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The Effect of Short Term Yoga and Tai-Chi Education Exercise on Antioxidant Capacity and Oxidative Stress Measures

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ABSTRACT This study aims to evaluate the effect of two exercise approaches, Yoga and Tai-Chi educational exercises, on antioxidant capacity and oxidative stress measures. For this study thirty-six female ages 18 to 20 were recruited from university and were randomly assigned to three groups: two experimental groups (Yoga and Tai-Chi groups) and one control group. Experimental groups practiced Yoga and Tai-Chi 3 times per week for 10 weeks. Each session included 10 min of warm-up, 40 min of Yoga or Tai-Chi practice, and 10 min of cool-down. Antioxidant capacity and oxidative stress measures were evaluated before and at the end of this study. Antioxidant capacity includes superoxide dismutase (SOD) and glutathione peroxidase (GSHPx). Oxidative stress measures include creative kinase (CK), lactate dehydrogenase (LDH) and malondialdehyde (MDA). The results show that Tai-Chi and Yoga educational exercise have significant influence on most of antioxidant capacity and oxidative stress measures. The Tai-Chi group showed 11.2 % decrease in LDH ($P< 0.01$), 15.4 % decreases in MDA ($P < 0.05$), as well as 4.8 % decrease in SOD ($P < 0.05$) and 7.5 % decrease in GSHPx ($P < 0.05$). The Yoga group showed 9.5 % decrease in LDH ($P< 0.01$). The control group showed no significant change in these variables. The results indicate that a 10-week Tai-Chi and Yoga educational training program have a positive influence on antioxidant capacity and oxidative stress measures and is effective for improving health fitness for females.

INTRODUCTION

Increasing production of ROS has been shown to induce damage in macromolecule, such as lipids, proteins and DNA where oxidative stress can occur (Packer 1997; Deaton 2003; Tauler et al. 2006). Regular physical moderate exercise has been demonstrated to reduce the incidence of diseases (Deaton 2003). The generation of reactive oxygen species (ROS) during regular physical exercise might be a trigger of adaptation in antioxidant capacity to prevent extensive cellular. Malondialdehyde (MDA), a by-product of lipid peroxide, is the most frequently studied marker of oxidative tissue damage during exercise. Studies have shown that regular exercise will improve health by boosting the immune system (Rook 2013; Sloan et al. 2013). Therefore, this decreases the body's tendency to be fatigued. Throughout the last century, because of the development of Western medicine, a person's realization of physicians who were incapable to curing diseases successfully became inclined to rely on conventional medicine to cure them when they became ill instead of taking responsibility for their personal health (Galantino 2003). However, the human body has self-healing ability, and there is power to keep health to be constant. For instance, physical activity has been shown to reduce atherosclerotic risk factors by improving blood lipid profile, insulin resistance and glucose intolerance, and psychosocial well-being; reducing stress, blood pressure, and mortality; and aiding weight loss (Taylor-Piliae et al. 2004: 8–11) and mental health problems such as depression, anxiety and insomnia are amongst the most common reasons for individuals to seek treatment with complementary therapies (Pilkington et al. 2005; Latner et al. 2013). Although a separation is common in Western medicine, other systems of medicine such as Traditional Chinese Medicine have maintained the interconnection of mind and body as central to the practice of successful healthcare (Luskin 2000; Wu et al. 2013). Traditionally non-Western physical activity such as Yoga and Tai-Chi therapies are beginning to receive increased research attention (Luskin 2000; Cowen 2005; Zhang 2006) and make healing available to the world population with a surprising degree of sophistication (Galantino 2003; Abbott and Lavretsky 2013). Though many types of physical activities exist,

Tai-Chi, and Yoga are widely practiced (Galantino 2003; Hong et al. 2005; Taylor-Piliae et al. 2006; Cheng 2007; Smith et al. 2007). Tai-Chi and Yoga practices share physical movements, specific breathing exercises, a directed focus of attention, and meditation and visualization practice (Luskin 2000). The two activities are not only a physical activity, but also one that involves the training of mental control (Kutner et al. 1997), mind-body relaxation exercise and self-defense (Koh 1981; Chen 1999; Pilkington et al. 2005; Hong 2005; Cheng 2006; Lee et al. 2007). Although it has little movement of the body and no extensive exercise, it leads to health benefits with all of our joints used. Therefore, to avoid sport injuries by doing entertainment sports, most people choose Tai-Chi or Yoga as options.

