

# Tai Chi Chuan's role in maintaining independence in ageing people with chronic disease

.....  
**Andrzej Jancewicz**

Abstract Tai Chi Chuan has traditionally been used and is still practised by millions of Chinese people, especially the elderly as an exercise and therapeutic tool. Since the advent of Traditional Chinese Medicine in the west, there has been an increasing interest in its potential health benefits by an increasing number of health professionals, including doctors, nurses, physiotherapists and occupational therapists. This literature review focuses on the increasing evidence of Tai Chi as an exercise activity which can improve fitness, and that with regular application can lead to an increase in functional abilities of coordination and joint mobility, as well as improve self esteem and confidence. The literature review on Tai Chi provides evidence as to the potential for Tai Chi in the prevention and treatment of many conditions associated with ageing, amongst them loss of balance and strength (frailty), and cardiorespiratory function, as well as psychological factors associated with the ageing process.

It is concluded that Tai Chi Chuan can prevent many of the problems associated with ageing, but that further research needs to be undertaken into the use of Tai Chi as a therapeutic tool for combating chronic disease.

© 2000 Harcourt Publishers Ltd.

Andrzej Jancewicz BSc(Hons), MRSS(T), FSMT Sports Massage Therapist, Clinical supervisor, Polyclinic, University of Westminster, London

Correspondence to: A. Jancewicz E-mail: [neuroki@aol.com](mailto:neuroki@aol.com) Received February 2000  
Revised and Accepted March 2000

..... Journal of Bodywork and Movement Therapies (2001) 5(1), 70-77

C, 2001 Harcourt Publishers Ltd doi:10.7054/jbmt.2000.0178, available online at <http://www.widealibrary.com> on IDE \* . !'

## Introduction

There is an increase in evidence that supports the hypothesis that exercise is of benefit for many conditions in ageing people, e.g. osteoporosis (McMurdo et al. 1997) and coronary artery disease, although the long-term benefits are still to be proven (Naughton 1992), as well as low intensity aerobic training for lowering blood pressure in hypertensive elderly people (Motoyama et al. 1998). Although physical strength tends to decline with age (Bemben 1998), the primary reason for this is due to decreasing use of the musculoskeletal system and changes in lifestyle (Payton & Poland 1983), factors that are reversible through exercise (Klitgard 1990). Ageing and the process of ageing is a normal biological process. It is important to stress that there is no set period at which old age starts. The physical conditions of ageing depends on a complex interaction of factors, and any generalizations concerning elderly people should be read with caution.

The history of Tai Chi can be controversial. It is generally assumed that Tai Chi (also called Tai Chi Chuan, Taijiquan, TaiChi Quan or T'ai Chi) has its beginnings some 300 years ago in the late Ming and early Qing dynasties of China (Wolf 1997), although its roots are steeped in Taoist philosophy and go back to 300 BC (Reid & Croucher 1987). Legend has it that Chang Sanfeng, a thirteenth century Taoist monk originated Tai Chi Chuan by adopting an earlier martial art form used by monks for protection (McFarlane 1997). Although Tai Chi is a martial art, it has many therapeutic qualities. This is because the emphasis on performing the movements of Tai Chi is not on exertion or strength, but on concentration, balance and relaxation which makes it particularly popular with millions of elderly Chinese people (Micozzi 1996). There are basic principles in Tai Chi irrespective of which style is practised. These include relaxation and extension of the body with an awareness of trunk alignment. The knees are kept bent and movement is achieved through shifting weight slowly from one leg to another. The sequence of movement begins in the waist and upper hips while maintaining a half squat position (Fig. 1), and progresses to the distal limbs which make careful and gentle circling and pushing gestures (Wolf et al. 1997). There is also emphasis placed on correct breathing.

Furthermore, Tai Chi, like all eastern movement therapies, e.g. yoga and qigong, incorporates a mind-body approach in rehabilitation of disorders, which distinguishes it from most western rehabilitation methods (Farrell et al. 1999).

