Original Research

The Effect of CardioWaves Interval Training on Resting Blood Pressure, Resting Heart Rate, and Mind-Body Wellness

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ABSTRACT

International Journal of Exercise Science 9(1): 89-100, 2016. An experimental study to examine the effects of CardioWaves interval training (CWIT) and continuous training (CT) on resting blood pressure, resting heart rate, and mind-body wellness. Fifty-two normotensive (blood pressure <120/80 mmHg), pre-hypertensive (120–139/80–89 mmHg), and hypertensive (>140/90 mmHg) participants were randomly assigned and equally divided between the CWIT and CT groups. Both groups participated in the assigned exercise protocol 30 minutes per day, four days per week for eight weeks. Resting blood pressure, resting heart rate, and mind-body wellness were measured pre- and post-intervention. A total of 47 participants (15 females and 32 males) were included in the analysis. The CWIT group had a non-significant trend of reduced systolic blood pressure (SBP) and increased diastolic blood pressure (DBP) while the CT group had a statistically significant decrease in awake SBP ($p = 0.01$) and total SBP ($p = 0.01$) and a non-significant decrease in DBP. With both groups combined, the female participants had a statistically significant decrease in awake SBP ($p = 0.002$), asleep SBP ($p = 0.01$), total SBP ($p = 0.003$), awake DBP ($p = 0.02$), and total DBP ($p = 0.05$). The male participants had an increase in SBP and DBP with total DBP showing a statistically significant increase ($p = 0.05$). Neither group had a consistent change in resting heart rate. Both groups showed improved mind-body wellness. CWIT and CT reduced resting blood pressure, with CT having a greater effect. Resting heart rate did not change in either group. Additionally, both CWIT and CT improved mind-body wellness.

KEY WORDS: Physical activity, intermittent exercise, steady-state exercise, hypertension

INTRODUCTION

According to the United States (U.S.) Department of Health and Human Services, the top four causes of death in the U.S. in 2011 were heart disease, malignant neoplasms (cancer), chronic lower-respiratory diseases, and cerebrovascular disease (stroke) (8). These conditions usually occur over a long period of time and may result in premature death. But there are risk factors that, if detected early and treated properly, may prevent disease from occurring. Two common risk factors for heart disease are hypertension (high blood pressure) (2) and high resting heart rate (15, 18, 20). Although the prevalence of uncontrolled high blood pressure has declined for all age groups of men and women between 1988-1994 and 2007-2010, in 2007-2010, nearly one-half of adults with hypertension continued to have uncontrolled high blood pressure (17). The association between blood pressure and greater incidence of cardiovascular disease (CVD) begins with "blood pressure levels as low as 115/75 mmHg, and doubles for each 20/10 mmHg increase in systolic/diastolic blood pressure" (2).

Lewington et al. state that reducing systolic blood pressure by 2 mmHg may lower stroke and ischemic heart disease mortality by approximately 10% and 7%, respectively (12). When compared to individuals whose resting heart rate levels remained below 70 beats per minute (bpm), individuals whose resting heart rate levels increased from 70 bpm to greater than 85 bpm had a 90% higher risk of death from ischemic heart disease, and a 50% higher risk of death from all causes. Nauman et al. reported these findings over a 10-year span (18). Fortunately, hypertension and high resting heart rate are modifiable through a healthy lifestyle that includes regular exercise (9).

One traditionally recommended method for the prevention and treatment of hypertension is continuous moderate-intensity training sustained for 30 minutes or more (2). The ACSM position statement on exercise and hypertension, states that exercise programs that primarily involve endurance activity prevent the development of hypertension and lower blood pressure (21). When measured objectively, only about 10% of U.S. adults meet federal recommendations of at least 150 min/wk of moderate-intensity or 75 min/wk of vigorous-intensity aerobic exercise, despite the many benefits regular exercise provides (30).