In China, Tai-Chi that has been practiced for many centuries (Wang et al. 2004) as a popular activity adopted by Chinese adults (Hong 2005; Hui et al. 2006). Tai-Chi is a form of ancient Chinese martial art with slow and graceful movements. It is not only a physical activity, but also one that involves the training of mental control (Kutner et al. 1997) and a mind-body relaxation exercise combination of Chinese philosophy, meditation and self-defense (Koh 1981; Chen 1999; Hong 2005; Cheng 2006; Lee et al. 2007). In addition, Tai-Chi can be practiced at any time, in any place and low cost because it needs neither much space nor any equipment (Ruth et al. 2004; Hong 2005; Taylor-Piliae et al. 2006; Cheng 2007).

Tai-Chi is Moderate Exercise Similar to Yoga

Although it has little movement of the body and no extensive exercise, it leads to health benefits since all of our joints are used. Therefore, to avoid sport injuries by doing entertainment sports, most people choose Tai-Chi or Yoga as options. Moderate exercise can result in greater health benefits than vigorous exercise (Masuda et al. 2002). Recently, public-health recommendations have emphasized the value of moderate exercise for improving cardiovascular health and reducing the risk of coronary heart disease (Swain and Franklin 2006). However, Yoga is an increasingly popular therapy. Yoga is used to maintain wellness and assist with the management of a range of health complaints (Smith et al. 2007; Carson et al. 2007), while Tai-Chi appears to be effective in promoting balance and flexibility, enhancing cardiovascular function, and reducing mental conditions such as depression and anxiety (Chen and Snyder 1999; Chou et al. 2004; Wang et al. 2004; Taylor-Piliae et al. 2006; Cheng 2007).Yoga can produce an animate effect on psychological and physical energy (Carson et al. 2007). It is able to remove the habit of unhealthy nutrition and to establish homeostatic balance (Singh 2006).

The benefits of regular moderate exercise on the well-being and the immune system are well known. However, these benefits are lost with exhaustion and lack of training. It has been reported that exhaustive exercise induces oxidative stress, which occurs when oxidant production overwhelms the antioxidant capacity (Tauler et al. 2006; Dennis et al. 2013). Moderate exercise significantly decreased the aging-associated development of oxidative stress by preventing but after high-intensity exercise will increase of oxidative stress (Badano et al. 1973; Bailey et al. 2003; Navarro et al. 2004; Bogdanis et al. 2013). Yoga and Tai-Chi has been defined as an exercise of moderate intensity (Lord et al. 1991; Rai et al. 1994; DiCarlo et al. 1995; Wang et al. 2004). In the study by Subudhi et al. (2003) subjects were classified as trained and untrained, it points out that aerobic power values of trained subjects were significantly higher than those of untrained subjects. Exercise training not only induces activities of antioxidant enzymes, but also affects the antioxidative capacity of the vascular wall protection (Kojda and Hambrecht 2005).

Some antioxidant system in the human body is for protecting our cells from harm by oxidization or free radical. The main components of the system are small molecules of antioxidant substances such as vitamin C, E and some kinds of enzymes such as superoxide dismutase (SOD) or glutathione peroxidase (GSHPx). These enzymes play an important role in preventing exterior oxidizations (Chung et al. 1999).

