REVIEW

The impact of Tai Chi exercise on coronary heart disease: A systematic review

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Abstract

Purpose: (a) To explore current studies on Tai Chi and its impact on coronary heart disease (CHD), (b) provide critique of existing studies, and (c) provide recommendations for clinical practice and future research.

Data sources: Comprehensive review of literature.

Conclusions: Tai Chi is a safe alternative exercise for patients who are at risk of CHD or with existing CHD. Implementing Tai Chi exercise may improve serum lipids, blood pressure, and heart rate.

Implications for practice: Nurse practitioners (NPs) are in an ideal position to facilitate health promotion and disease prevention. NPs may prescribe Tai Chi as an alternative exercise therapy for their patients who are at risk for developing CHD and even for those with existing CHD. Tai Chi exercise may help prevent and even reverse the progression of cardiac disease.

Coronary heart disease (CHD) is the leading cause of death in the United States (U.S.). Nearly every 25 seconds, an American will have a coronary event related to CHD, and every minute someone will die from one (American Heart Association [AHA] Heart Disease & Stroke Statistics, 2011 Update). The literature reflects that many of the major risk factors of CHD are modifiable (Smeltzer, Bare, Hinkle, & Cheever, 2008). In fact, the major risk factors for CHD—physical inactivity, overweight, hypertension (HTN), and elevated serum lipids—remain a major issue for most Americans (AHA, Heart Disease & Stroke Statistics, 2011 Update).

However, there are treatment approaches to combat these problems that include both pharmacological and nonpharmacological modalities. Although pharmacological therapy for HTN and hyperlipidemia is often emphasized in clinical research (Wang, Lan, Chen, & Wong, 2002), nonpharmacological therapy and lifestyle modifications, such as physical activity, are also recognized by The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7, 2009) as an alternative approach for preventing CHD.

Regular physical activity in the form of exercise has been used as an alternative therapy for many cardiovascular diseases, particularly CHD (Anspaugh, Hunter, & Dignan, 1996). The National Heart, Lung, and Blood Institute and AHA highly recommend exercise to individuals with and without CHD as a result of its impact on cardiovascular health. It is well documented that exercise prevents and even reverses CHD (Apullan et al., 2008; Freeman, 2009), combating risk factors such as hyperlipidemia, HTN, obesity, and type 2 diabetes mellitus (Booth, 2000). Exercise improves serum lipids in patients with hyperlipidemia by lowering serum triglyceride levels, total cholesterol, and low-density lipoprotein cholesterol (LDL-C) levels, while increasing high-density lipoprotein cholesterol (HDL-C) levels (AHA, Heart Disease & Stroke Statistics, 2011 Update; Anspaugh et al., 1996; CDC, 2001; Rothenbacher, Koenig, & Brenner, 2006; Tran & Weltman, 1985). Even intermittent or several short exercise sessions can positively alter serum lipids. In sedentary individuals, lipoprotein and lipid changes can even occur after a single exercise session when one expends at least 350 kcal (Altena, Michaelson, Ball, & Thomas, 2004; Crouse,

The U.S. Department of Health and Human Services (2008) developed a list of recommendations on health promotion and disease prevention outlined in the Healthy People 2010 Objectives. Reduction of cardiovascular deaths and promotion of physical activity are two of the major goals outlined in this document. Therefore, healthcare providers are encouraged to promote healthy lifestyle by counseling their patients to engage in physical activity to reduce CHD risks.

Many individuals engage in exercise programs that are enjoyable and interesting to them. In addition, exercises that are low impact, do not require special equipment, and are low in cost are more appealing to individuals regardless of age, race, and gender (Maxwell, Bastani, Vida, & Warda, 2002). One type of low-impact exercise that has gained popularity in recent years is Tai Chi. Studies have shown associations between Tai Chi exercise and improved cardiovascular health. Tai Chi reduces CHD risk by improving blood pressure (BP; Yeh, Wang, Wayne, & Phillips, 2008) and serum lipids (Lan, Chen, Wong, & Lai, 2008a; Lan, Su, Chen, & Lai, 2008b; Taylor-Piliae & Froelich, 2004; Taylor-Piliae, Haskell, & Froelicher, 2005; Taylor-Piliae, Haskell, Scotts, & Froelicher, 2006; Thomas et al., 2005; Tsai et al., 2003; Zhang & Fu, 2008). Furthermore, Tai Chi has been shown to be as equally effective as aerobic exercise in reducing both systolic and diastolic BP (Young, Appel, Jee, & Miller, 1999).