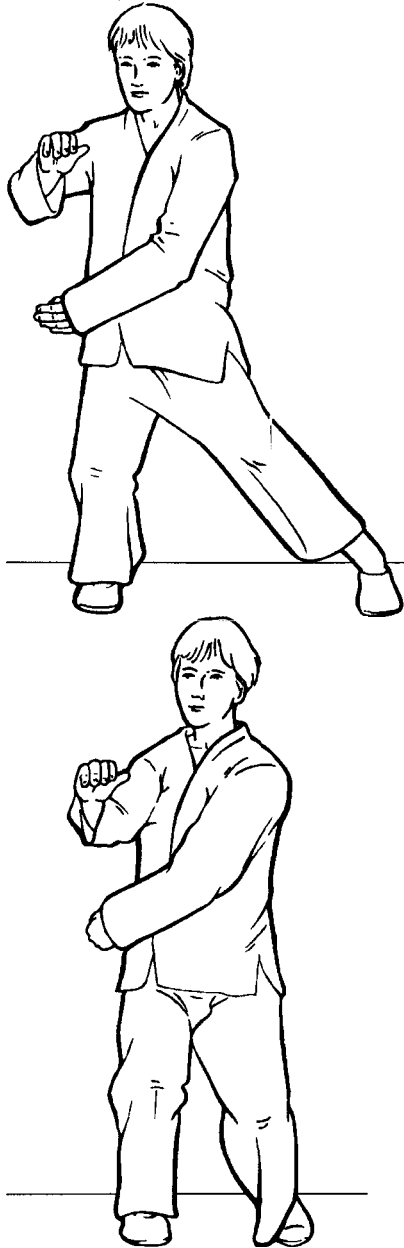


Fig. i. 'Waving hands in the clouds' - an example of using the waist and shifting bodyweight.

The early studies that were conducted into the benefits of Tai Chi, and which were performed in China, are unfortunately not very well researched (Wolf 1997). The first US publication of Tai Chi literature was in 1982 and was written by an Australian physician, a self report on the effects of Tai Chi on ankylosing spondylitis (Koh 1981), whereas the first clinical study to incorporate the philosophical principles of Tai Chi and a control group was conducted in 1987 (Wolf). Since then there has been a wide range of studies conducted in other countries including Canada, Taiwan and the UK.

## **Contemporary knowledge**

### **Balance control and reducing falls in the elderly**

The risk of falling in some elderly people increases due to the rise of specific chronic disabilities (Tinetti et al. 1986). Falls and the resulting injuries among elderly people in the UK are the most frequent and serious public health and medical problems associated with ageing (Simpson 1993). It is also the sixth leading cause of death among people over 65 in the USA (Province et al. 1995). Research has shown that moderate Tai Chi exercise can help to reduce falls and has physiological benefits for the older person (Wolf et al. 1996). One of the theories as to why Tai Chi improves balance control in the

elderly is that despite consisting of slow movements, it nevertheless requires whole body coordination (Woollacott & Tang 1997). A study of Tai Chi and postural control in the well elderly concluded that when comparing performance of elderly Tai Chi practitioners and non practitioners, the Tai Chi practitioners had significantly better postural control than the sedentary non practitioners in three out of five balance tests (Tse & Bailey 1992).

Another study compared Tai Chi and computerized balance training (Wolf et al. 1996). Unlike the research mentioned above by ShuKuen Tse, which only used a comparison of nine Tai Chi practitioners with nine non practitioners, this research used a total of 200 ambulatory participants, 162 women, 38 men, with an average age of 76.2 years. In this study, the two exercise systems were evaluated over a period of 15 weeks. The effects of exercise were recorded according to biomedical data, the occurrence of falls, and functional and psychosocial indicators of frailty. Throughout the study, falls were monitored continuously and the scores according to the indicators were taken before and after intervention, and also 4 months later. There were a number of favourable outcomes associated with Tai Chi. These included less loss in left hand grip strength, lowered systolic blood pressure after a 12 min walk and reduced fear of falling.

A different study using Tai Chi for balance control and strength training involved 3 months of intensive balance and/or weight training followed by 6 months of low intensity Tai Chi training for maintenance of gains. This involved 110 healthy participants, average age 80 (Wolfson et al. 1996). This study demonstrated that the combined strength and balance group managed to maintain some of the gains made during the research through practising Tai Chi. However, the researchers point out, that a programme of balance and strength exercises instead of Tai Chi might be worth testing, as it may be more effective. Balance training on its own, improved performance which was equal to that of a level of people 3-10 years younger, whereas the strengthening programme increased isokinetic torques in the lower extremities. It is worth pointing out however, that the biggest problem with measuring the validity and reliability of balance and functional performance of elderly people is the large variety of available assessment methods (Meldrum & Finn 1993). Results therefore lack the continuity and consistency which would verify previous research.