Numerous studies have measured the effect of interval training (IT) versus continuous training (CT) on resting blood pressure (3, 6, 10, 15, 16, 19, 25, 26, 28, 29, 31-34) and resting heart rate (6, 10, 15, 16, 19, 25, 32, 34). A great amount of these studies' IT protocols resulted in a mean decrease in systolic blood pressure of 6–11 mmHg and a mean decrease in diastolic blood pressure of 4–7 mmHg (3, 6, 10, 15, 26, 28, 29) as well as a mean decrease in resting heart rate of 3.4–9.8 bpm (10, 15, 16). Conversely, the CT protocols resulted in a mean decrease in systolic blood pressure of 6–8 mmHg and a mean decrease in diastolic blood pressure of 4–5 mmHg (3, 6, 10, 19, 26, 28) and a mean decrease in resting heart rate of 6.0–9.8 bpm (10, 19). The IT protocol in each study varied, but most contained at least one minute or more of steady-state exercise (heart rate sustained at the same intensity) in each exercise interval (3, 6, 15, 16, 19, 25, 26, 28, 29, 31, 32, 34).

There are many types of IT protocols, including CardioWaves IT (CWIT) which has been "developed from 35 years of research and testing and drawing upon what world-class athletes already do to enhance their performance" (13). The elite training protocol was modified to primarily focus on mind-body wellness by adding a more complete recovery interval. CWIT is an IT protocol in which heart rate is continually elevated or lowered during the entire workout in a wavelike pattern (13). Each exercise interval has a desired upper heart-rate target and each recovery interval has a desired heart rate personal-recovery range according to each individual's heart rate.

Wearing a heart rate monitor is preferred so heart rate can be measured throughout the exercise and recovery intervals.

To lower heart rate in the recovery intervals, both physical and mental relaxation techniques are used (13). Recent efforts have been made to include both the physical body and the mind in defining overall health. This is known as mind-body medicine (5) or mind-body wellness (13). For example, "a 'well' person is satisfied in work, is spiritually fulfilled, enjoys leisure time, is physically fit, is socially involved, and has a positive emotional-mental outlook" (4). IT studies have shown an improved quality of life, as measured by self-report questionnaires (15, 34), with one of the studies specifically showing an additional improvement in social function (15). All elements of an individual's life (emotional, mental, physical, social, and spiritual) affect one another; therefore, exercise has the potential to influence the facets of wellness. The CWIT method is designed to improve one's mind-body wellness by being mindful of what the body is doing during the exercise and recovery intervals (13). Increased mindfulness may increase the ability to relax, increase positive feelings, and reduce anxiety (13).

The hypothesis of this study is that those participating in CWIT will experience a normalizing of resting blood pressure, lowering of resting heart rate, and improvement in mind-body wellness. Studies have reported the effects of IT on resting blood pressure and resting heart rate, but fewer studies have also considered the effects on mind-body wellness. To date, no published studies have tested CWIT on the above variables.

METHODS

Participants

This experimental study considered the effects of exercise training on resting blood pressure, resting heart rate, and mind-body wellness. The participants were randomized into two groups: a CWIT group and a CT group.

A minimum sample size and minimum effect size power analysis (with α of 0.05, β of 0.2, and standard deviation of 12 for blood pressure) was calculated to detect a change in blood pressure of 10 mmHg between the CWIT group and the CT group. The power analysis indicated 23 participants per group would be needed to provide adequate statistical power. To accommodate a potential dropout rate of 10%, a total of 26 participants per group were recruited.

Participants included males and females who currently had normotensive (<120/80 mmHg), pre-hypertensive (120–139/80–89 mmHg), and hypertensive (>140/90 mmHg) blood pressure levels and were not taking blood pressure altering medications. To control for other blood pressure altering factors, participants were excluded for the following: currently smoking, having a BMI greater than 40, or consuming alcohol and excessive amounts of caffeine (>400 mg/d) within the last 24 h (1). Individuals were also excluded if they currently participated in intense regular physical activity, defined as a "high" current physical-fitness-activity level (300+ min/wk of moderate-intensity or 150+ min of vigorous-intensity aerobic exercise), as these individuals may have already been experiencing a blood pressure lowering training effect (23).

Participant recruitment via flyers occurred on the university campus, at local hospitals and physician clinics, on social media, and through referrals. Medical clearance was required for participation in this study and included a record of each participant's blood pressure, BMI, and current physical-fitness-activity level. Participants were required to sign informed consent prior to acceptance into the study. Approval of the study protocol was obtained through the university Institutional Review Board prior to data collection.

Protocol
Fifty-two participants were randomly assigned to the CWIT group or CT group through a stratified random sample to ensure that baseline resting blood pressure levels were equally distributed between the groups.