Theoretical base and therapeutic uses of Tai Chi

Tai Chi, also known as Tai Chi Chuan or Shadow Boxing, is a mind-body practice that originated in China in approximately 12th century A.D. and is currently used as an alternative form of physical activity practiced in the U.S. and other parts of the world (National Center for Complementary and Alternative Medicine [NCCAM], NCAAM, 2011; Tsai et al., 2003). The underlying concept of Tai Chi is based on the Chinese philosophy of Yin and Yang forces. According to this concept, Yin and Yang make up the universe. Yin is believed to have the qualities of water (characterized by coolness, darkness, stillness, and inward and downward directions) and to be feminine in character (characterized by gentleness). Yang is believed to have the qualities of fire (characterized by heat, light, action, and upward and outward movements) and to be masculine in character. Based on this philosophy, the Yin and Yang need to be in harmony in order for the individual to be disease free (NCCAM, 2011).

Tai Chi is well known for its slow, rhythmic movements, breathing, and concentration. Lan et al. (2008a) described Tai Chi as a low- to moderate-intensity exercise, consisting of several different movements (also known as postures or routines), styles, and variations. The most popular types are the long form (also known as Yang or the classic type) and the short form (also known as the competition style). Researchers have centered their attention on both of these forms of Tai Chi in cardiovascular research because of their popularity in the community.

Problem statement and purpose

The most predictive and statistically strongest modifiable risk factors of CHD are hyperlipidemia, HTN, and lack of physical activity (Freeman, 2009; Karalis, 2009). While hyperlipidemia causes formation of plaque, which leads to hardening of the coronary arteries (AHA, Heart Disease & Stroke Statistics, 2011 Update; Huether & McCance, 2004; Nakazomo et al., 1991), both hyperlipidemia and HTN have negative effects on the arterial wall as they both cause atherosclerosis. If not treated, these effects can lead to a myocardial infarction, a life-threatening complication of CHD.

Preventing the development and progression of CHD contributes to the overall reduction in cardiovascular morbidity and mortality. However, little is known about what studies have been examined and published regarding Tai Chi and its impact on CHD. The purposes of this report were to critically examine the literature to discover the benefits of Tai Chi exercise and to evaluate what type of Tai Chi exercise is best for improving CHD. This report also includes a critique of the existing studies, including their strengths and limitations.

Methods

A literature search was conducted utilizing electronic literature searches via Medline/PubMed and the Cochrane Library database using keywords “Tai Ji,” “Tai Chi,” “Tai Chi Chuan,” “lipids,” “hyperlipidemia,” and “coronary heart disease.” Reference lists from related articles were also perused. The articles were selected based on the following criteria: (a) clinical trial studies, (b) randomized control trial studies, (c) written in English, and (d) published between the years of 1985 and 2008. When the keyword Tai Chi was entered, there were 289 studies found yet only 12 related to CHD. However, five of these articles were eliminated because they did not meet the inclusion criteria for the search.
Review and results

Overview of research literature

The variables evaluated in the studies reviewed for the purposes of this report were serum lipids, BP, and heart rate (HR). Each study examined a combination of these variables.

Serum lipids

Two studies examined Tai Chi’s effect on serum lipids in a 12-month Tai Chi exercise program (Lan et al., 2008b; Thomas et al., 2005). Because resistance training has been reported to improve skeletal muscle mass, memory, and well-being (Dunn, Trivedi, & O’Neal, 2001; Fielding, 1995; George & Goldberg, 2001; Perrig-Chiello, Perrig, Ehrsam, Staehelin, & Krings, 1998), Thomas et al. (2005) compared the effect of resistance training and Tai Chi exercise on cardiovascular risk factors. They examined three groups (Tai Chi, N = 64; resistance group; N = 65, control, N = 78). Lan et al. examined two groups of patients with hyperlipidemia and HTN (Tai Chi, N = 28; control, N = 25).

The investigators in these studies differed in their sample selection method and the type of Tai Chi that they implemented. Lan et al. (2008b) used convenience sampling and the classic Yang form of Tai Chi that consists of 108 movements. Thomas et al.’s (2005) study used random selection of sample and utilized the short form of Tai Chi consisting of 24 movements. These studies employed similar exercise length (1 h, three times per week), but they differed in overall exercise sessions. Lan et al. included 20-min warm-up and 10-min cool-down periods in their study, and Thomas et al. (2005) included 15-min warm-up exercise, but no cool-down period.

