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Menopause, the metabolic syndrome, and mind-body therapies

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Abstract

Cardiovascular disease risk rises sharply with menopause, likely due to the coincident increase in insulin resistance and related atherogenic changes that together comprise the metabolic or insulin resistance syndrome, a cluster of metabolic and hemodynamic abnormalities strongly implicated in the pathogenesis and progression of cardiovascular disease. A growing body of research suggests that traditional mind-body practices such as yoga, tai chi, and qigong may offer safe and cost-effective strategies for reducing insulin resistance syndrome-related risk factors for cardiovascular disease in older populations, including postmenopausal women. Current evidence suggests that these practices may reduce insulin resistance and related physiological risk factors for cardiovascular disease; improve mood, well-being, and sleep; decrease sympathetic activation; and enhance cardiovagal function. However, additional rigorous studies are needed to confirm existing findings and to examine long-term effects on cardiovascular health.

Keywords

Menopause; Metabolic syndrome; Cardiovascular disease; Yoga; Tai chi; Qigong; Mind-body; Insulin resistance

Menopause represents a period of accelerated physical, physiological, and neuroendocrine aging in women. The constellation of adverse changes that occurs in response to the altered hormonal environment characterizing menopause, especially the sharp decline in estrogens that marks this transition, results in a dramatic rise in the risk of cardiovascular disease (CVD), 1›2 currently the leading cause of death in US women.3–5 This precipitous increase in CVD risk likely reflects the coincident rise in the prevalence of specific metabolic and hemodynamic abnormalities related to insulin resistance and strongly predictive of CVD, collectively termed metabolic or insulin resistance syndrome (IRS).3›6–10 Insulin resistance (ie, resistance to insulin-stimulated glucose uptake) is generally considered the primary defect underlying IRS and is a cardinal feature linking IRS with the development of atherosclerosis and CVD.11›20 Insulin resistance is a strong independent risk factor for CVD in both diabetic21 and nondiabetic individuals21–27 and has been causally linked to elevated blood pressure,[13,28,30] dyslipidemia,[13,31,32] inflammation,[19,33] impaired fibrinolysis, [13,19] endothelial dysfunction,[13,19,32,34] sympathetic activation, [13,29,34] and other indices of CVD risk.[13,18,19] Insulin resistance increases dramatically with menopause,[1,6,7,35,36] and is considered to be a key factor underlying the abrupt increase in CVD risk among women after menopause.[6,36,37]

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Other related changes associated with menopause include increases in blood pressure,[1,7,38,40] visceral adiposity,[1,7,36] proinflammatory cytokines,[2,7,36] and oxidative stress;[41,42] reductions in glucose tolerance[1] and heart rate variability;[43–45] atherogenic changes in lipid and coagulation profiles;[1,6–8,46,47] and impairment of endothelial function.[1,6] Postmenopausal women also demonstrate reduced insulin-like growth factor-1 bioavailability,[48] a factor that may contribute to insulin resistance, impaired lipid metabolism, and other IRS-related abnormalities[12,49–53] and play an important role in the pathogenesis of CVD[54–56] and other IRS-associated disorders.[57] In addition, menopause has been independently associated with increased arterial stiffness (measured as brachial-ankle pulse-wave velocity),[58,59] a factor that has been strongly linked to insulin resistance[60–63] and the IRS.[60,64]

Menopause has also been associated with an increase in plasma catecholamines,[65] resting heart rate[44,66] and other markers of sympathetic activity,[44,66] a rise in neuroendocrine and cardiovascular reactivity,[44,67–69] and a reduction in parasympathetic tone,[44,45] factors strongly implicated in the pathogenesis of both IRS and CVD.[70–75] In addition, the menopause transition is often accompanied by depressive symptoms, including tension, anger, anxiety, and irritability,[76–79] which have been attributed in part to neuroendocrine dysregulation.[76] Such negative affective states are strongly associated with insulin resistance and other components of the IRS in a bidirectional manner[80] and are powerful predictors of CVD.[73,81–86] Sleep disturbance in women also rises dramatically during the midlife years[87] and is likewise thought to reflect sympathetic hyperactivity.[70] Sleep deprivation has been experimentally shown to promote insulin resistance and other features of IRS[70,88,89] and has been indirectly linked to CVD morbidity and mortality.[90,91] Figure 1 summarizes the key IRS-related changes that characterize menopause and are linked to increased risk of atherosclerosis and CVD.