### **Cardiorespiratory function**

Studies into cardiorespiratory responses to Tai Chi have been investigated. A study was conducted at the School of Physical and Health Education, University of Toronto, Canada, in order to determine the physiological demands of Tai Chi (Zhuo et al. 1984). Oxygen cost, related metabolic variables, heart rate and blood pressure were monitored, as well as flexibility scores. The participants in this study were on average 28.4-years-old. It was found that Tai Chi had a therapeutic value for conditions of increased tension, and the improved flexibility scores suggested an increase in the range of motion in joints, however, there was insufficient metabolic intensity in order to have any significant effect on cardiorespiratory function. It is of importance to remember that this study was conducted on healthy young male adults.

In 1995 a research project was conducted in a hospital-based exercise physiology laboratory, into cardiorespiratory function among older individuals regularly practising Tai Chi (Lai et al. 1995). Eighty-four healthy adults, with an average age of 64 years took part. Twenty-three males and 22 females had been practising Tai Chi regularly for between 6.7 and 3.3 years. The control group consisted of 18 female and 21 male sedentary subjects of the same body size and age as the practising Tai Chi group. This study compared the cardiorespiratory function of both groups over a period of 2 years. The results suggest that with regular practise, Tai Chi

may maintain and slow down the gradual loss of cardiorespiratory function in ageing people. This is a direct contradiction of the study by Dahong Zhuo. The apparent aerobic effects achieved in this study might be explained by the fact that Tai Chi involves various concentric and eccentric contractions, performed in a semi squatting postures that place moderate demand on the legs. In addition the participants practised Tai Chi three times a week for one hour, suggesting that Tai Chi for ageing people is aerobic in nature, although moderate in intensity (Lai et al. 1995). Therefore, the evidence suggests that the decline in cardiorespiratory function in ageing people can be delayed through practising Tai Chi, but that it is not intense enough to improve the cardiorespiratory function in younger people.

Another study to determine the fitness of elderly Tai Chi practitioners with between 5 and 11 years of experience was conducted at a hospital-based exercise physiology laboratory, with 76 people taking part, mean age 70 (Lan et al. 1996). The Tai Chi group consisted of 22 men and 19 women, matched in body size and age by the control group, which consisted of 18 men and 17 women who had not performed any systematic exercise programme for at least 5 years. The researchers found that in the Tai Chi group there was a higher peak oxygen uptake when performing peak exercise, as well as at the ventilatory threshold. In comparison with the control group, the Tai Chi practitioners had a lower percentage of body fat and greater flexibility. They concluded that Tai Chi encouraged health-related fitness in ageing people.

A study by The National Taiwan University Hospital and Chang Gung Memorial Hospital (Lan et al. 1999), demonstrated that Tai Chi *Tai Chi Chuan* could be used as a cardiac rehabilitation treatment for low risk patients who have undergone coronary artery bypass operation. The results suggest that Tai Chi could enhance cardiorespiratory function in low risk patients in a phase II supervised outpatient programme. Cardiorespiratory function and blood pressure levels were measured over a period of one year, for both the Tai Chi group and control group who performed a home-based self adjusted exercise programme. However, only 29 patients with an average age of 56.5 years participated in this study, nine in the Tai Chi group and 11 in the control group. Given the number of subjects who took part, this paper can only be regarded as a pilot study. Furthermore, despite having coronary artery bypass surgery, the subjects were relatively young. The results nevertheless may have implications for prescription of health care exercises for elderly people.

Research undertaken by The Chinese University of Hong Kong (Hong et al. 2000), showed overall improvement in cardiovascular fitness, balance control and flexibility among older Tai Chi practitioners. The authors suggest that short-term Tai Chi practice had little effect on a number of parameters. In this study, 28 male Tai Chi practitioners, mean age 67.5 and with an average of 13.2 years Tai Chi experience, were compared to a control group of 30 sedentary men, mean age 66.2. A number of measurements were taken to determine balance, flexibility and cardiovascular fitness. The Tai Chi group showed significantly better scores in all measurements.