Another set of theories suggests that exercise induces oxidative stress, which occurs when oxidant production overwhelms the antioxidant capability (Tauler et al. 2006). This is different to the previous researches. Free radical has been confirmed by the medical profession that it will cause the oxidation of human cells injury, aging, cancer and cardiovascular disease. Course of the campaign, in addition to several times the muscle

will increase oxygen consumption, it would also lead to the formation of free radicals brought oxidative stress (Aruoma 1994). Malondialdehyde (MDA), a by-product of lipid peroxide, is the most frequently studied marker of oxidative tissue damage during exercise. MDA levels have been found to increase both in different tissues and plasma during exercise.

Sen et al. (1994) emphasized the largest of the non-campaign after 30 minutes, MDA in the blood significantly increased after exercise with oxidative stress. Child et al. (1998) collected 17 marathon athletes with half of the marathon distance movement and found that MDA indicators CK increased significantly which the main component cause sport injures. Chang et al.'s (2000) study found that, compared with women in general, weightlifter in Glutathione Peroxidase (GSHPx) was lower, and MDA, Creatine kinase (CK**)** was higher, by training five hours a day six days a week, Superoxide Dismutase (SOD) decline and CK activity increased. After two weeks training, CK and MDA both increased significantly. By the other way, serum CK and Lactic dehydrogenase (LDH) (were used as an indirect index of exercise-induced muscle damage (Morillas-Ruiz et al. 2006). Generally speaking, the researchers found substances such as SOD and GSHPx could use to measure antioxidative capability and in the other hand, CK, LDH and MDA in the opposite way to represent antioxiative stress.

This aim of the present study was to determine the effect of antioxidative capability and the occurrence of oxidative stress after the Yoga and Tai-Chi training. And antioxidant capacity is measured by SOD and GSHPx. Simultaneously, oxidative stress is measured by CK, LDH and MDA (Terblanche et al. 1998; Satoh et al. 2004; Hoelzl et al. 2005). This study then compares which is good at enhancing antioxidative capability between Yoga and Tai-Chi.

METHODS

Participants

Participants in the present study included 36 voluntary undergraduate female students (Tai-Chi group, n=12; Yoga group, n=12; control group with no training, n=12). Table 1 summarizes the baseline characteristics of the subjects in each group. With the means and standard deviations about age, height, and weight for pre-training, there were not significant differences between three groups on age (mean max=18.83, min=18.75), height (mean max=160.58, min=159.58) and weight (mean max=51.75, min=50.33). No participants had previous experience with any exercise training.

Exercise Training

There were two different exercise training groups and a control group without any training. In group 1, the Tai-Chi program was a 13-movement styles (Opening form, Crane spreads its wings, Strum the lute, Step back to repulse monkey, Single whip, Wave hands like clouds to both sides, Single whip, High pat on horse, Right heel kick to the corner, Double wind goes through the ears, Turn to kick with the left heel, Cross hands, Close form) taught by an experienced instructor, one-to-two movements were taught each week for 10 weeks (40 minutes each time, three times a week). At the same period, participants with Yoga program taught by an experienced instructor with 9 styles *(Savasana, Surya-Namaskara, Majariasana, Ustrasana, Padmasana, Mudra, Natarajasana, Utthita Parsva-konasana, Utthita Hasta Padangus-thasana).* In group 3, participants were control group without any training.

Procedure

Thirty-six undergraduate female students volunteered to participate in the study. They were

Table 1: Descriptive statistics of three groups

Group	*Age* *Mean (SD)*	*P value*	*Height* *Mean (SD)*	*P value*	*Weight* *Mean (SD)*	*P value*
Tai-Chi group	18.75(0.62)	0.914	159.88(5.58)	0.908	51.75(5.45)	0.806
Yoga group	18.83(0.39)		159.58(4.83)		50.33(4.91)	
Control group	18.75(0.62)		160.58(6.60)		51.00(5.44)	
Total	18.78(0.54)		160.01(5.57)		51.03(5.15)	