In Lan et al.’s (2008a, 2008b) research, participants in the Tai Chi group showed a significant improvement in their serum triglyceride levels (p = .024), total cholesterol levels (p = .025), LDL-C levels (p = .016), and an increase in the HDL-C levels compared to the control group. There were no conclusions made by the authors regarding the effect of Tai Chi on serum lipid in Thomas et al.’s (2005) study. However, their study revealed that Tai Chi decreases serum blood glucose levels.

Two of the studies examined the effect of Tai Chi exercise on lipid profile of randomly selected patients with HTN (Tsai et al., 2003) and type 2 diabetes mellitus (Zhang & Fu, 2008) using group comparison. These studies employed a shorter duration of a Tai Chi exercise program (between 3 and 4 months). Both groups practiced Tai Chi three times per week and used either the short or the long form. Tsai et al. (2003) used the classic Yang style, and Zhang and Fu (2008) implemented the short style. The length and sessions noted in these studies also varied, as Tsai et al. (2003) used a 50-min exercise session, including a 10-min warm-up and a 10-min cool-down period. Zhang and Fu (2008) used a 70-min exercise session including a 10-min warm-up without a cool-down period. The age ranges of the participants in these studies also varied. In Tsai et al.‘s (2003) study, younger participants, between 37 and 65 years old (mean age was 52 years), were included in their study. Zhang and Fu (2008) included participants who were older (57–63 years).

The Tai Chi group in Tsai et al.’s (2003) showed an overall improvement of their serum lipids compared to the control group. There was a significant reduction in the Tai Chi group’s total cholesterol (205.2–190.0 mg/dL, p ≤ .05), triglyceride levels (172.4–148.6 mg/dL, p ≤ .05), and LDL-C levels (130–110 mg/dL, p ≤ .05). There was also a significant increase in their HDL-C levels (51.2–55.9 mg/dL, p ≤ .05) compared to the control group.

These findings are consistent with Zhang and Fu’s (2008) study outcome. They also used group comparison (Tai Chi, N = 10; control group, N = 10). Those who participated in the Tai Chi exercise program had a reduction in their total cholesterol, triglycerides, and LDL-C levels and had an increase in their HDL-C levels. A significant difference in the triglyceride levels was found in these studies.

BP and HR

It has been documented in the literature that Tai Chi also improves BP and HR (Yeh et al., 2008). Participants who performed Tai Chi exercise for 3 months (Taylor-Piliae et al., 2006; Zhang & Fu, 2008) to 12 months (Lan et al., 2008b; Thomas et al., 2005) duration had a significant reduction in their BP and HR. Below is an overview and critique of the studies.

The type of Tai Chi exercise programs used by the investigators in these studies varied in styles, length, and overall sessions. The Yang style was used in three studies (Chang et al., 2008; Lan et al., 2008b; Wang et al., 2002) and the short form was implemented in three studies (Taylor-Piliae et al., 2006; Thomas et al., 2005; Zhang & Fu, 2008). The length of the Tai Chi programs also varied (3–12 months long) and they were implemented either two, three, or five times per week. Two of the studies were implemented for 3 months and Tai Chi was practiced three times per week (Taylor-Piliae et al.; Zhang & Fu, 2008). One study was completed in 9 months and Tai Chi was practiced two times per week (Chang et al., 2008). Two studies were completed in 12 months and Tai Chi was practiced three times per week (Lan et al.; Thomas
et al., 2005). The overall Tai Chi exercise sessions were at least 60-min long and included warm-up and cool-down periods.

Three studies implemented Tai Chi exercise for over 60 min without a cool-down period (Chang et al., 2008; Thomas et al., 2005; Zhang & Fu, 2008). These studies also differed in their sample characteristics. The majority of the participants in these studies were older (> 55 years, < 75 years). Four studies used convenience sampling (Chang et al., 2008; Lan et al., 2008b; Taylor-Piliae et al., 2006; Wang et al., 2002) and three of them had random sample selection (Thomas et al., 2005; Tsai et al., 2003; Zhang & Fu, 2008). One study had a small sample size (N = 53) and included participants who were taking medications and those who were on a special diet (Lan et al., 2008b). One study had a large sample size (N = 207), but it was conducted in China (Thomas et al., 2005).

**Discussion**

From this review, a picture emerges of the beneficial effects of Tai Chi exercise on CHD. Results indicate that practicing Tai Chi improves serum lipid profiles (Lan et al., 2008b; Thomas et al., 2005; Tsai et al., 2003; Zhang & Fu, 2008) and lowers BP and HR (Chang et al., 2008; Lan et al., 2008a, 2008b; Taylor-Piliae et al., 2006; Thomas et al., 2005; Wang et al., 2002; Zhang & Fu, 2008).