All participants received written and verbal instruction on their assigned exercise protocol by a research assistant. Additionally, all participants wore a RS300X Polar heart-rate monitor (Polar Electro Oy, Professorintie 5, FI-90440 Kempele, Finland) during each exercise session to monitor HR and to record each workout.

The CWIT group participated in the CWIT protocol for 30 minutes per day, four days per week for eight weeks. The CWIT participants started with a beginning level workout and gradually increased their intensity throughout the eight-week intervention. The beginner, intermediate, and advanced workouts as described in the CardioWaves book (13) were given to the participants as examples of workouts they could follow (see Table 1). The participants were asked to increase the intensity of their workout when they felt the workout level was becoming too easy. The participant's resting heart rate and max HR were determined by a research assistant at the beginning of the intervention. The participants were instructed not to exceed their max HR during any of the workouts. The CWIT protocol consisted of continuously elevating and lowering heart rate through the exercise and recovery intervals via any mode of cardiovascular physical activity, such as running, swimming, or using an elliptical. Each exercise interval had a desired upper heart-rate target (see Table 1 for examples of varying levels of upper heart-rate targets). Immediately after reaching the target, heart rate was actively lowered to the lowest pulse rate the participant could attain and within the recovery range (resting heart rate plus 20). The participant attained this by discontinuing the exercise, sitting down, and focusing on taking deep breaths to lower their heart rate as quickly as possible. As soon as the lowest recovery pulse was

Table 1. CardioWaves Workout Examples: Upper Heart-Rate Targets for the Exercise Intervals.

Exercise Intervals	Beginner	Intermediate	Advanced
1	120	125	130
2	125	130	135
3	130	135	140
4	140	145	150
5	140	175	155
6	140	145	160
7	130	175	170
8	125	145	180
9	120	135	170
10		130	160
11		125	155
12			150
13			140
14			135
15			130

reached, heart rate was again elevated for the next exercise interval. The length of time for each exercise and recovery intervals varied due to how quickly each participant could elevate and lower his or her heart rate to the desired target.

The CT group followed the current ACSM exercise guidelines for hypertensive individuals (21) by participating in steady-state moderate-intensity exercise (40 - <60% of VO_2 reserve (21) or HR reserve (27)) for 30 minutes per day, four days per week for eight weeks via any mode of cardiovascular physical activity. A research assistant calculated the specific heart rate range for each CT participant by using a predicted maximum heart rate value (220 minus age) and the participant's resting heart rate. The formula of maximum heart rate minus resting heart rate was used to determine heart rate reserve. The heart rate reserve value was then multiplied by .40 and .60 to determine the moderate-intensity heart rate range needed for each CT workout.

Every two weeks throughout the intervention a research assistant met with the participant to electronically download the workout data from the heart-rate monitor. The research assistant reviewed the participant's workouts to verify if the participant was performing the assigned exercise protocol correctly and instructed the participant on any necessary changes.

To better control for confounding variables, the participants were asked to not change any lifestyle habits except the assigned exercise protocol. At the beginning and end of the study, the participants were asked general questions about their current lifestyle habits. There was not a difference in the answers to these questions except for the participants' exercise habits, which infers the participants complied with the requirements of the study.

Resting blood pressure, resting heart rate, and body mass were measured pre- and post-intervention. To avoid the acute lowering effect of blood pressure post-exercise (33), each participant abstained from exercise 24 hours (h) prior to placement of an Accutracker II ambulatory blood pressure device (ABPD) (SunTech Medical, Inc., Morrisville, NC). The ABPD was worn for 24 h and took blood pressure and heart rate measurements three times per h (about every 20 min) from 6:00 AM until 11:00 PM (awake time period) and once per h from 11:00 PM until 6:00 AM the following day (asleep time period). Throughout the 24 h, if an error occurred, the ABPD repeated the measurement.