* The mean difference is significant at the 0.05 level.

assigned randomly to one of three groups: a Tai-Chi group, a Yoga group and one control group. Tai-Chi and Yoga groups were training at same time and different places to process the experiment. In phase 1, the objective and procedure of the experiment were clearly described to participants. In phase 2, before the experiment, each participant was required to sign consent and take a check list about the health situation. This study excludes those participants who were hurt, getting hurt, having muscle or skeleton disease, or not fit for this experiment. The participants' blood biochemical data was also collected before experiment. The data were compared with pretest and posttest. In Phase 4, the two experimental groups received a regular schedule on Yoga and Tai-Chi training for ten weeks. Fasting blood samples were collected after the 10-week training program for measurements of plasmatic indices of antioxidant capacity (SOD and GSHPx) and oxidative stress (CK, LDH and MDA).

Statistical Analysis

Statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS 10 for Windows). Results are expressed as means, SD (standard deviation), t-test, ANOVA and post-hoc Scheffe test, and P <0.05 was considered statistically significant. All the data was tested for their F distribution. Student's t-test for paired data was used to determine the significance of the data.

RESULTS

There is no statistically significant difference among three groups in the pretest. All of the measured five markers show no statistical significant difference among three groups (Table 2). Two measured markers, LDH and MDA, are both significantly different (LDH: F=9.16, P=0.001<0.05; MDA: F=4.72, P=0.016<0.05) (Table 3). In LDH marker, posted test shows that the LDH value in both Tai-Chi and Yoga group are significantly lower than that in control group (Table 4). But in MDA marker, Yoga group's LDH value is significantly higher than the control group, as well as the Tai-Chi group (Table 5). Table 6 shows paired t-test comparisons between pretest and posttest for each of the five markers in Tai-Chi group. The marker, CK, is not significantly different between pretest and posttest, whereas all others are significant (LDHpre-LDHpost, t_{11}=7.81, P=0.000<0.05; MDApre-MDApost, t_{11}=2.45, P=0.032<0.05; SODpre-SODpost, t_{11} = -2.56, P=0.026<0.05; and GSHPx pre- GSHPx post, t_{11}=-2.29, P=0.043<0.05). Similarly, the results of the pair wise t-tests for Yoga group are given in Table 7. It can be found a significant difference between pretest and posttest on LDH (LDHpre-LDHpost, t_{11}=3.64, P=0.004<0.05).

For the control group, the paired t-test comparisons show no statistically significant differences between pretest and posttest on all markers (Table 8).

Table 2: ANOVA of pretest (three groups)

Item	*F-value*	*P-value*
CK	0.02	0.984
LDH	0.11	0.894
MDA	0.32	0.728
SOD	0.17	0.847
GSHPx	0.05	0.953

* The mean difference is significant at the 0.05 level

Table 3: ANOVA of posttest (three groups)

Item	*F-value*	*P-value*
CK	1.71	0.196
LDH	9.16	0.001*
MDA	4.72	0.016*
SOD	1.12	0.338
GSHPx	0.65	0.530

* The mean difference is significant at the 0.05

Table 4: Post Hoc of LDH

Groups	*alpha = .05*	
	1	*2*
Tai-Chi(n=12)	386.25	
Yoga(n=12)	397.58	
Control(n=12)		457.33

Table 5: Post Hoc of MDA

Groups	*alpha = .05*	
	1	*2*
Tai-Chi (n=12)	0.33	
Control (n=12)	0.41	0.41
Yoga (n=12)		0.43

Table 6: Pair t-test of Tai-Chi group

		Mean		SD	t-value	P-value
		Pretest	Posttest			
Couple 1	CK-pre-CK-post	82.83	70.83	24.68	1.69	0.120
Couple 2	LDH-pre-LDH-post	434.75	386.25	21.52	7.81	0.000*
Couple 3	MDA-pre-MDA-post	0.39	0.33	0.07	2.45	0.032*
Couple 4	SOD-pre-SOD-post	1525.00	1598.67	99.62	-2.56	0.026*
Couple 5	GSHPx -pre- GSHPx -post	65.18	70.09	7.45	-2.29	0.043*

* The mean difference is significant at the 0.05 level.

