

The Effects of Tai Chi Chuan Relaxation and Exercise on Stress Responses and Well-Being: An Overview of Research

Erica S. Sandlund¹ and Torsten Norlander^{1,2}

The rationale of this article is to review, analyze, and discuss studies concerning the role of Tai Chi in stress management and well-being, linking those studies to research on exercise, yoga, and relaxation with regard to physiological and psychological wellness. All studies reported in PsychLit and Medline between 1996 and 1999 directly related to the subject, plus other studies relevant for the analysis, are addressed in this review. Studies reviewed in this article characterize Tai Chi as a form of moderate exercise. Although Tai Chi may not be suitable for achieving aerobic fitness, it may enhance flexibility and overall psychological well-being. Cognitively, there are indications that Tai Chi exercise may lead to improvements in mood. However, it is not clear whether the positive effects of Tai Chi are due solely to its relaxation and meditation component, or whether they are the consequence of various peripheral factors, since it is known that stress reduction often occurs when we indulge in activities we find pleasurable and satisfying. An important finding is that all studies on the benefits of Tai Chi for senior adults have revealed positive results.

KEY WORDS: Tai Chi; stress management; progressive relaxation; aerobic exercise; yoga; meditation.

INTRODUCTION

Relaxation research has generated a number of subfields involving stretching and autogenic exercises (Smith, 1993). Further examples would be relax-

¹Karlstad University, Sweden.

²Correspondence should be directed to Dr. Torsten Norlander, Department of Psychology, Karlstad University, SE-651 88 Karlstad, Sweden; e-mail: at.norlander@mailbox.swipnet.se.

ation with the help of certain devices such as the flotation tank (Norlander, Bergman, & Archer, 1998; Norlander, Bergman, & Archer, 1999), and the physioacoustic method (Norlander, Sandholm, & Anfelt, 1998). A number of other studies have supported the hypothesis that exercise has beneficial effects on stress responses (e.g., Greist, 1987; Sime, 1987; Morgan & Goldston, 1987). A review of literature concerning exercise and mental health by Plante and Rodin (1990) reveals that 75% of the correlational studies conducted identified significant relationships between exercise and positive mood. As the awareness of both relaxation and exercise in modern stress research has increased, the method termed Tai Chi Chuan has come to be of interest to scientists in psychology, medicine, and exercise physics, and the number of studies being conducted all over the world is growing rapidly. Since Tai Chi has the unique feature of combining the exercise of rhythmic movement and self-defense practice with a kind of yogic relaxation through deep breathing, self-awareness, and the attempted connecting of mind and body, it is interesting from several research perspectives. In this article, all studies directly concerned with Tai Chi in connection with stress and well-being reported in Psychlit and Medline databases during 1996–1999 will be reviewed. Further, in order to give some historical perspectives, a representative look at earlier studies are included.

Tai Chi Chuan, meaning “supreme ultimate boxing,” originated in China about 300 years ago as a martial art based on the Taoist philosophical principles of Yin and Yang (the opposite forces) and breathing techniques. Today it is widely practiced in different styles, primarily as a means for relaxation and moderate exercise, all over the world. Among the martial arts, Tai Chi is noticeable with its flowing, slow, dance-like movements and its function as a system of calisthenics and self-defense, as well as being a vehicle for meditation and spiritual well-being. Depending on the practitioners’ preferences, different aspects of the art can be emphasized, but the attempted integration of mind and body in every motion through respiration, mental, and visual concentration and dynamic relaxation is crucial in Tai Chi (Dunn, 1987). The dynamics of Tai Chi emphasize movement in graceful patterns. Besides deep, diaphragmatic breathing, Tai Chi is characterized by complete weight shifts, moving from deep relaxation to full speed and force, and for balance and whole body connection. The art of Tai Chi rests on five basic principles:

- (a) *Relaxation*. Attempts are made to apply just enough strength for every movement or task, thereby conserving energy and maintaining stamina.
- (b) *Separating Yin and Yang*. This principle refers to the philosophy of opposites in nature, for example force versus relaxation, speed versus stillness, weight shifts, and so on.
- (c) *Turning the waist*. A strong and flexible waist is essential in connecting the upper and lower body. Ultimate power also originates from muscles

connected to the waist which then transfers it to smaller muscles and extremities.