Mind-body wellness was measured pre- and post-intervention via the following self-reported validated psychometric online questionnaires: Brief Inventory of Perceived Stress (Stress) (11), The Functional Assessment of Chronic-Illness Therapy—Spiritual Well-Being Scale (Spiritual Well-being) (Cronbach's a = .81–.88) (22), and Worth Index ($r = .86$, $p < .001$; test retest reliability $r = .74$, $p < .001$) (14). These questionnaires were chosen to measure the components of mind-body wellness: stress, spiritual well-being, and perception of self-worth. A decrease in scores on the Stress survey indicates a decrease in overall stress while an increase in scores on the Spiritual Well-being survey indicates an increase in spiritual well-being. The Worth Index survey has four subscales: 1) basic human worth, 2) personal security, 3) performance, and 4) appearance. An increase in scores means an improvement in one's perception of his/her individual worth—the individual perceives self-worth to be inherent rather than dependent on outside influences. These questionnaires were administered using Qualtrics online survey software (Qualtrics, Provo, UT), included a total of 58 questions, and required approximately 5–15 minutes to complete. Participants answered additional demographic, lifestyle, and satisfaction questions for descriptive purposes.

The participants received a FT1 Polar heart-rate monitor as compensation for completing the study and to provide motivation to continue exercising post-intervention.

Statistical Analysis

Statistical Analysis Software (SAS), version 9.3 (Cary, NC) was used for data analysis. The ABPD resting blood pressure data, ABPD heart-rate data, and mind-body wellness data were analyzed using ANCOVA, with the ABPD data additionally analyzed using regression analysis. Participant demographics were analyzed using basic statistics and chi-square analysis. Statistical significance was set at $p < 0.05$.

RESULTS

The majority of the participants were Caucasian (97%), married (88%), and working part-time or full-time (73%). Table 2 shows additional participant demographics.

Each participant's body mass, and consequently BMI, did not change significantly for the duration of the intervention. At the beginning of the study, baseline resting blood pressure and heart rate were not significantly different across participants (see Table 3).

Table 2. Participant Demographics.

Variables	All participants (n = 52)	Males (n = 36)	Females (n = 16)
Age (y)	38.94 ± 10.51	37.06 ± 9.51	43.19 ± 11.70
Body mass (kg)	84.69 ± 16.26	89.77 ± 14.66	73.56 ± 14.20
BMI (kg/m²)	27.28 ± 4.41	27.22 ± 4.01	27.43 ± 5.36

Results are described as mean ± standard deviation.

Table 3. Baseline Resting Blood Pressure (mmHg) and Resting Heart Rate (bpm).

Variables	CWIT group	CT group	F	p
Awake SBP	120.96± 1.86	119.50± 1.94	0.30	0.59
Asleep SBP	108.04± 2.70	103.50± 2.76	1.38	0.25
Total SBP	119.19± 1.82	117.92± 1.89	0.24	0.63
Awake DBP	74.19± 1.28	73.13± 1.33	0.34	0.57
Asleep DBP	62.60± 1.66	61.67± 1.69	0.15	0.70
Total DBP	72.50± 1.34	71.88± 1.40	0.10	0.75
Awake HR	70.54± 2.06	69.96± 2.15	0.04	0.85
Asleep HR	61.56± 2.11	59.25± 2.15	0.59	0.45
Total HR	69.46± 2.03	68.71± 2.11	0.07	0.80

Results are described as mean ± standard error
Results are analyzed from pre-SBP/DBP measurements from ambulatory blood pressure devices (ABPDs)
No significant difference ($p < 0.05$)

Approximately half of the participants had resting blood pressure in pre-hypertensive or hypertensive ranges, and the other half of the participants were in normotensive ranges (see Table 4).

Table 4. Distribution of Participants According to Baseline Resting Blood Pressure.

BP	CWIT group (n = 25)		CT group (n = 22)	
	Male (n=17)	Female (n = 8)	Male (n = 15)	Female (n = 7)
Hypertensive	0	0	1	0
Pre-hypertensive	10	3	6	3
Normotensive	7	5	8	4

Results are analyzed from pre-total SBP/total DBP measurements from ambulatory blood pressure devices (ABPDs)
Hypertensive BP = blood pressure >140/90 mmHg
Pre-hypertensive BP = blood pressure 120–139/80–89 mmHg
Normotensive BP = blood pressure <120/80 mmHg

The participants were asked to complete a total of 32 workouts over the eight-week study. All participants completed an average of 27 ± 6.33 workouts, with 64% of both the CWIT group and the CT group completing more than 27 workouts. Five participants dropped out of the study—one participant from the CWIT group and four participants from the CT group. Therefore, a total of 47 participants (15 females and 32 males) were included in the analysis.

