

EFFECTS OF TAI CHI ON THE PHYSICAL AND PSYCHOLOGICAL WELL-BEING OF CHINESE OLDER WOMEN

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The objective of this study was to determine the effects of Tai Chi training on perceived change in physical and mental health, life satisfaction, functional capacity, balance, muscle strength and flexibility in 38 Hong Kong Chinese older women (mean \pm SD: age, 72.9 \pm 5.5 yrs; weight, 57.2 \pm 8.8 kg; height, 1.51 \pm 0.06 m; body mass index, 24.9 \pm 3.4 kg m⁻²). A prospective controlled clinical trial with a 3-month intervention was used in which the participants (15 in the experimental group, 23 in the control group), were assessed before and after intervention. Using independent *t* tests, we found that at baseline measurement, participants in the experimental group began with slightly poorer balance and less flexibility than those in the control group. After controlling for these baseline characteristics by analysis of covariance, the Tai Chi intervention group experienced significantly greater percentage improvements over baseline in both psychological and physical well-being than the control group; when compared to the control group, perceived well-being for the intervention group was 13.5% higher than baseline, functional capacity was 4.5% higher, knee extension strength was 10.1% higher, and flexibility was 10.6% higher. We conclude that a moderate Tai Chi intervention program can enhance both psychological and physical health among Hong Kong Chinese older women.

Keywords: Tai Chi, physical health, psychological health, elderly

Introduction

A longer life expectancy coupled with a marked decline in the birthrate has resulted in a rapidly aging population in Hong Kong. The number of people aged \geq 65 years has increased from 150,000 in 1961, to 739,739 in 2001 (4.8% and 11.0% of total population, respectively), and it is expected to increase to approximately 2.1 million by 2031 (24.0% of the total population) (Census &

Statistics Department 2002; 1997). This rapid increase in the number of the aging population presents a serious challenge to policymakers in dealing with social, economic, and political issues related to the older adults in Hong Kong. Some of the serious challenges to a rapidly aging population include many public health concerns, such as the high prevalence of chronic diseases, frailty and cognitive impairment. Therefore, important goals in public health have entailed finding ways to limit further age-related degeneration and to maintain or, ideally, improve the physical and/or psychological health of older adults.

Regular physical exercise is well known to be an effective intervention in maintaining and improving the physical and mental health of older adults (Landers &

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Arent 2001; Shepard 1997; McAuley & Rudolph 1995). In addition to the traditional Western forms of aerobic physical exercise, such as jogging, swimming, and cycling, alternative modes of physical activity have the potential to be equally beneficial, yet more culturally appropriate, to some elderly ethnic groups. One such activity, Tai Chi, is an ancient form of a traditional Chinese physical exercise that has been practiced for self-defense and health promotion for centuries (Yan & Downing 1998; Liang 1977). Tai Chi adopts a holistic approach of balancing the interaction between mind and body, with its physical movements having similar benefits to walking, whereas its cognitive aspect resembles a mental state of meditation (Zhuo et al. 1984; Liang 1977). Thus, Tai Chi involves cognitive, cardiovascular and musculoskeletal responses that lead to measurable physiologic (Lan et al. 1999; Young et al. 1999) and psychological improvements (Brown et al. 1995; Jin 1992). These benefits may include the maintenance of greater mobility and flexibility in the musculoskeletal system (Li et al. 2002; Li et al. 2001b; Hong et al. 2000; Da-Hong 1982), because Tai Chi exercise includes a series of individual dance-like movements linked together in a continuous sequence. Tai Chi has also been shown to improve several aspects of health-related fitness, including cardiorespiratory performance, balance, muscular strength, and a reduction in the risk of falling in older adults (Tsang et al. 2004; Wu 2002; Hong et al. 2000; Sandlund & Norlander 2000; Lan et al. 1998; Wolf et al. 1996; Wolfson et al. 1996; Jin 1992).