- (d) *Keeping the back erect.* Keeping the body perpendicular to the ground in order to achieve balance comfort, relaxation and optimal energy is a principle used in yoga as well as other martial arts.
- (e) *Total body involvement.* Synonymous with body synchronization—that the whole body moves together and not limb by limb—is said to be achieved through adherence to the other four principles.

Since ancient times Tai Chi practitioners have declared a number of beneficial effects from its frequent use: relief from muscular tension, reduced anxiety, stress, and pain, and increased balance, self-awareness, and strength. Tai Chi is said to provide a buffer against arthritis, malfunctioning metabolism, and other illnesses (Dunn, 1987). According to Qu (as cited in Yan, 1995) there are two major reasons for these experiences. First, participants have to be very focused and concentrated when practicing, and by doing so they exclude other distractions and stressors and experience an inner peacefulness. Second, the nature of the art, with smooth, slow and rhythmic movements, facilitates muscular relaxation and flexibility.

However, there is still little scientific evidence regarding special health benefits of Tai Chi. Empirical studies have shown that yoga and other forms of meditative disciplines (see Roberts, 1973), as well as different kinds of relaxation techniques, have positive effects as coping strategies in reducing stress and tension (e.g., Benson, 1975; Everly & Rosenfeld, 1981). Additional studies on exercise and wellness indicate that moderate exercise has favorable effects on reducing stress, anxiety, and depression, and enhancing mood and self-esteem (e.g., Greist et al., 1979). Studies on other martial arts in relation to well-being (e.g., Konzak & Boudreau, 1984) have shown positive results in terms of both mental and physical fitness. It may be that since Tai Chi combines exercise, yoga techniques, and relaxation, some of the favorable effects demonstrated by research in those areas might occur in Tai Chi as well. This will require empirical testing, as attempted by an increasing number of researchers.

RESEARCH ON TAI CHI

Comparisons Between Tai Chi and Other Forms of Exercise and Relaxation

Tai Chi practitioners claim that one should practice Tai Chi in a mindful manner and learn the philosophy behind the movements in order to deal with stress effectively (Chan, 1992). A study that emphasized the cognitive aspect of

exercise was done by a group of researchers from different East Coast universities (Brown et al., 1995). The main purpose of the study was to see if exercise that involved cognition led to greater psychological benefits than noncognitive exercise. One hundred thirty-five sedentary, healthy, older adults (aged 40–69 years) exercised three times a week for 16 weeks for a total of 48 exercise sessions. Participants were randomly assigned to one of five experimental conditions: (1) Moderate intensity walking (MW), 65–75% of maximum heart rate; (2) Low intensity walking (LW), 45–55% of maximum heart rate; (3) Low intensity walking plus relaxation response (LWR, relaxation tape); (4) Mindfulness exercise (ME)—Tai Chi exercise; (5) Control (C). The walking groups used an indoor walking track while the Tai Chi group participated in group sessions with an instructor. The dependent measures for physiological changes were *aerobic capacity* and *body composition*, and psychological measures involved *mood*, *self-esteem*, and *life-satisfaction* and *personality* inventories. The results showed that women in the ME group achieved a significantly greater decrease in anger and total mood disturbance than the LW, LWR, and C groups, and also a greater reduction in tension and confusion than those in the LW and LWR groups. Compared to the LWR condition, the women in the ME group also showed a significantly greater decrease in depression. Decreases in anger, trait anxiety, negative affect, and increase in anger control were observed for all the experimental conditions, and the same findings also were obtained for life satisfaction and self-esteem post-testing. For the male participants, the MW conditions had more favorable effects on mood than the other conditions, and all four conditions showed more positive effects after testing than before on the life-satisfaction, self-esteem (physical ability), and personality inventories. The findings indicated that gender is an important factor in exercise, since men reacted positively to the MW training whereas women seemed to benefit more from the Tai Chi program with regards to mood improvement. The hypothesis that exercise modes that contained a cognitive component would result in more beneficial psychological outcomes was partially rejected, since the LWR condition did not lead to changes in mood, self-esteem, and so on. The researchers concluded that “mindful exercise programs” such as Tai Chi will benefit those individuals who feel comfortable with that kind of activity, or those who, due to illness or various physiological limitations, are not suited for vigorous exercise.