Given that IRS-related abnormalities increase so strikingly with menopause and that the association between IRS and risk of CVD is particularly strong among middle-aged women,[3] identifying potential cost-effective strategies for reducing IRS-related risk factors for CVD in postmenopausal women is clearly warranted. Given the importance of neuroendocrine changes, sympathetic activation, and psychosocial factors in the development of insulin-resistant states and the synergistic, mutually exacerbating effects of these and other IRS-related risk factors, mind-body therapies may have promise for the prevention of CVD and other insulin resistance conditions in women post-menopause. One mind-body therapy that merits further investigation as a health promotion and therapeutic measure for older women is yoga. Yoga is an ancient discipline that is fast gaining popularity among women of all ages in Western industrialized countries as a means of reducing stress, improving emotional well-being, and enhancing health and fitness.[92–95] Widely used in India to help prevent and manage a variety of chronic insulin resistance conditions,[96–98] yoga may also offer a cost-effective intervention for at-risk Western populations. A growing body of research suggests that yoga-based interventions can improve cardiovascular risk profiles and aid in the management of CVD and other IRS-related conditions in a wide range of populations, including older women.[96,97] Similarly, recent studies indicate that certain other traditional mind-body practices such as tai chi chuan and qigong may also reduce risk for CVD and related disorders.[96,99–102] In the following sections, we review the evidence regarding the potential beneficial effects of these traditional active mind-body modalities on CVD risk profiles.

EFFECTS OF YOGA ON CVD RISK

Originating in India at least 4000 years ago, yoga is a traditional mind-body discipline that has been successfully used in India for the prevention and management of hypertension, diabetes, and related chronic insulin resistance conditions associated with aging.[94,96,97] There is increasing evidence, reviewed in detail elsewhere,[96,97] suggesting that even the short-term

practice of yoga can decrease both psychological and physiological risk factors for CVD and may attenuate signs, reduce complications, and improve the prognosis of those with clinical or underlying disease.[94,96,97] For example, controlled studies of both healthy and chronically ill adults in India, the United States, Europe, and Thailand indicate that yoga may improve glucose tolerance and serum lipid profiles[96,97] reduce blood pressure and body weight,[96,97,103,104] decrease oxidative stress,[96,97,105] and lower sympathetic reactivity.[96,97] Limited data on healthy Indian and German adults also suggest that yoga practice may improve coagulation profiles.[96,97] In addition, recent studies in Indian and European populations suggest that the practice of yoga and yoga-based meditation can improve heart rate variability and baroreflex sensitivity in both healthy and hypertensive adults.[96,97]

Similarly, there is a growing body of research suggesting that yoga therapy may also be effective in reducing psychosocial risk factors for CVD in both healthy adults and those with chronic disorders.[96,97] For example, recent controlled investigations in India,[106–116] the United States,[117–121] Europe,[122–124] Thailand,[104] Israel,[125] and Turkey[126] have reported decreased perceived stress[104,106,107,113,124] and reactivity to stressors,[123] enhanced stress-related coping,[107,117] reduced symptoms of depression[108–113,115,120,124,127] and anxiety,[108,112,113,117,119,120,124,125,128] and decreased anger[114,120,122] and fatigue[116,120–122,124,126,129] following yoga-based interventions. Likewise, recent studies in India,[116,128,130,131] Turkey,[126] and the United States[132–134] have indicated that yoga practice may improve sleep in both healthy[116,128,130,133,134] and chronically ill populations.[116,126,131,132]

Yoga's rapidly increasing popularity among older women in the Western industrialized world, coupled with the numerous recent studies suggesting that yoga-based programs may improve CVD risk profiles in older adults, indicate that yoga may represent a promising intervention for postmenopausal women at risk for CVD and related chronic disorders.