To promote compliance during an intervention and to enhance habituation after the intervention ceases, it is important that the participants feel positively inclined toward the intervention. Because Tai Chi is already popular in Hong Kong's elderly population, and even among Chinese-American older adults (Allison & Geiger 1993; Kwan 1990), this form of traditional Chinese exercise was considered to be the most appropriate for this population. However, despite the potential benefits of Tai Chi, only a few studies of Chinese older adults have been conducted to assess its effect on health (Yau & Packer 2002; Tse & Bailey 1992). Moreover, most studies on Tai Chi have focused on its impact on physical health and only a few have examined its benefits on psychological well-being (Li et al. 2001a; Jin 1992). The study reported here aimed to assess the impact of Tai Chi on

both physical and psychological well-being, among a sample of Hong Kong elderly Chinese women.

Methods

Participants

The participants were 38 elderly Chinese women aged 65 and older, invited to participate through a community center for the elderly in Hong Kong. All participants gave informed consent, and none reported any previous experience in practicing Tai Chi. Eligibility criteria for the study consisted of: living in the community, living independently, having no major neurologic or musculoskeletal diagnosis that could result in a loss of balance or fall (e.g. stroke or low-extremity joint replacement), having no cognitive impairment such as dementia, and the capacity to understand and follow instructions.

Procedures

A total of 60 elderly people participated in a health seminar about the importance of physical exercise. After the talk, they were invited to take part in the Tai Chi exercise program, and those who declined the invitation were asked to participate in this study as members of the control group. As a result, 15 elderly women participated in the experimental and 23 women were in the control group. All participants underwent a physical and psychosocial assessment, which was repeated at the end of the 3-month intervention. The assessment included demographic data, physical activity habits, perceived physical and psychological well-being due to physical exercise, life satisfaction, perceived functional capacity, and measures of balance and muscle strength.

Tai Chi training

Experimental group members took part in a Tai Chi training program involving three, 45-minute sessions per week, over the entire 3-month intervention period. The nature of Tai Chi exercise chosen was an 18-form version of Yang's style, which is commonly practiced in Hong Kong's aged population. Each session consisted of a 10-minute warm-up, 25 minutes of Tai Chi practice, and a 10-minute cool-down. All sessions were led by an experienced Tai Chi practitioner, who demonstrated

the warm-up and cool-down exercises, taught Tai Chi movements, and promoted relaxation, deep breathing, and concentration. In addition, Tai Chi participants were encouraged to continue with any other physical activity to which they were accustomed.

Controls

Participants in the control group were advised to continue their usual physical activities and were invited to attend another health seminar, 3 months after the baseline evaluation, so that all physical and psychosocial measures could be reassessed.

Physical activity assessment

Before beginning the intervention, participants supplied five items of information pertaining to their exercise history: (1) whether or not they considered themselves to be exercisers; (2) the number of days per week that they typically engaged in exercise; (3) the average number of minutes per session that they engaged in exercise; (4) the particular type of exercise that they typically did; and (5) the average level of intensity of their exercise. This information was used to classify participants into three levels of physical activity: light, moderate, and heavy, according to the guidelines set by Taylor et al. (1978).

Perceived well-being

This scale was designed to examine the exercise-related changes in mood and well-being in healthy participants (King et al. 1989). Participants rated their perceived changes on 14 items of mental and physical function after the 3-month intervention, using an 11-point Likert scale that ranged from no change (0) to substantial change (10). The items included quality of sleep, physical shape and appearance, depression, tension or anxiety, concentration, alertness, confidence and well-being, energy, appetite, physical fitness, stress, coping with stress, mood, and weight. The final scores were the unweighted sum of all items.

Life satisfaction

Global life satisfaction was measured with the Satisfaction with Life Scale (Diener et al. 1985), a five-item inventory that has been used extensively in a variety of populations. It has been found to have adequate internal

consistency, test-retest reliability, and construct validity. The five items were scored on a standard seven-point scale ranging from 1 (strongly disagree) to 7 (strongly agree), and the final score was the unweighted sum of the five component items, with the higher scores indicating a greater amount of satisfaction.

Functional capacity

The participant's functional status was measured on a scale that included 16 items on Activities of Daily Living, Instrumental Activities of Daily Living, and Physical Performance (Mihalko & McAuley 1996; Tinetti et al. 1994). Participants were asked to rate their perceived abilities to carry out the 16 tasks on a scale ranging from 1 (completely unable) to 7 (completely able), and the final score was the unweighted sum of all items, with low scores indicating more disability.