Jin conducted a study (1991) that compared four different methods for stress reduction: brisk walking, meditation, reading, and Tai Chi, and like another study (Brown et al., 1995) this research emphasized the physical and cognitive components of the art. Ninety-six healthy males and females (48 of each) were recruited from different Tai Chi clubs in Melbourne, Australia, and randomly assigned to one of the four treatment conditions. A “blind” experimenter who had the subjects come in twice to the laboratory conducted the experiment. The participants were then subjected to both *mental* and *emotional*

stress: arithmetic and other difficult mental tests under time pressure and loud noise, and an emotionally stressful movie. After the second session, the groups continued with one hour of each of the experimental activities. The dependent variables were measured by means of heart rate, urine, blood pressure, and tension/mood scales (POMS and STAI-Y). The participants' expectations were also taken into account in a short survey. The results showed that the exercise intensity of Tai Chi and brisk walking was considered as moderate and resulted in a release of noradrenaline, which may be beneficial to health. All four conditions appeared to be effective in reducing mood disturbance, and the Tai Chi group showed a significantly greater reduction in state anxiety compared to the reading group, a result that might have been influenced by the high expectations in the Tai Chi condition.

Channer, Barrow, Barrow, Osborne, and Ives (1996) studied changes in hemodynamic parameters following Tai Chi Chuan and aerobic exercise in patients recovering from acute myocardial infarction. Patients ($N = 126$) were randomly assigned to three groups—Tai Chi, aerobic exercise, or a nonexercise support group—following acute myocardial infarction. Measurements on heart rate and blood pressure were recorded during eight weeks. Results indicated lower diastolic blood pressure only in the Tai Chi group, but significant trends in systolic blood pressure occurred in both exercise groups.

Szabo, Mesko, Caputo, and Gill (1999) compared post-exercise affect after sessions of aerobic dance, weight training, martial arts, Tai-Chi and yoga, and as a control, music appreciation. One obvious problem with this study was that there was no pure Tai Chi condition. However, results indicated that the combined Tai Chi and yoga group reported higher levels of "tranquillity" than all other exercise groups. Further, they reported lower psychological distress, fatigue, and exhaustion as compared to the martial arts group.

Stress-Management and Tai Chi

The above studies suggest positive psychological effects of Tai Chi intervention, although the degree of benefit may be based on individual differences and preferences. Mack (1980) proposes that Tai Chi is a stress-management strategy. He based this idea on a study targeting African Americans in the United States, who constantly live with the stressor of the negative sociopolitical, cultural, and religious attitudes associated with their skin color. In dealing with this genetic stressor, the only strategy shown to have effects is "a style of flexible stress-management that is self-directed and contingent on the specific demands that are faced" (Mack, 1980, p. 28). The choice of Tai Chi was based primarily on its meditative nature; meditation is believed to reduce anxiety, hypertension and blood pressure, fear and anger.

The participants consisted of a number of African-American males who in pretest interviews reported headaches, restlessness, hypertension, constipation, and ulcerated stomachs. In a 24-week program, they were instructed in Tai Chi and afterward completed post-test surveys of affect, sense of control, and physiological and psychological experiences. Participants noted a significant difference in their consciousness of somatic tension, awareness of stressful events, and a sense of control through behavioral strategies that deal with the tension. The author attributes the results to the *relaxation response* elicited by Tai Chi exercise: "an integrated hypothalamic response, the cortical-thalamic pause which leads to decreased activity of the sympathetic nervous system and relaxes the skeletal muscles, decreases blood pressure, respiration and pupil constriction" (Mack, 1980, p. 37). Further, Mack states that Tai Chi relieves somatic stress more quickly than deep meditation and provides African-American people with a "flexible response repertoire" to deal with both situational and generic stress.