The authors concluded that long-term regular practice of Tai Chi has a more positive effect than short-term Tai Chi exercise on physical conditions in elderly adults.

### **Tai Chi and psychological factors**

The loss of independence as a result of ageing can lead to the loss of full autonomy and a range of associated mental and emotional problems, not least with loneliness, depression and ultimately social integration (Arnetz 1985). Group exercises - &.n encourage the development of social support, for example, by forming friendships outside of the class and a sharing of similar problems (Crook et al. 1998). Tai Chi can change the physiological and psychological functioning in practitioners, with increased noradrenaline excretion in urine, decreased salivary cortisol concentration and raised heart rate (Jin 1989), leading to a less general mood disturbance with feelings of more vigour and less tension, anger, fatigue, confusion, state anxiety and depression. Indeed, the social understimulation and isolation of elderly people can have a wide range of metabolic and psychoendocrine effects (Arnetz et al. 1983), including an increase in plasma levels of testosterone, dehydroepi and rosterone, estradiol and an increase in haemoglobin Alc. Furthermore, a study conducted by a Department of Psychology in Australia, suggests that whilst enhancing vigour, Tai Chi can reduce mental and emotional stress, reduce salivary cortisol levels can improve mood states, although the author admits, that this could be due to the high expectancy level of people practising Tai Chi (Jin 1992). Nevertheless, group programmes such as Tai Chi could counter social isolation and maintain mental health (Wienfield 1994). Furthermore, the sense of involvement in activities of interest and rehabilitation could maintain enthusiasm for life while recovering from disabling ailments (Buddenberg 1998). It is important to remember that not only the biomechanical and physiological benefits of Tai Chi are addressed in group exercise, but that the psychological benefits of Tai Chi group exercise classes should also be recognized. As such, more research needs to be undertaken in this area. It must also be recognized that not everyone will be comfortable participating in group exercises.

## Miscellaneous

Other studies into Tai Chi include its safety and potential use as a weightbearing exercise for rheumatoid arthritis patients in two separate studies (Kirsteins et al. 1991). These searchers found that, practised once or twice a week for 10 weeks, Tai Chi does not exacerbate joint symptoms in people, aged between 37 and 72, with rheumatoid arthritis in comparison with the control group, which performed self applied range of motion exercises. Despite serious design flaws the outcome of this research has important implications in regard to ageing people. For example the testing of hand grip strength improved overall in the Tai Chi group. This is consistent with the study done into a comparison between Tai Chi and computerized balance training (Wolf 1996) in which the left hand grip strength was found to be less likely to decline; and also consistent with a study (Wolf 1996) where there was an increase in hand grip strength in ageing people practising Tai Chi, in comparison with a non practising control group. Hand grip strength is of extreme importance in ageing people, in order for them to maintain independence. It is not at all clear as to how Tai Chi can slow down decline in, or improve, hand grip strength. It is possible that the posture 'single whip' or 'fist under elbow' or other postures might be responsible for producing this benefit (Fig. 2).

Other studies which are of interest include a comparative study of Tai Chi with Wing Chun (Schneider & Leung 1991) which evaluated respiratory and metabolic responses. Wing Chuan, which translates as 'beautiful springtime', is a style of martial art which originates from southern China. Legend has it that a woman called Yim Wing Chun was taught the art by a Shaolin nun called Ng Mui (Lewis 1998). In this study of martial arts experts, unspecified age, a lower ventilatory equivalent for oxygen was shown by Tai Chi practitioners. This may suggest that practising Tai Chi results in better breathing pattern than Wing Chun, which is more of an energetic martial art and therefore less useful for the elderly. This in turn may suggest that Tai Chi breathing patterns are more useful than higher intensity exercises, which is relevant in regard to possible benefits in ageing people. The University of Connecticut Health Centre in America (Judge et al. 1993) conducted a study into the effects of 12 weeks balance and resistance training performed three times a week, on gait measures and strength in participants, average age 82. The control group performed weekly flexibility exercises from a chair. Tai Chi played a prominent part in the balance exercises, as balance plays a role in gait velocity (Imms & Edholm 1981). The researchers confirmed that this was the case.