Balance

Each participant's balance was assessed using the Berg Balance Scale (Berg et al. 1992), which has 14 items and is scored on a metric of 0 to 4 metric (scale range = 0 to 56). It assesses how well participants can successfully carry out activities such as standing with eyes closed, standing up from a chair without support, standing on one foot, and turning through 360°. Each of the 14 items was scored using a standardized report sheet that provided clear test instructions, together with an objective assessment criterion for each of the five possible scores. The final scores were the unweighted sum of all 14 items, with high scores indicating a greater ability to maintain balance.

Muscle strength

Hip flexion and knee extension were both measured isometrically using a Nicholas Manual Muscle Tester (Lafayette Instruments, Lafayette, IN). Two maximal 'break-force' measures were taken for each leg, and the final scores were the average of the four measures for hip flexion and the four measures for knee extension. The positioning and test measurements were based on the procedures devised by Kendall (1983), with the participant seated for both tests. To assess hip flexion, the participant was asked to raise the knee about 10 cm above the horizontal; with the instrument placed just proximal to the patella, the experimenter then applied a

breaking force sufficient to slightly depress the limb, despite maximal isometric hip flexion by the participant. To assess knee extension, the ankle was extended about 10 cm beyond the vertical; with the instrument placed just proximal to the ankle joint, the experimenter applied sufficient force to overcome a maximal isometric knee extension. Repeat measurements were made on alternating limbs with at least 30 seconds between each successive test.

Flexibility

The Chair Sit-and-Reach Test was used to measure the flexibility of the hamstring (Jones et al. 1998). After a demonstration, each participant sat on a chair and was asked to move forward until they were sitting near the front edge. Each participant was then instructed to extend her preferred leg in front of the hip, with foot dorsiflexed at an angle of approximately 90°, the knee fully extended, and the other leg flexed so that the sole of the foot was flat on the floor about 15–30 cm to the side of the body's midline. With the extended leg as straight as possible and hands on top of each other with palms down (tips of the middle fingers even), each participant was asked to “slowly bend forward at the hip joint, keep the spine as straight as possible and head in normal alignment with the spine” (not tucked). Participants were instructed to reach down the extended leg in an attempt to touch the toes and to hold a static position for 2 seconds, while the assessor read the “reached score” using a metric (cm) ruler positioned parallel to the lower leg. The middle of the toes at the end of the shoe represented a “zero” score. Reaches short of the toes were recorded as a negative score, and reaches beyond the toes were recorded as a positive score; thus higher scores indicated a greater degree of flexibility.

Attrition analyses

The attrition rate was zero, in that all 38 cases assessed at the baseline were successfully reassessed at the 3-month follow-up. For those in the Tai Chi training group, the average attendance rate exceeded 80% over the total of 36 sessions.

Data processing and statistical analysis

We conducted bivariate analyses, *t* tests, and χ^2 tests to compare the age, extent of physical activity, and physi-

cal and psychological well-being characteristics at baseline. Because several differences existed in pretest scores, analysis of covariance (ANCOVA) was used to examine the effect of Tai Chi on the changes of outcome measures between the pre- and post-intervention assessment, with the baseline characteristics as the covariate after examining for homogeneity of regression slopes. A *p* value of less than 0.05 was used to judge statistical significance.

Results

Characteristics of respondents

The baseline characteristics were comparable between the experimental and control groups. Of nine baseline measures investigated, only two differed significantly between groups. Table 1 provides data for all baseline characteristics for each group. Baseline biologic data showed that the Berg Balance Scale score was slightly higher for the control group than for the experimental group, whereas participants in the experimental group had lower hamstring flexibility than those in the control group.

The following results for changes in outcome variables from before to after the intervention are based on ANCOVA, with the baseline variables used as the covariates. Table 2 shows that, with the exception of hip flexion, there was a clear trend for greater improvements from before to after the intervention in all variables measured in the experimental group when compared with the control group, although only four of the seven variables reached statistical significance. These four significantly greater percentage improvements in the experimental group, when compared to the control group, represent a 13.5% greater improvement for perceived well-being, a 4.5% greater improvement for functional capacity, a 10.1% greater improvement in knee extension strength, and a 10.6% greater improvement in flexibility.