OTHER TRADITIONAL ACTIVE MIND-BODY THERAPIES TO DECREASE CVD RISK: TAI CHI CHUAN AND QIGONG

Although yoga remains perhaps the most extensively studied mind-body therapy with respect to effects on IRS-related indices of cardiovascular risk, findings from recent clinical trials suggest that other traditional active mind-body modalities, such as tai chi chuan (tai chi) and qigong, may also have promise for the prevention of CVD in postmenopausal women and other at-risk populations.

Internal qigong is a major branch of traditional Chinese medicine[135] that originated in China more than 2,500 years ago. Like yoga, qigong has many forms, blending meditation and controlled breathing techniques with precise gentle movements and postures.[102,135,136] Qigong has been practiced for hundreds of years by emperors to achieve health and longevity, by monks to attain peace and inner clarity, and by martial artists to increase inner strength and power.[135–137] Tai chi is an ancient Chinese martial art derived from qigong that traces its origins back to at least the seventh century AD.[138] Tai chi is thought to have originated as a formal discipline in the 13th century with the teachings of the legendary Taoist monk Zhang San Feng.[138,139] Although there are multiple styles of tai chi (Chen, Yang, Old Wu, Wu, and Sun), all combine deep diaphragmatic breathing with specific postures that are performed in a coordinated, dancelike sequence of slow, graceful movements.[101,138,140–143] Due to the typically slow pace, gentle nature, and low impact movements characterizing tai chi and qigong, these practices are particularly appropriate for older individuals.[144] Qigong and tai chi are practiced widely in China to promote physical, mental, and spiritual health; to improve balance and flexibility; and to enhance memory and concentration.[99,102] Like yoga, these ancient practices are also gaining favor in Western industrialized nations as alleged means of reducing stress, enhancing psychological well-being, and improving health and fitness.[101,

[140–142,145] The growing popularity of these practices among older adults in the United States and other Western industrialized countries,[144–146] coupled with recent research involving both healthy[141,146–152] and chronically ill older women[141,153] in Western[146,148–155] and non-Western populations[150] suggest that tai chi and qigong may represent acceptable and attractive interventions for postmenopausal women at risk of CVD.

QIGONG AND CVD RISK

Recent studies from China, Korea, Japan, Sweden, and the United States suggest that qigong may also help to reduce CVD risk in both healthy and chronically ill populations.[102,137,156–158] For example, recent controlled trials in Chinese and Korean adults with hypertension or CVD suggest that qigong practice may decrease blood pressure,[100,135,137,159–163] lower fasting cholesterol[162] and triglyceride levels[159,160] and increase high-density lipoprotein concentrations relative to usual care or waitlist controls[135,159–161] and baseline values.[159,162] In a recent randomized, controlled trial of diabetic adults in Japan, Tsujiuchi et al[164] reported significant reductions in glycated hemoglobin and C-peptide in the qigong versus the usual care group. Likewise, uncontrolled studies conducted in China[156,159] and Korea[165] have demonstrated significant improvements in blood pressure,[165] lipid profiles,[156] and markers of insulin resistance and glucose tolerance.[156,159] Similarly, a recent Hong Kong randomized, controlled trial of qigong in community-dwelling adults with mild hypertension demonstrated significant declines in body mass index, weight, and waist circumference that were comparable to those following a conventional exercise program. [162] Controlled studies investigating the effects of qigong programs in both healthy adults[166] and those with hypertension[135,161,162] have also reported significant decreases in resting heart rate,[162] urinary catecholamine,[135,161,166] cortisol levels,[161] and other measures of sympathetic activation[166] relative to baseline[135,161,162] or controls.[166]

Evidence from recent research suggests that qigong may reduce certain psychosocial risk factors for CVD as well. For example, controlled trials of both healthy adults and adults with chronic conditions[162–164,167,168] have reported qigong to decrease anxiety[163,164] and depression,[162,167,168] and to improve mood[163,164] and psychological well-being.[163,167,168] Similarly, more limited data suggest that qigong may lower perceived stress.[158,161,166,169,170]