In a recent paper, the authors suggest that Tai Chi used in combination with traditional Chinese medication can change patients pain outcomes via neuroendocrine immune functioning (Yocum et al. 2000).

In a pilot study carried out at the University of South Alabama, the authors (Ross et al. 1999) evaluated the effects of Tai Chi on movement,

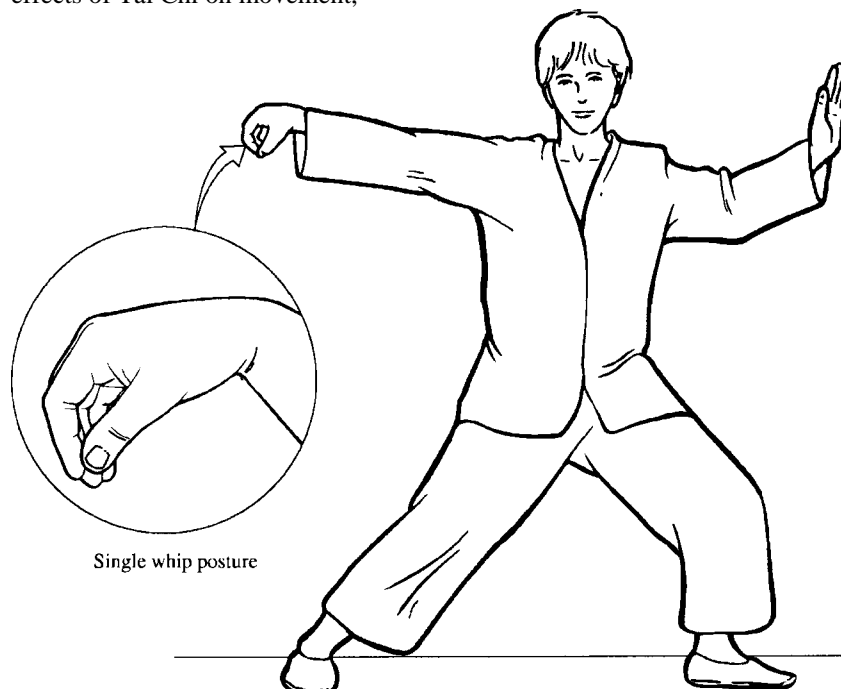


Fig. 2. Postures responsible for increasing hand grip strength.

pain and mood in the elderly. Improvement was noted in all of the measured parameters. Both papers suggest that the effects of Tai Chi exercise on practitioners can lead to an overall improvement in their quality of life.

Multiple sclerosis (MS) is a progressive disease of the central nervous system and usually starts in the third decade of life (Smith et al. 1999). However, because of other medical problems that can affect elderly people, the late onset of MS could well be overlooked. Furthermore, the disease can be slowly progressive, or it can be

briefly active in young age and then resume again in older age. For this reason it is worth mentioning the pilot study by Mills et al. (2000). Eight subjects took part in an intervention programme which included Tai Chi exercises. Unfortunately, and by the authors' own admission, it is not clear whether the positive outcomes recorded were due to Tai Chi, Qi Gong, self massage (tui na), audio and video teaching aids, or a combination of these. In short there were too many variables to warrant a replication utilizing a larger sample size, as it is not at all clear which aspect of the programme is responsible for improvement.

## Discussion

This literature review attempts to provide evidence of the value of Tai Chi in maintaining and also improving balance, aerobic power (cardiopulmonary), preserving muscular strength (musculoskeletal benefits) and preserving mental and emotional wellbeing in the elderly. Using martial arts as a therapeutic tool in the UK is not a new idea (Robertson 1993). However, there remain a number of questions that need to be answered. For example, most of the studies mentioned were conducted on ageing people who were in good health. Although this is still commendable, it nevertheless leaves the question of 'does Tai Chi maintain independence in ageing people "with" chronic disease?', unanswered. It is of interest to note that other health care professionals are taking an interest (Fisher & Ward 1994) and are quite happy to implement and use Tai Chi on people who are not just ambulatory, but also who sometimes have debilitating conditions. For example, working with physically handicapped people (Dennis 1996), cardiac rehabilitation therapy (Channer et al. 1996) and in the author's experience of teaching Tai Chi to elderly people recovering from mild stroke, Parkinsons or chronic balance problems as part of their rehabilitation and ongoing physiotherapy treatment using the elderly mobility scale (Smith 1994). In the authors' opinion, more research is required in this area, i.e. does Tai Chi maintain independence in ageing people 'with' chronic disease, and how effective and safe is it in those situations? For example, mild exercise may lower blood pressure (Sakai et al. 1998), which in the long run is associated with better survival in the elderly (Glynn et al. 1995), but a distinction needs to be made between a healthy rise in blood pressure in the elderly, as a fall may indicate disease (Starr et al. 1998).