Discussion

The primary objective of this study was to examine the physical and psychological impact of Tai Chi training in

Table 1. Distributions of variables between the control and experimental groups at baseline (mean \pm SD) and test of significance between groups

| Variable | Experimental group (n = 23) | Control group (n = 15) | p* |
|---------------------------------------|--------------------------------|---------------------------|-------|
| Age (yrs) | 74.7 \pm 4.7 | 71.7 \pm 5.6 | 0.094 |
| Mass (kg) | 55.8 \pm 7.9 | 58.0 \pm 9.4 | 0.450 |
| Height (m) | 1.50 \pm 0.08 | 1.52 \pm 0.05 | 0.356 |
| Body mass index (kg m ⁻²) | 24.7 \pm 3.0 | 25.1 \pm 3.8 | 0.770 |
| Physical activity (%) | | | |
| Light | 20 | 13 | 0.36 |
| Moderate | 73.3 | 87 | |
| Heavy | 6.7 | 0 | |
| Psychological well-being | | | |
| Perceived well-being | 84.8 \pm 29.0 | 82.1 \pm 21.0 | 0.744 |
| Satisfaction with Life Scale | 27.1 \pm 5.5 | 27.9 \pm 4.3 | 0.541 |
| Physical well-being | | | |
| Functional capacity | 100.2 \pm 14.0 | 103.3 \pm 6.7 | 0.357 |
| Berg Balance Scale | 52.1 \pm 4.0 | 54.1 \pm 2.0 | 0.047 |
| Muscle strength | | | |
| Hip flexor (kg) | 13.1 \pm 1.8 | 12.6 \pm 2.2 | 0.480 |
| Knee extensors (kg) | 11.5 \pm 1.8 | 11.3 \pm 1.9 | 0.686 |
| Flexibility | | | |
| Chair sit-and-reach test (cm) | -15.1 \pm 4.4 | -9.1 \pm 6.7 | 0.004 |

*Determined by *t* test or χ^2 test.

Table 2. Change of scores between the values after and before intervention values from the psychological and physical well-being indicators in the control and experimental groups*

| | Experimental Mean \pm SD (% change) | Control Mean \pm SD (% change) | ANCOVA F-ratio [1,35] p |
|------------------------------|---|--|-------------------------------|
| Psychological well-being | | | |
| Perceived well-being | 18.5 \pm 13.8 (+21.9) | 6.9 \pm 8.7 (+8.4) | 16.811 (0.000) |
| Satisfaction with Life Scale | 2.1 \pm 3.0 (+7.9) | 0.9 \pm 2.2 (+3.0) | 2.615 (0.115) |
| Physical well-being | | | |
| Functional capacity | 5.3 \pm 6.4 (+5.3) | 0.8 \pm 3.8 (+0.8) | 7.310 (0.011) |
| Berg Balance Scale | 1.3 \pm 1.9 (+2.4) | 0.5 \pm 1.2 (+0.9) | 0.003 (0.955) |
| Muscle strength | | | |
| Hip flexors (kg) | 0.3 \pm 1.3 (+2.4) | 0.5 \pm 0.8 (+3.6) | 0.181 (0.673) |
| Knee extensors (kg) | 1.5 \pm 1.8 (+12.9) | 0.3 \pm 1.2 (+2.8) | 5.503 (0.025) |
| Flexibility | | | |
| Chair sit-and-reach (cm) | 2.8 \pm 2.9 (+18.7) | 0.7 \pm 2.2 (+8.1) | 6.025 (0.019) |

*Data shown for mean \pm SD (% change) and analysis of covariance (ANCOVA) results between the control and experimental groups. Percentage change was calculated as ([Mean difference between scores after and before intervention]/Mean of scores before intervention) \times 100.

older Chinese women. Tai Chi training resulted in significantly greater improvements in perceived changes in physical and psychological well-being, perceived functional capacity, knee extension strength, and flexibility that ranged from 4.5%–13.5% more than the percentage changes seen in the control group. Although other positive trends were observed, no statistically significant

effects of Tai Chi were seen in the other psychological outcomes, the global measures of life satisfaction, and other physical health outcomes such as a balance. Future studies should be conducted to determine whether these nonsignificant positive trends were due to the low sample size, and also to explore the mechanism underlying the observed beneficial effects of Tai Chi on the

four significantly-enhanced physical and psychological variables. However, Li and colleagues (2001c) have already suggested that the impact of Tai Chi on functional capability is possibly manifested through the sense of control in physical functioning. Although in our study significant improvements were seen in only four variables, our findings remain notable for several reasons.