TAI CHI AND CVD RISK

A growing body of research from both Western and Eastern countries offers evidence that the practice of tai chi may also lower CVD risk in older adults.[143,145,171] For example, several recent randomized, controlled trials of British and American adults with myocardial infarction;[172] healthy American,[173] Korean,[174] and Taiwanese[175] adults with mild to moderate hypertension; and community-dwelling[176,177] and frail American elderly[178] have reported significant reductions in blood pressure in participants completing a supervised tai chi program relative to baseline,[172,173,175] wellness education controls,[176,178] or usual care controls.[174,177] Likewise, nonrandomized, controlled investigations of healthy middle-aged American women[179] and older Chinese adults[180] have documented significant declines in blood pressure in those assigned to tai chi versus waitlist[179] or no intervention[180] control groups. More limited data from both controlled[151,175,178,181,182] and uncontrolled studies[183] in older American[151,178] and Asian populations[175,181,183,184] suggest that tai chi practice may also improve lipid profiles,[175,183] reduce body mass index,[178] enhance endothelial function,[181] lower heart rate[175,178] and other markers of sympathetic activation,[151,182,184] and improve cardiovagal function.[151,184] Findings from a recent pre-post investigation in Taiwan suggest that tai chi may also decrease glycated hemoglobin and fasting glucose levels in adults with type 2 diabetes.[185]

In addition, there is increasing evidence that tai chi may help reduce psychological indices of CVD risk in both Western and non-Western populations.[99,145,186] For example, recent controlled studies regarding the effects of tai chi in both healthy and chronically ill older adults have reported tai chi to decrease anxiety[101,147,175,180] and depression,[174,187,188] to improve mood[101,147,174] and psychological well-being,[101] and to reduce anger, tension,[147,189] and confusion[147] relative to exercise,[147] education,[174] wellness program,[188] attention, [189] or waitlist/usual care controls.[175,180,187] Similarly, several controlled investigations offer evidence that tai chi may lower perceived stress,[101,177] enhance stress-related coping,[190] and improve sleep[191] relative to exercise[191] or usual care/no treatment controls.[177,190]

LOGISTICAL ADVANTAGES OF TRADITIONAL MIND-BODY THERAPIES AND CURRENT LIMITATIONS IN THE LITERATURE

In addition to the numerous reported health benefits, yoga and other traditional mind-body disciplines have many practical advantages as therapeutic intervention and health promotion measures. These practices are relatively simple to learn and are economical, noninvasive therapies with few side effects and multiple collateral lifestyle benefits.[92,94,140,150,192–194] Group practice of these ancient disciplines can offer a source of social support, a factor strongly associated with decreased CVD risk.[73,195] Group and individual practice may also help to improve lifestyle choices and health-related attitudes, in part by enhancing psychological well-being,[195] and thereby contribute significantly to CVD prevention and health promotion.[195] In addition, stress reduction programs based on mind-body therapies have been shown to be cost-saving relative to usual treatment for the management of CVD and related conditions. [196] For example, Blumenthal and colleagues[196] showed significant reductions in coronary events for patients randomized to a yoga-based stress management intervention and found significant cost savings associated with the program relative to exercise or usual medical care.

Mind-body therapies may also provide an attractive alternative to conventional exercise for many older women. There are mounting data to suggest that older adults, especially older women, may experience greater barriers to initiating and continuing conventional exercise programs than young adults.[197,198] Although the Centers for Disease Control and Prevention, the National Institute on Aging, the American College of Sports Medicine, and other national organizations strongly encourage physical activity to enhance health and prevent cardiovascular and other chronic disease, most older women do not engage in regular physical activity.198 In 1998, only 10% of Americans aged 65 to 74 years reported participating in strength or endurance exercise 2 or more days per week, and this figure may be even lower in women.[198,199] Among older adults engaged in physical activity, adherence rates indicate only 15% of older women (vs 30% of older men) actually participate in regular sustained activity. [200] Moreover, an estimated 50% or more of older adults who begin an exercise program are reported to drop out within the first 6 months,197 with adherence rates much lower in certain populations.[197,201,202] Standard exercise programs often require travel, a considerable time commitment, and special clothes, facilities, and/or equipment. [198] Initiation and maintenance of an exercise routine may also be compromised by safety, monetary, hygiene, weather, discomfiture, injury, and other concerns that are particularly important among older women. [197,198,203,204] The perceived benefits of standard physical exercise are typically delayed, further discouraging continued practice.[197]