Some interesting findings were also noted in this review. All studies differed in their sample selection. In any research study, random selection of a sample is highly recommended to decrease sampling error related to systematic bias (Polit, 1996). However, despite the difference in sample selection, most studies showed similar results: improvement in serum lipids and reduction in BP and HR. This CHD risk improvement is promising; however, additional studies are needed to strengthen the findings noted in this review. All but one (Thomas et al., 2005) of the studies reviewed used a small sample size (N ≤ 100). Because small samples may limit the generalizability of any study findings, further research is needed with the inclusion of a larger population sample.

The type of Tai Chi exercise may be another factor to consider in future research. Based on this review, the classic Yang style did not show significant findings in BP and HR but showed significant results in serum lipids (Lan et al., 2008b; Tsai et al., 2003). This suggests the Yang style may benefit individuals with hyperlipidemia or those at risk for this disease, while the short form of Tai Chi may benefit those with HTN and CHD.

The participants in the studies reviewed were older (57–76 years old) except for one study (Tsai et al., 2003). In Tsai et al.’s study, the majority of the participants were younger (35–65 years old). It is unknown whether age was a confounding factor influencing the overall results of these studies. Therefore, future research is needed, including age as a variable of interest.

Gender is another factor that may impact the outcome of any study. Most investigators in the studies did not mention gender in their sample selection. It is unknown if gender was also a confounding factor that may have influenced the study results. Perhaps examination of gender differences on the effect of Tai Chi on CHD is another area that needs to be explored. One study only included female participants (Zhang & Fu, 2008), and this limits the generalizability of their findings.

The outcome of the studies that included participants who were on lipid lowering and anti-hypertensive agents (Lan et al., 2008b; Thomas et al., 2005) may not be applicable to the general population. It is unknown how much of the variability in the outcome was accounted for by the medications. Consideration of medications as a predictor in future research may also be an important area to explore.

Diet is another factor to consider in future research. Only one study (Tsai et al., 2003) mentioned diet in their research, but investigators merely stated that their participants “maintained” dietary intake throughout the study and did not describe what was included in the diet plan. Therefore, it is not known what type of diet the participants had. The type of diet may have also contributed to the study’s outcome.

Findings from this review shed important information for future research in cardiovascular disease. This is the first systematic review report that examined the effects of Tai Chi specific to serum lipids. However, this review has some limitations. Because Tai Chi is a new and emerging topic in cardiovascular research, studies focusing on CHD are limited. In addition, this review is only Medline based. There were no additional data available from other sources.

**Implications for practice**

Nurse practitioners (NPs) are in an ideal position to facilitate health promotion and disease prevention. NPs may prescribe Tai Chi as an alternative exercise therapy for their patients who are at risk for developing CHD and even for those with existing CHD.

Short exercise sessions that are intermittent or continuous, or several exercise sessions that are performed on a single day, have been shown to alter serum lipids and lipoprotein levels (Altena et al., 2004; Crouse et al., 1997; Visich et al., 1996). Based on the studies reviewed, Tai Chi exercise (either short or long form) may benefit individuals with hyperlipidemia and HTN. If practiced three times
per week for about 60 min per session, Tai Chi may significantly improve serum lipids, BP, and HR. NPs could recommend this type of exercise to their patients with borderline or Stage 1 HTN with or without hyperlipidemia (Lan et al., 2008b; Tsai et al., 2003). The intensity and duration of Tai Chi exercise meets the recommendations of major U.S. health agencies. The American College of Sports Medicine (ACSM) and AHA recommend that endurance exercise should be 30 min (of moderate intensity) per day, five times per week or 30 min (vigorous intensity) per day, three times per week, and 8–10 strength training exercises, 8–12 repetitions of each exercise two times per week (AHA, 2011; ACSM, 2007). The U.S. Department of Health and Human Services (USDHHS, 2008) and the Centers for Disease Control (2008) recommend that vigorous exercise should be at least 75 min a week of vigorous intensity or 150 min a week of moderate intensity and at least 2 days of muscle-strengthening activities that involve all major muscle groups.

Conclusions

This systematic review examined the current literature on CHD prevention, utilizing Tai Chi as primary prevention. In addition, this review explored evidence to which this nontraditional therapy positively impacts CHD. Findings from this review yield significant information on the beneficial effect of Tai Chi on CHD. Implementing Tai Chi is a useful exercise strategy for enhancing cardiovascular health. Knowledge obtained from this review may inspire researchers to further explore the cardiovascular benefits of Tai Chi. NPs are in an ideal position to reinforce health promotion by educating their patients on the importance of physical activity and the health benefits of routine exercise.

References