A study by Slater and Hunt (1997) indicated that even a period of brief Tai Chi training resulted in reduced nightmares among female undergraduates as compared to a control group. Although this study was small in scale and primarily investigated the effect of post-vestibular stimulation on dreaming, its results are interesting in terms of the general well-being produced by Tai Chi.

Jin (1989) was interested in determining the effects of Tai Chi practice on heart rate, noradrenaline, cortisol, and mood. The researcher recruited 33 Tai Chi practitioners of each sex between 16 and 75 years old, from two different schools in Melbourne, Australia. Using a three-way factorial design, the subjects were divided into groups on the basis of experience, time of day, and phase (before, during, or after Tai Chi intervention.) Participants filled out the Profile of Mood States (POMS) and Trait Anxiety Inventory form before and after testing, and their heart rate, noradrenaline excretions, and cortisol concentrations were measured pre-testing and post-testing. Elevated heart rates during testing qualified Tai Chi as a moderate cardiovascular exercise mode. Heart rate elevation was greater in the group that had more experience, perhaps suggesting that Tai Chi is a slowly learned skill which will result in more benefits as skills become more advanced. Cortisol levels dropped compared to pre-testing; Jin explains this with the fact that the Tai Chi physical workload only represents 50% of $VO_{2\text{ max}}$, (indicating a low workload). Mood improved significantly during Tai Chi, and remained positive one hour after practice. Participants reported less tension, anger, fatigue, depression, confusion, and state anxiety, but it is not clear if this effect is due to Tai Chi per se or to the fact that Tai Chi practice serves as a distraction from problems and anxiety.

Tai Chi and Senior Adults

When subjected to stress, the human immune system will decrease in functioning (show immunosuppression) and the production of lymphocytes will increase (Blonna, 1996). Xusheng, Yugi, and Ronggang (1990) wanted to investigate the effect of Tai Chi on humoral immunity in a group of healthy senior citizens in Shanghai. They divided participants into two groups: a Tai Chi group with seven years of experience, and a control group that performed no form of physical activity. Blood samples were taken before and immediately after Tai Chi exercise (and from the control group as well) and the dependent measures were the percentage of ZC rosette-forming cells, lymphocytes, and the total number of white blood cells. At rest, no difference was found between the exercise and control groups with respect to ZC rosettes. The post-exercise percentage of ZC rosettes was elevated, and there was a direct relationship between the number of lymphocytes and ZC rosettes whether at rest or immediately after Tai Chi exercise. The detection of ZC rosettes can reflect the capacity of humoral immunity to some extent, since it indicates a higher number of antibodies produced by B-cells—that is, an immune response that is important in defending the organism against pathogens and enhancing resistance to disease. So, according to this study, there may be a correlation between Tai Chi practice and enhanced humoral immunity in older people.

More recent studies have more or less confirmed the beneficial effects of Tai Chi for senior adults. The majority of studies on Tai Chi conducted between 1996 and 1999 have touched on the health and well being benefits of Tai Chi exercise for senior adults. In fact, no less than 80% of the studies reported in PsychLit and Medline have dealt with this aspect. The results show that Tai Chi can lead to improved balance (Kutner et al, 1997; Schaller, 1996; Wolfson et al., 1996), reduced fear of falling (Wolf, Barnhart, Ellison, & Coogler, 1997), higher oxygen uptake (Lan, Lai, Wong, & Yu, 1996), greater flexibility (Chen & Sun, 1997; Lan, Lai, Wong, & Yu, 1996; Sun, Dosch, Gilmore, Pemberton, & Scarseth, 1996), muscle relaxation (Chen & Sun, 1997), enhancement of lateral body stability (Jacobson, Ho-Cheng, Cashel, & Guerrero, 1997), reduced anxiety (Chen & Sun, 1997), lower percentage of body fat (Lan, Lai, Wong, & Yu, 1996), increased strength (Wolfson et al., 1996), and a healthier blood pressure level (Chen & Sun, 1997; Wolf et al., 1996).

The results of these studies are intriguing; however, there are methodological and other limitations in some of them. Nevertheless, we can conclude that there now is concordance in recent research that Tai Chi in a number of ways is beneficial for senior adults. The strong focus on the senior population in this field can also be seen as confirmation that this area is where the major breakthroughs in Tai Chi research have been made.