Another question that needs to be answered is, which style of Tai Chi is most effective therapeutically? Although all Tai Chi styles have the same fundamental theoretical ideas and standard principles (Horwitz et al. 1987), there are nevertheless postural differences which emphasize the contraction and stretching of different muscle groups, as well as a difference in the speed and type of energy used, e.g. Chen style and spiralling energy (Frantzis & Abel 1988). Would one style be more suited to a particular condition or person? Furthermore, and perhaps most importantly, by 'what standard should people who teach Tai Chi be measured?' (Frontline 1998).

## Conclusion

Age brings with it an apparently imperative loss of physical performance and body mass (Bemben 1998). As a result many ageing people live close to the border line of being functionally independent, that is to say, remaining able to perform functionally important activities. A loss of independence, sometimes can have a catastrophic impact on the quality of their lives. Primary healthcare, and in particular physiotherapy, is underresourced with limited resources available to provide for the increasing demands being made on NHS services. The outcome is that many ageing people, especially in nursing homes, miss out on therapy that could make the difference between being mobile and independent or requiring nursing care (Johnstone et al. 1993). Furthermore, with understaffing and financial constraints, there are increasing difficulties in filling vacancies with suitably qualified physiotherapy practitioners (Palastanga 1995). One way of easing this problem could be by undertaking group exercise classes (Crook et al. 1998), of which Tai Chi is a very good example (Henderson et al. 1998).

There is a growing body of evidence regarding the efficacy of Tai Chi interventions in improving or maintaining function in older people (Ross et al. 1998). In my opinion, the study and research carried out in more recent times has been to a high standard and implies that Tai Chi should indeed be used at the forefront of primary and maintenance interventions. Tai Chi has the advantage that it can be implemented at low cost and is also a low technology approach to conditioning that can be used in different facilities throughout the community. Costs for staff and equipment is minimal, convenience is maximal (Blair & Garcia 1996). Tai Chi can help maintain strength and balance gains (Woollacott & Tang 1997), reduce the risks of multiple falls (Henderson et al. 1998), and increase aerobic function (Lan et al. 1998), as well as reduce mental and emotional stress through its effect in group work as a social supporting and therapeutic modality (Uchino et al. 1996).

