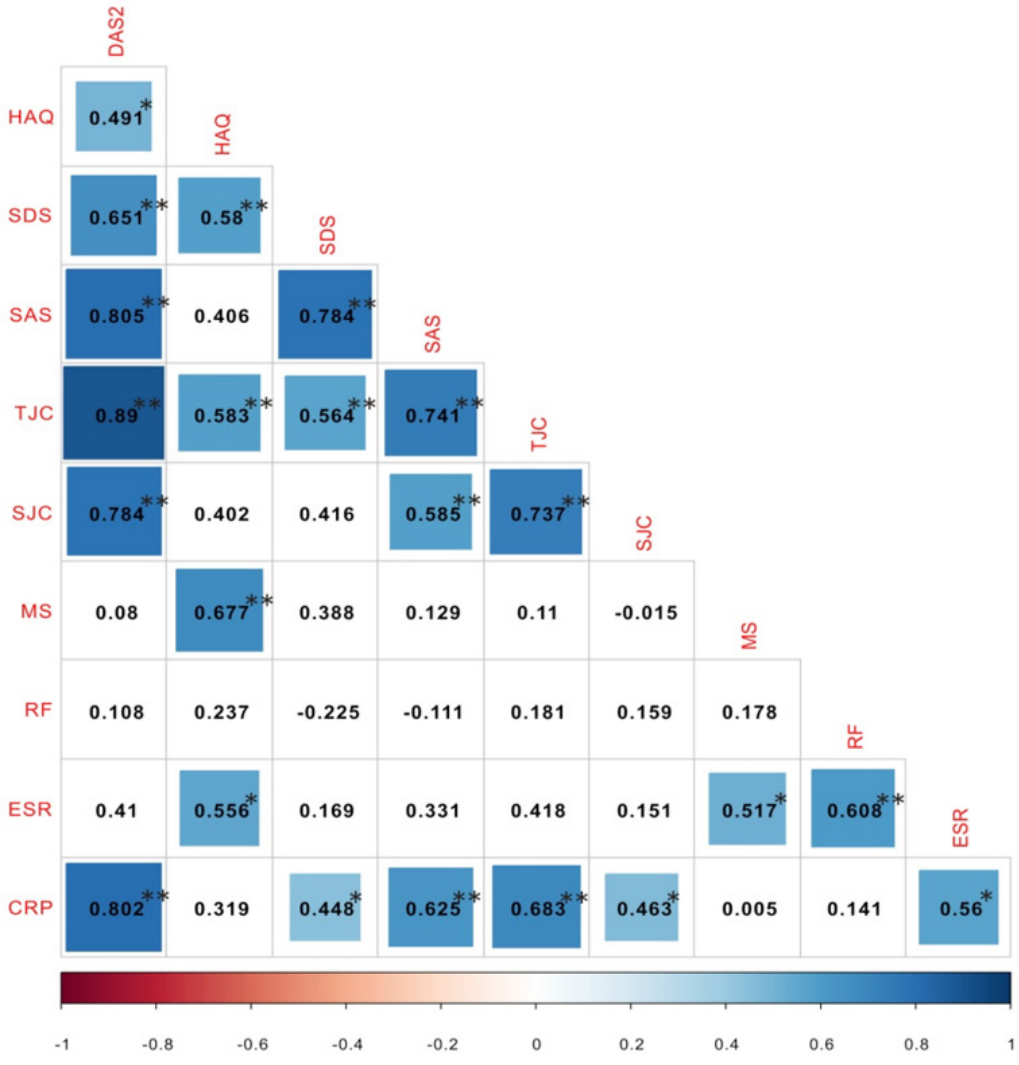

Figure 2. Correlation analysis between DAS28, HAQ, SDS, SAS and RA-related indicators.

group were observed. There are several factors that may explain the positive effects of *tai chi* and hand exercise on these symptoms of RA patients. First, the efficacy of *tai chi* training on relieving joint pain symptoms in patients with RA has been well demonstrated. In this study, we select suitable *tai chi* movements for RA patients, cooperating with hand exercises to enhance the improvement. And, the results verified the efficacy of this intervention on relieving RA-related symptoms. Second, some studies reported that *tai chi* movements could relieve the chronic pain by activating central nervous system [23]. That is to say, *tai chi* can give patients confidence to overcome their fear of pain, as well as improve their health quality and psychological discomfort. This is consistent with our study that the participants in the *tai chi* and hand exercise group showed significant improvements in quality of life (HAQ), depression (SDS) and anxiety (SAS).

We also observed that the improvements showed strong correlation with MS, TJC as well as SJC, suggesting pain symptoms of RA have been closely linked to health-related quality of life and mood disorders. Moreover, the significant changes (improvements) of biochemical indicators for RA patients, including serum rheumatoid factor (RF), C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), were also observed after 12 weeks interventions, and these serum indicators have been regarded as important risk factors for joint destruction for RA.

In this study, DAS28 is used to evaluate disease activity in patients, which is comprised of the number of tender and swollen joints, C-reactive protein. DAS28 score was reduced significantly in *tai chi* and hand exercise group, and the significant correlation between DAS28 and TJC as well as SJC was observed, suggesting the relief of joint pain symptoms was a potent signal for the improvement of diseases for RA patients by *tai chi* and hand exercise. In addition to demonstrating improvement relationship with joint pain symptoms, DAS28 in the *tai chi* and hand exercise group also showed significant correlation with quality of life (HAQ), depression (SDS) and anxiety (SAS). So, in our study, the selected *tai chi* movements and hand exercise can benefit two main categories of outcomes for RA patients: disease-related symptoms and systemic manifestations. The most direct effect of the *tai chi* and hand exercise is to relieve joint pain symptoms, thereby improving biochemical indicators for RA patients, and further reducing disease activity, quality of life, depression and anxiety.

The results of these studies are a clear proof not only that widely understood martial arts (*tai chi* in this work) when used in a competent manner can bring many benefits in relation to somatic and mental health. They are also proof that the separation of a new scientific sub-discipline – science of martial arts [24] – is a great achievement in fulfilling the social mission of science. This statement is underlined by the conclusion that a serious threat to public health is the promotion, especially on the Internet, of neo-gladiatorism disguised as Mix Martial Arts [25, 26].

CONCLUSIONS

The selected *tai chi* movements and hand exercise is an effective treatment for RA that improves joint pain, disease activity, quality of life, depression and anxiety. This area is worth exploring because it is low cost and has the potential of having widespread physical and psychological effects. However, the potential limitation of the study was relatively small sample size that might neglect other small effects on the results of the intervention benefits, and a further study are needed to demonstrate the generalizability of *tai chi* and hand exercise benefits on a larger population with RA.

HIGHLIGHTS

The selected *tai chi* movements and hand exercise is an effective treatment for RA. The selected *tai chi* movements and hand exercise relieves joint pain symptoms. The exercise in this study improves health quality and psychological discomfort. It is low cost and easy to practice.

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