DISCUSSION

Summary and Analysis of Research Results

On the basis of our review, the status of Tai Chi research can be summarized as follows.

(a) The majority of studies on Tai Chi in recent years have concerned its benefits for senior adults. This is also where research has proven tangible results. It is not yet clear which of the components in Tai Chi makes the exercise form especially effective for seniors; neither have corresponding effects in younger and middle-aged people been investigated properly. The previously quoted study by Brown et al. (1995) indicated that those who are not suited for vigorous exercise due to illness or various physiological limitations benefited most from Tai Chi.

(b) The gender aspect is almost entirely absent from research on Tai Chi so far. One study (Brown, et al., 1995) touched upon gender differences—male participants appeared to benefit more from exercise in terms of mood enhancement than females, while females showed a greater decrease in total mood disturbance after a “mindful exercise” (Tai Chi). With respect to Tai Chi, this does not necessarily indicate a gender difference in benefits due to practice, but it might show that men prefer a more strenuous form of exercise when placed under stress than women. Extensive and longitudinal studies directly addressing the gender aspect are conspicuous by their absence.

(c) Studies that directly compare Tai Chi with other forms of stress management techniques (exercise, relaxation, meditative disciplines) are few. Attempts have been made to classify Tai Chi as a form of exercise, relaxation, and meditation. Research designs need to draw lessons from related and more explored areas. In addition, studies reviewed above (e.g., Jin, 1991; Mack, 1980) characterize Tai Chi as moderate exercise, perhaps not suitable for achieving aerobic fitness, but enhancing flexibility and overall psychological well-being (Jin, 1991; Brown et al., 1995; Mack, 1980).

(d) Time is an important factor in a good study of physical and psychological interventions. In several of the studies of stress management and Tai Chi, procedures were in effect for only a few weeks, a duration that could be too short to truly obtain possible beneficial effects. Early stages of practice might actually increase stress responses. Mack’s study (1980), by contrast, was conducted across 24 weeks, increasing the chances that Tai Chi was learned properly and that participants felt more confident and relaxed in their practice. The problem with longitudinal studies is often that with time, the number of peripheral variables increases in the lives of the participants, and the reliability of the study decreases. The Mack study showed positive effects of Tai Chi practice on stress and anxiety reduction, but the participants all suffered various

stress-related and psychosomatic symptoms at pre-testing. Their hopes and expectations that the intervention would relieve their tension also might have affected the results.

(e) Finally, we should not ignore possible individual differences in stress management. Just as some people do better on exams if they study intensively a few days before, while others prefer to study just an hour a day for weeks ahead, so too people differ in their preferences and susceptibilities to various stress coping strategies. The Pekala and Forbes study (1988) is a good example of how personality differences can be important in choosing a coping strategy. They concluded that people with low hypnotic susceptibility benefited more from progressive relaxation than hypnosis, and that people who had an open mind toward and felt comfortable with meditative and relaxing exercises would benefit more from those than other people. This is probably true for Tai Chi as well as exercise, yoga, or progressive relaxation—people differ in their perceptions of the world, affecting susceptibility to different methods. Whatever the positive outcomes of Tai Chi practice may be, there are some who will benefit more from it than others. Moreover, since participation in most studies is strictly voluntary, there is always a risk that participants differ from other individuals in some aspect (e.g., participants may be more open-minded, have a higher need for attention than others, and so on) rendering results difficult to generalize.

SOME SUGGESTIONS FOR FUTURE STUDIES

Since the link between Tai Chi and health still is a quite new field, especially in the Western world, there is a lot to do when it comes to research methods and definitions. First, studies that define the skill level and correctness of Tai Chi needed for health gains (i.e., how should Tai Chi be practiced optimally, and how much experience do we need in order to start benefiting from practice) would facilitate future studies in this area. This would be necessary since the studies conducted so far have used participants with very different levels of proficiency in Tai Chi.