A growing body of research suggests that yoga, tai chi, qigong, and other active mind-body interventions are readily accepted by older women in both Western and non-Western countries, [96,146,150,152,205] and, as documented above, may improve a range of physical, physiological, and mental health outcomes related to cardiovascular risk in older populations. These traditional mind-body therapies are all typically low speed, low impact, and noncompetitive in nature and can be safely practiced even by elderly, ill, unfit, and overweight individuals,

[92,94,96,99,101,102,140,160,167,206] rendering each appropriate for older sedentary women. These ancient practices can be performed virtually anywhere and for any length of time, an important consideration given that perceived inconvenience and lack of time have been cited as major factors underlying the high attrition often associated with physical activity programs.[197,198,204,207,208] In contrast to most conventional Western exercise programs, the practice of yoga and other similar mind-body therapies typically brings immediate positive benefits, including feelings of relaxation and tranquility,[123,125,209–211] helping to encourage continued adherence. Moreover, even short-term (2–12 weeks) yoga and other active mind-body interventions have been shown to result in significant gains in cardiovascular and psychological health, as well as in flexibility, endurance, and strength,[151,161,163,212–217] offering powerful incentives for continued practice. Several studies have, in fact, documented excellent adherence and long-term maintenance of benefits among older adults.[218–222] Thus, a yoga, tai chi, or other traditional active mind-body program, especially one that is specifically designed for older adults and easily performed in the home, may offer an excellent alternative to conventional exercise programs for women post-menopause.

In summary, yoga, tai chi, and qigong may offer acceptable and cost-effective interventions for postmenopausal women and other populations at risk of CVD, IRS, and related insulin resistance conditions, demonstrating promise for the improvement of both psychological and physical health and ultimately for the prevention and management of CVD and associated chronic disorders. However, despite the growing popularity and apparent therapeutic potential of yoga, tai chi, qigong, and other mind-body therapies, rigorous, controlled studies investigating the effects of these practices on CVD risk factors or related clinical endpoints remain relatively few, especially in Western populations. [94,96,100–167] Interpretation of many existing studies is also hampered by design and other methodological limitations, including selection bias, small sample sizes, lack of appropriate control groups, lack of randomization, exposure to multiple interventions, failure to adjust for lifestyle characteristics and other potential confounders, inadequacies in statistical analysis and presentation, or other methodological problems.[96,97,100–102,141,174] In addition, the large variation in the duration, intensity, nature, and delivery methods of the interventions used renders comparisons among studies difficult. Publication bias may also influence the selective reporting of positive results, [223] especially in non-Western countries where these disciplines are more widely accepted and more likely to be integrated into healthcare. Few studies have examined the long-term effects of yoga and other mind-body therapies, and the mechanisms underlying the reported benefits associated with these disciplines remain poorly understood. Clearly, additional high-quality research is warranted to confirm and further explore the putative beneficial effects of yoga, tai chi, qigong, and other promising mind-body therapies on CVD risk and to further investigate the potential long-term benefits of and adherence to these therapies, especially in older women in Western countries.

CONCLUSIONS

CVD risk rises sharply with menopause, likely due to the coincident increase in insulin resistance and related atherogenic changes that together comprise IRS, a cluster of metabolic and hemodynamic abnormalities strongly implicated in the pathogenesis and progression of CVD. There is growing evidence that traditional mind-body practices such as yoga, tai chi, and qigong may offer safe and cost-effective strategies for reducing IRS-related risk factors for CVD in older populations, including postmenopausal women. However, additional rigorous studies are needed to confirm existing findings and to examine long-term effects on cardiovascular health.