First, the results suggest that the effect of Tai Chi on different aspects of physical and psychological well-being might not be equivalent, although several explanations are possible. The mixed findings might reflect the differential impact of the short duration of Tai Chi training (i.e. 3 months) and/or the restricted number of postures in the 18-form Yang style, compared with the traditional 108 forms. A longer intervention may have been needed to achieve improvements in life satisfaction; indeed, Li et al. (2001a) found that participants who completed a 6-month 24-form Tai Chi training program reported significantly higher life satisfaction than those in the control group. The low number of postures that placed a considerable load on hip flexion may have contributed to its lack of strength development in our experimental group; in contrast, a higher number of postures placing a greater load on knee extension might have contributed to its significant improvement. The restricted 18-form program may also have been responsible for the lack of significant improvements in balance; indeed, a similar lack of balance improvement was reported after a 4-month program using 24 forms (Shih 1997). Additional studies are thus required to examine the possible interaction between program duration and the number of Tai Chi postures required to benefit physical and psychological well-being.

Second, findings from the present study indicate that Tai Chi participants reported greater positive changes in both physical and psychological well-being indicators after a relatively short intervention. It is possible that the combined physical and mental components of Tai Chi provided a mastery experience that increased the participants' sense of control over their physical and psychological health. That the beneficial effects of a Tai Chi program can be experienced within a short period of time suggests that older women could be motivated to engage in greater physical activity after a short period of Tai Chi training, especially those who are habitually

sedentary. These rapidly acquired benefits might also explain why Tai Chi is such a popular physical exercise among elderly persons in Hong Kong. Short-intervention courses of Tai Chi thus may have considerable health-related benefits in this elderly population, although further studies are needed to determine the extent to which habituation remains after the intervention program is completed.

Third, it was clear that the lower leg strength and flexibility in the Tai Chi intervention group improved significantly, with a smaller nonsignificant improvement in balance. Coupled with the reported enhancement in functional capacity, these findings indicate that Tai Chi training may have an important preventative role in maintaining functional independence, as well as reducing the risk of falling among older Chinese adults living in a high-density city like Hong Kong, with its limited opportunity for other recreational pursuits. These findings complement the results of previous studies, in which Tai Chi has been shown to be an simple, effective, low-cost, and easily implemented intervention for the enhancement of leg strength, flexibility and balance, and the prevention of falling in other aged populations (Lan et al. 2002; Wu 2002; Hong et al. 2000; Jacobson et al. 1997; Wolf et al. 1996; Wolfson et al. 1996; Tinetti et al. 1994).

This study was limited by its small sample size, its involvement of only older women, and the lack of randomization of participation-group status. Therefore, it is possible that the positive findings observed are the result of chance, and these limitations make it difficult to generalize on our findings. It may have been methodologically ideal to randomize the group status, but from a public health stance, it can be argued that it is unethical to place volunteers who are interested in improving their health into an inactive control group. Furthermore, health behavior theories, such as the transtheoretical model (Prochaska & DiClemente 1983), would predict greater success in changing activity patterns in a homogeneous group that were already at a contemplative or preparative state, rather than randomly including participants who may be simply in a precontemplative state and unprepared to change their behavior. Nevertheless, future studies with a larger sample size, an equal proportion of older men and women, randomization of the participants' group status, and the use of experimenters

who are blinded with respect to each participant's group status, should be conducted to determine whether or not the tentative results presented here can be replicated. In conclusion, this study shows that Tai Chi could be useful as an alternative form of physical activity for maintaining and enhancing physical and psychological health in older adults. Tai Chi participation may also promote a greater commitment to exercise from a Chinese elderly population than to other Western-derived physical activity programs; therefore, it seems to be a simple but cost-effective community-based intervention for this particular population.

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