Also, since Tai Chi is classified as a moderate exercise, results from aerobic exercise studies may not be directly comparable. What is needed is to know the minimum duration of training necessary for the body to fully relax when practicing. William C. C. Chen, the grandmaster of one of the styles of Tai Chi, states that one has to do the forms for at least ten minutes before feelings of relaxation and flow will occur (Anderson, 1993). There is also a need for empirical assessment of the neuromuscular activity occurring in doing the form.

There is a need for more longitudinal studies as mentioned in the previous

section. Methods must be improved so that effects of expectancy and demand characteristics are minimized.

Studies on the effects of Tai Chi on the immune system are still very exploratory, but the intriguing and positive results are worth pursuing in larger studies. Individual differences in benefits from Tai Chi are also important to study, such as differences in trait anxiety, hypnotic susceptibility, personality and interest variables, and gender and age factors.

Whether the positive effects of Tai Chi are due solely to its relaxing, meditative, and exercise aspects, or to more peripheral gains, stress reduction often occurs when we engage in activities in which we find pleasure and believe. Therefore, Tai Chi may be an efficient means of stress reduction for people who successfully learn the art and who enjoy its philosophical, martial, and mental aspects.

ACKNOWLEDGMENTS

This research was supported by grants from Swedish National Center for Research in Sports, Stockholm.

REFERENCES

- Anderson, D. A. (1993). Test indicates T'ai Chi may assist in healing. *T'ai Chi Magazine*, 17, 20.
- Benson, H. (1975). *The relaxation response*. New York: Morrow.
- Blonna, R. (1996). *Coping with stress in a changing world*. St Louis: Mosby.
- Brown, D. R., Wang, Y., Ward, A., Ebbeling, C. B., Fortlage, L., Puleo, E., Benson, H., & Rippe, J. M. (1995). Chronic psychological effects of exercise and exercise plus cognitive strategies. *Medicine and Science in Sports*, 27, 765-775.
- Chan, L. (1992). How I use T'ai Chi to reduce stress. *T'ai Chi Magazine*, 18, 30-31.
- Channer, K. S., Barrow, D., Barrow, R., Osborne, M., & Ives, G. (1996). Changes in haemodynamic parameters following Tai Chi Chuan and aerobic exercise in patients recovering from acute myocardial infarction. *Postgrad Medical Journal*, 72, 349-351.
- Chen, W., & Sun, W. Y. (1997). Tai Chi Chuan, an alternative form of exercise for health promotion and disease prevention for older adults in the community. *International Quarterly of Community Health Education*, 16, 333-339.
- Dunn, T. (1987). The practice and spirit of T'ai Chi Chuan. *Yoga Journal Nov/Dec*, 62-68.
- Everly, G. S., & Rosenfeld, R. (1981). *The nature and treatment of the stress response*. New York: Plenum Press.
- Greist, J. H. (1987). Exercise intervention with depressed outpatients. In W. P. Morgan & S. E. Goldston (Eds.), *Exercise and mental health. The series in health psychology and behavioral medicine* (pp. 117-121). Washington, DC: Hemisphere Publishing Corp.
- Greist, J. H., Klein, M. H., Eischens, R. R., Faris, J., Gurman, A. S., & Morgan, W. P. (1979). Running as treatment for depression. *Compr Psychiatry*, 20(1), 41-54.
- Jacobson, B. H., Ho-Cheng, C., Cashel, C., & Guerrero, L. (1997). The effect of Tai Chi Chuan training on balance, kinesthetic sense, and strength. *Perceptual and Motor Skills*, 84, 27-33.
- Jin, P. (1989). Changes in heart rate, noradrenaline, cortisol and mood during Tai Chi. *Journal of Psychosomatic Research*, 33, 197-206.