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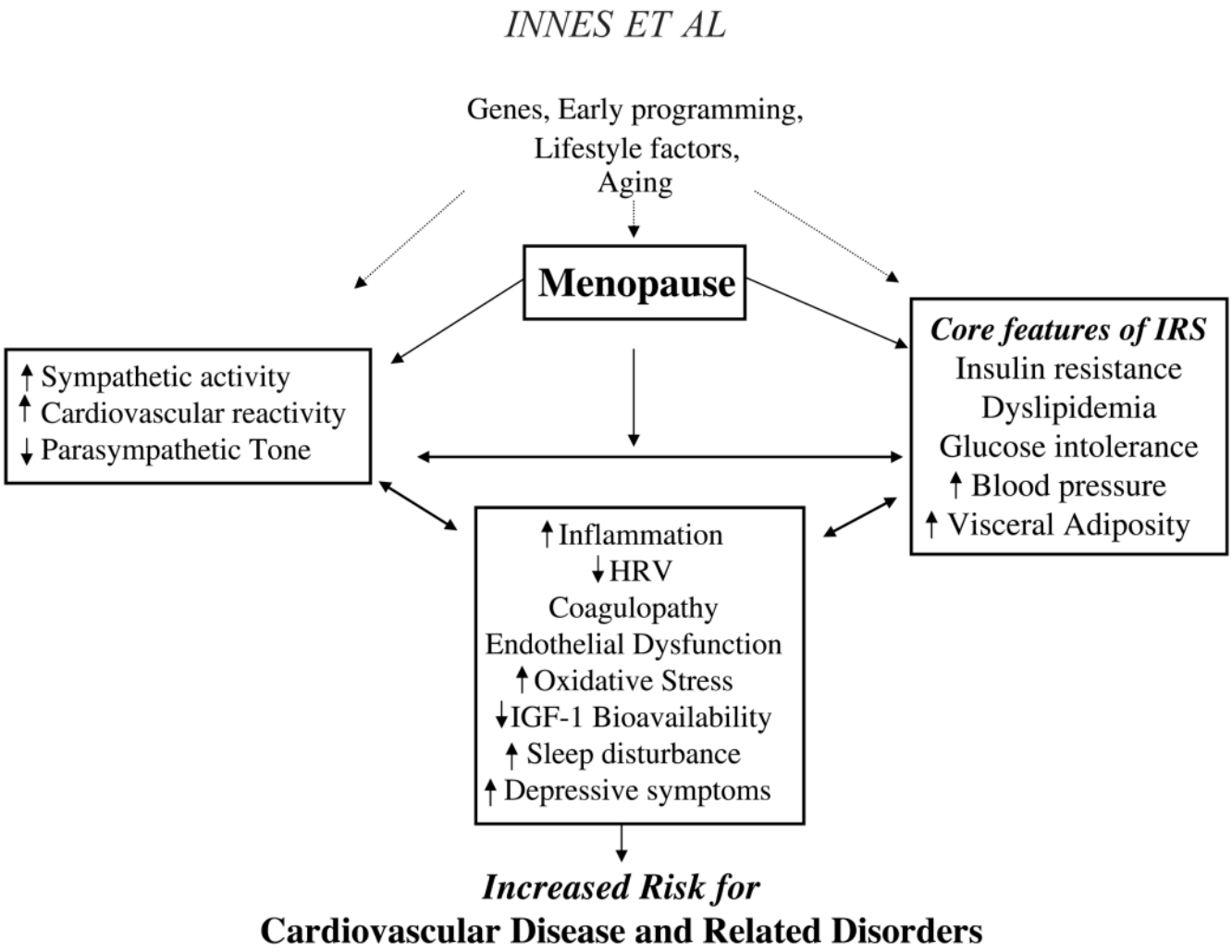

FIG. 1.
Change in cardiovascular risk profiles with menopause. HRV, heart rate variability; IGF-1, insulin-like growth factor 1; IRS, insulin resistance syndrome.