Table 7: Pair t-test of Yoga group

		Mean		SD	t-value	P-value
		Pretest	Posttest			
Couple 1	CK-pre-CK-post	83.50	78.42	26.95	0.65	0.527
Couple 2	LDH-pre-LDH-post	439.08	397.58	39.50	3.64	0.004*
Couple 3	MDA-pre-MDA-post	0.36	0.43	0.10	-2.16	0.054
Couple 4	SOD-pre-SOD-post	1504.00	1447.67	107.77	1.81	0.098
Couple 5	GSHPx -pre- GSHPx -post	66.73	59.13	34.53	0.76	0.462

* The mean difference is significant at the 0.05 level.

Table 8: Pair t-test of control group

		Mean		SD	t-value	P-value
		Pretest	Posttest			
Couple 1	CK-pre-CK-post	84.96	88.30	15.02	-0.81	0.437
Couple 2	LDH-pre-LDH-post	446.08	457.33	62.79	-0.62	0.547
Couple 3	MDA-pre-MDA-post	0.39	0.41	0.08	-0.74	0.475
Couple 4	SOD-pre-SOD-post	1565.67	1554.00	385.39	0.11	0.918
Couple 5	GSHPx -pre- GSHPx -post	63.72	61.63	43.07	0.17	0.870

* The mean difference is significant at the 0.05 level.

DISCUSSION

The study shows that a form of Tai-Chi can have significant effect and Yoga can have partial effect on antioxidative capability and oxidative stress in females. It was found that the blood levels of LDH and MDA value decreased significantly ($p<0.05$), while SOD and GSHPx value increased significantly ($p<0.05$) for the Tai-Chi group at the end of training, as compared to the onset. It was also noted that LDH value decreased significantly ($p<0.05$), while the other indexes remained unchanged ($p>0.05$) during the course of study for the Yoga group. The results demonstrated that Tai-Chi will enhance antioxidative capability and may well reduce oxidative stress in the undergraduate female students. Yoga also may reduce oxidative stress in the undergraduate female students.

This is one of the strongest contributions of Tai-Chi to enhance antioxidative capability and to reduce oxidative stress. Tai-Chi has been defined as an exercise of moderate intensity (Lord et al. 1991; Wang et al. 2004). The findings of this study confirm those of previous research that moderate exercise significantly decreased the aging-associated development of oxidative stress (Badano et al. 1973; Bailey et al. 2003; Navarro et al. 2004).

The benefits of introducing Yoga are supported by ample literature. In this study, although LDH value has been decreased, the performance of Yoga is not better than Tai-Chi. This non-significant observation may result from a fact that incorporating a training session of 10 weeks is not long enough for this study to have statistically significant results. Although in literature comparatively less discussion has focused on Tai-Chi, this study empirically supports that Tai-Chi has better antioxidative capacity than Yoga. There are statistically significant differences and

significant decrease in oxidative stress (LDH and MDA) and increase in antioxidative capability (SOD and GSHPx). The findings suggest that further research can have more time for training and chase the following development in the future, and compared the difference between Yoga and Tai-Chi.

CONCLUSION

The results demonstrated that Tai-Chi is a moderate exercise, which will enhance anti-oxidative capability and may well reduce oxidative stress in the college female students. Yoga can reduce some antioxidative capability of the individual. For 18-20 year-old college female students, who had ten weeks of Tai-Chi exercise training, could better enhance their antioxidative capability. The findings of this study confirm those of previous research that moderate exercise significantly decreased the aging-associated development of oxidative stress.

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