- Jin, P. (1991). Efficacy of Tai Chi, brisk walking, meditation, and reading in reducing mental and emotional stress. *Journal of Psychosomatic Research*, *36*, 361–270.
- Konzak, B., & Boudreau, F. (1984). *Canada's Mental Health*, December 1984, 2–7.
- Kutner, N. G., Barnhart, H., Wolf, S. L., McNeely, E., & Xu, T. (1997). Self-report benefits of Tai Chi practice by older adults. *Journals of Gerontology: Psychological Sciences and Social Sciences*, *52B*, 242–246.
- Lan, C., Lai, J. S., Wong, M. K., & Yu, M. L. (1996). Cardiorespiratory function, flexibility, and body composition among geriatric Tai Chi Chuan practitioners. *Archives of Physical Rehabilitation*, *77*, 612–616.
- Mack, C. (1980). A theoretical model of psychosomatic illness in Blacks and an innovative treatment strategy. *Journal of Black Psychology*, *7*, 27–43.
- Morgan, W. P., & Goldston, S. E. (1987). *Exercise and mental health. The series in health psychology and behavioral medicine*. Washington, DC: Hemisphere Publishing Corp.
- Norlander, T., Bergman, H., & Archer, T. (1998). Effects of flotation REST on creative problem solving and originality. *Journal of Environmental Psychology*, *18*, 399–408.
- Norlander, T., Bergman, H., Archer, T. (1999). Primary process in competitive archery performance: Effects of flotation REST. *Journal of Applied Sport Psychology*, *11*, 202–217.
- Norlander, T., Sandholm, C., & Anfelt, O. (1998). The physioacoustic method. *Perceptual and Motor Skills*, *86*, 1091–1096.
- Pekala, R. J., & Forbes, E. J. (1988). Subjective effects of several stress management strategies. *Behavioral Medicine*, *16*, 39–42.
- Plante, I., & Rodin, J. (1990). Physical fitness and enhanced psychological health. *Current Psychology*, *9*, 3–24.
- Roberts, N. (1973). *The yoga thing*. New York: Hawthorn Books, Inc.
- Schaller, K. J. (1996). Tai Chi Chuan: An exercise option for older adults. *Journal of Gerontologic Nursing*, *22*, 12–17.
- Sime, W. E. (1987). Exercise in the prevention and treatment of depression. In W. P. Morgan & S. E. Goldston (Eds.), *Exercise and mental health. The series in health psychology and behavioral medicine* (pp. 145–152). Washington, DC: Hemisphere Publishing Corp.
- Slater, J., & Hunt, H. T. (1997). Post-vestibular intergration and forms of dreaming: A preliminary report on the effects of brief T'ai Chi Chuan training. *Perceptual and Motor Skills*, *85*, 97–98.
- Smith, J. C. (1993). *Understanding stress and coping*. New York: Macmillian Publishing Company.
- Sun, W. Y., Dosch, M., Gilmore, G. D., Pemberton, W., & Scarseth, T. (1996). Effects of a Tai Chi Chuan program on Hmong American older adults. *Educational Gerontology*, *22* (2), 161–167.
- Szabo, A., Mesko, A., Caputo, A., & Gill, E. T. (1999). Examination of exercise-induced feeling states in four modes of exercise. *International Journal of Sport Psychology*, *29*, 376–390.
- Wolf, S. L., Barnhart, H. X., Ellison, G. L., & Coogler, C. E. (1997). The effect of Tai Chi Quan and computerized balance training on postural stability in older subjects. Atlanta FICSIT Group. Frailty and injuries: Cooperative studies on intervention techniques. *Physical Therapy*, *77*, 371–81.
- Wolf, S. L., Barnhart, H. X., Kutner, N. G., McNeely, E., Coogler, C., & Xu, T. (1996). *Journal of American Geriatric Society*, *44*, 489–497.
- Wolf, S. L., Coagler, C., & Xu, T. (1997). Exploring the basis for Tai Chi Chuan as a therapeutic exercise approach. *Archives of Physical Medicine*, *78*, 886–892.
- Wolfson, L., Whipple, R., Derby, C., Judge, J., King, M., Amerman, P., Schmidt, J., & Smyers, D. (1996). Balance and strength training in older adults: intervention gains and Tai Chi maintenance. *Journal of American Geriatric Society*, *44*, 599–600.
- Xusheng, S., Yugi, X., & Ronggang, Z. (1990). Detection of ZC rosette-forming lymphocytes in the healthy aged with Taichiquan (88 style) exercise. *Journal of Sports Medicine and Physical Fitness*, *30*, 401–405.
- Yan, J-H. (1995). The health and fitness benefits of Tai Chi. *The Journal of Physical Education, Recreation and Dance*, *66*, 61–63.