## REFERENCES

- Arnetz BB, Theorell T, Levi L, Kallner A, Eneroth P 1983 An experimental study of social isolation of elderly people: psychoendocrine and metabolic effects. *Psychosomatic Medicine* 45: 395-406
- Arnetz BB 1985 Gerontic occupational therapy psychological and social predictors of participation and therapeutic benefits. *American Journal of Occupational Therapy* 39: 460-465
- Bemben MG 1998 Age related - alterations in muscular endurance. *Sports Medicine* 25:259-269
- Blair SN, Garcia ME 1996 Get up and move: A call to action for older men and women. *Journal of the American Geriatrics Society* 44: 599-600
- Buddenberg LA 1998 Getting the elderly back on their feet. *Topics in Geriatric Education* 13: 52-68
- Charner KS, 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. *Postgraduate Medical Journal* 72: 349-351
- Crook P, Stott R, Rose M, Peters S, Salmon P, Stanley I 1998 Adherence to group exercise - physiotherapy led experimental programmes. *Physiotherapy* 84: 366-372
- Dennis M 1996 Gently does it. *Therapy Weekly*, April 18, 1996
- Farrel SJ, Ross AD, Sehgal KV 1999 Eastern movement therapies. *Physical Medicine and Rehabilitation Clinics of North America* 10: 617-629
- Fisher P, Ward A 1994 Complementary medicine in Europe. *British Medical Journal* 309: 107-110
- Frantzis B, Abel J 1988 Tai Chi for health. *Fighting Arts International* 9: 50-52
- Frontline 1998 A certified training course in Tai Chi Chuan as a cardiac rehabilitation therapy in conjunction with the cardiology department. 4: 29
- Glynn RJ, Field TS, Rosner B, Hebert PR, Taylor JO, Hennekens CH 1995 Evidence for a positive linear relation between blood pressure and mortality in elderly people. *The Lancet* 345: 825-829
- Henderson NK, White CP, Eisman JA 1998 The roles of exercise and fall risk in the prevention of osteoporosis. *Endocrinology and Metabolism Clinics of North America* 27: 369-387
- Hong Y, Man J, Robinson PD 2000 Balance control, flexibility, and cardiorespiratory fitness among older Tai Chi practitioners. *British Journal of Sports Medicine* 34: 29-34
- Horwitz T, Kimmelman S, Lui HH 1987 *Tai Chi Chuan - the technique of power*. Rider, London
- Imms FJ, Edholm OG 1981 Studies of gait and mobility in the elderly. *Age Ageing* 10: 147-156
- Jin P 1989 Changes in heart rate, noradrenaline, cortisol and mood during Tai Chi. *Journal of Psychosomatic Research* 33: 197-206
- Jin P 1992 Efficacy of Tai Chi, briskwalking, meditation and reading in reducing mental and emotional stress. *Journal of Psychosomatic Research* 36: 361-370
- Johnstone J, Judd M, Langley J et al. 1993 Can older people resident in private nursing homes receive NHS physiotherapy? *Physiotherapy* 79: 403-1105
- Judge JO, Underwood M, Gennosa T 1993 Exercise to improve gait velocity in older persons. *Archives of Physical Medicine and Rehabilitation* 74: 400-406
- Kirsteins AE, Dietz F, Hwang SM 1991 Evaluating the safety and potential use of a weight-bearing exercise, Tai Chi Chuan, for rheumatoid arthritis patients. *American Journal of Physical Medicine and Rehabilitation* 70: 136-141
- Klitgaard H, Mantoni M, Schiaffino S et al. 1990 Function, morphology and expression of ageing of skeletal muscle - a cross sectional study of men with different training backgrounds. *Acta Physiologica Scandinavica* 140: 41-54
- Koh TC 1981 Tai Chi Chuan. *American Journal of Chinese Medicine* 9: 15-22
- Lai JS, Lan C, Wong MK, Teng SH 1995 Two year trends in cardiorespiratory function among older Tai Chi Chuan practitioners and sedentary subjects. *Journal of the American Geriatrics Society* 43: 1222-1227
- Lan C, Lai JS, Wong MK, Yu ML 1996 Cardiorespiratory Function, Flexibility, and Body Composition Among Geriatric Tai Chi Chuan Practitioners. *Archives of Physical Medicine and Rehabilitation* 77: 612-616
- Lan C, Lai JS, Chen SY, Wong MK, 1998 12 month Tai Chi training in the elderly: its effect on health fitness. *Medicine and Science in Sports and Exercise* 30: 345-351
- Lan C, Chen SY, Lai JS, Wong MK, 1999 The effect of Tai Chi on cardiorespiratory function in patients with coronary artery bypass surgery. *Medicine and Science in Sports and Exercise* 31: 634-638
- Lewis P 1998 *Myths and Legends of the Martial Arts*. Prion, London, pp 23-26
- McFarlane 1997 *The Complete Book of Tai Chi*. Dorling Kindersley London
- McMurdo MET, Mole PA, Paterson CR 1997 Controlled trial of weight bearing exercise in older women in relation to bone density and falls. *British Medical Journal* 314: 569
- Meldrum D, Finn AM 1993 An investigation of balance function in elderly subjects who have and have not fallen. *Physiotherapy* 79: 839-842
- Micozzi MS 1996 *Fundamentals of Complementary and Alternative Medicine*. pp. 225-230. Churchill Livingstone, London
- Mills N, Allen J, Carey Morgan S 2000 Does Tai Chi/Qi Gong help patients with Multiple Sclerosis? *Journal of Bodywork and Movement Therapies* 4: 39-48
- Motoyama M, Sunami Y, Kinoshita F et al. 1998 Blood pressure lowering effect of low intensity aerobic training in elderly hypertensive patients. *Medicine and Science in Sports and Exercise* 30: 818-823
- Naughton J 1992 Exercise training for patients with coronary artery disease. *Sports Medicine* 14: 304-319
- Palastanga N 1995 Manpower planning and the physiotherapy profession. *Physiotherapy* 81: 393-397
- Payton O, Poland J 1983 Ageing process - implications for clinical practice. *Physical Therapy* 63: 41-48
- Province MA, Hadley EC, Hombrook MC et al. 1995 The effects of exercise on falls in elderly patients. *Journal of the American Medical Association* 273: 1341-1347
- Reid H, Croucher M 1987 *The Way Of The Warrior*. pp. 8Cr117. Century, London
- Robertson D 1993 Catching *tip* with the wheelchair warriors. *Fighting Arts International* 78: 40-44
- Ross MC 1998 The therapeutic effects of Tai Chi for the elderly. *Journal of Gerontological Nursing* 24: 45-47
- Ross MC, Bohannon AS, Davis DC, Gurchiek L 1999 The effects of a shorter term exercise programme on movement, pain, and mood in the elderly. Results of a pilot study. *Journal of Holistic Nursing* 17: 139-147
- Sakai T, Ideishi M, Miura S et al. 1998 Mild exercise activates renal dopamine system in mild hypertensives. *Journal of Human Hypertension* 12: 355-362
- Schneider D, Leung R 1991 Metabolic and cardiorespiratory responses to the performance of Wing Chun and Tai Chi Chuan exercise. *International Journal of Sports Medicine* 12: 319-323
- Simpson JM 1993 Elderly people at risk of falling: the role of muscle weakness. *Physiotherapy* 79: 831-835
- Smith ME, Eller NL, McFarland HF, Racke MK, Raine CS 1999 Age dependence and pathological manifestations of autoimmune demyelination. Implications for multiple sclerosis. *American Journal of Pathology* 155: 1147-1161

- Smith R 1994 Validation and reliability of the elderly mobility scale. *Physiotherapy* 80: 744-747
- Starr MJ, Inch S, Cross S, MacLennan WJ, Deary IJ 1998 Blood pressure and ageing: longitudinal cohort study. *British Medical Journal* 317: 513-514
- Tinetti ME, Franklin Williams T, Mayewski R 1986 Fall risk index for elderly patients based on number of chronic disabilities. *The American Journal of Medicine* 80: 429-434
- Tse SK, Bailey DM 1992 Tai Chi and postural control in the well elderly. *American Journal of Occupational Therapy* 46: 295-300
- Uchino BN, Cacioppo JT, Kiecolt-Glaser JK 1996 The relationship between social support and physiological processes: a review with emphasis on underlying mechanisms and implications for health. *Psychological Bulletin* 119: 488-531
- Wienfield HR 1994 The nature and elicitation of social support: some implications for the helping professions. *Behavioral Psychotherapy* 12:318-330
- Wolf SL, Barnhart HX, Kutner NG et al. 1996 Reducing frailty and falls in older persons: an investigation of Tai Chi and computerized balance training. *Journal of the American Geriatrics Society* 44: 498-497
- Wolf SL, Coogler C, Xu T 1997 Exploring the basis of Tai Chi Chuan as a therapeutic exercise approach. *Archives of Physical Medicine and Rehabilitation* 78: 886-892
- Wolfson L, Whipple R, Derby C et al. 1996 Balance and strength training in older adults: intervention gains and Tai Chi maintenance. *Journal of the American Geriatrics Society* 44: 498-506
- Woollacott MH, Tang PF 1997 Balance control in the older adult: research and its implications. *Physical Therapy* 77: 646-658
- Yocum DE, Castro WL, Cornett M 2000 Exercise, education, and behavioral modification as alternative therapy for pain and stress in rheumatic disease. *Rheumatic Diseases Clinics of North America* 26: 145-159
- Zhuo D, Plyley MJ, Davis GM 1984 Cardiorespiratory and metabolic responses during Tai Chi exercise. *Canadian Journal of Applied Sports Science* 9: 7-1