The ABPD data output gave an average measurement for resting systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) for the awake, asleep, and total period the ABPD was worn. The covariates age, gender, BMI, and workout compliance (number of completed workouts) were used in the analysis to see if any of the variables had an impact on resting blood pressure or HR levels. After the initial analysis, group (CWIT or CT) was also included as a covariate to determine any within- and between-group differences.

Table 5 shows the change in resting blood pressure by group. The CT group had a statistically significant decrease in awake SBP (p = 0.01) and total SBP (p = 0.01).

Table 5. Change in Resting Blood Pressure (mmHg) by Group.

Variables	CWIT group	CT group
Awake SBP	-0.31 ± 1.59 (p = 0.85)	-4.37 ± 1.64 (p = 0.01)*
Asleep SBP	-2.22 ± 2.19 (p = 0.32)	-2.12 ± 2.15 (p = 0.33)
Total SBP	-0.28 ± 1.61 (p = 0.86)	-4.24 ± 1.66 (p = 0.01)*
Awake DBP	0.44 ± 1.10 (p = 0.69)	-2.07 ± 1.18 (p = 0.09)
Asleep DBP	0.85 ± 1.73 (p = 0.63)	-0.44 ± 1.71 (p = 0.80)
Total DBP	0.78 ± 1.17 (p = 0.51)	-1.86 ± 1.25 (p = 0.14)

Results are described as mean ± standard error
Results are analyzed from pre- and post-SBP/DBP measurements from ambulatory blood pressure devices (ABPDs)
*Significant at p < 0.05

Gender was a covariate that was statistically significant for all blood pressure measures, except asleep DBP (p = 0.09). Table 6 shows the change in resting blood pressure by gender. With both groups combined, the female participants had a statistically significant decrease in awake SBP (p = 0.002), asleep SBP (p = 0.01), total SBP (p = 0.003), awake DBP (p = 0.02), and total DBP (p = 0.05). The male participants had a statistically significant increase in total DBP (p = 0.05).

Table 7 shows the change in resting HR. Neither group had a statistically significant change for all HR measurements.

Table 6. Change in Resting Blood Pressure (mmHg) by Gender

Variables	Males	Females
Awake SBP	2.00 ± 1.36 (p = 0.15)	-6.68 ± 2.06 (p = 0.002)*
Asleep SBP	3.08 ± 1.74 (p = 0.09)	-7.41 ± 2.80 (p = 0.01)*
Total SBP	1.99 ± 1.37 (p = 0.15)	-6.51 ± 2.07 (p = 0.003)*
Awake DBP	1.75 ± 0.95 (p = 0.07)	-3.38 ± 1.42 (p = 0.02)*
Asleep DBP	2.53 ± 1.40 (p = 0.08)	-2.12 ± 2.20 (p = 0.34)
Total DBP	2.02 ± 1.01 (p = 0.05)*	-3.10 ± 1.51 (p = 0.05)*

Results are described as mean ± standard error
Results are analyzed from pre- and post-SBP/DBP measurements from ambulatory blood pressure devices (ABPDs)
*Significant at $p < 0.05$

Table 7. Change in Resting Heart Rate (bpm) by Group

Variables	CWIT group	CT group
Awake HR	1.54 ± 1.13 (p = 0.18)	-0.02 ± 1.20 (p = 0.98)
Asleep HR	-0.31 ± 1.16 (p = 0.79)	0.58 ± 1.16 (p = 0.62)
Total HR	1.03 ± 1.09 (p = 0.35)	0.05 ± 1.16 (p = 0.96)

Results are described as mean ± standard error
Results are analyzed from pre- and post-SBP/DBP measurements from ambulatory blood pressure devices (ABPDs)
No significant change ($p < 0.05$)

A total of 10 post-intervention surveys were not completed—five from the participants who dropped out and five from participants that had missing post-intervention survey data. Therefore, a total of 42 pre- and post-intervention survey results were included in the analysis.

Table 8 shows the change in the results of the mind-body wellness surveys. Both groups displayed positive improvement for all surveys. The CWIT group had a statistically significant reduction in stress (p = 0.002) and the CT group had a statistically significant increase in spiritual well-being (p = 0.005). The CWIT group had statistically significant improvement with their perceptions of their personal security (p = 0.03) as related to their individual self-worth. Additionally, the CT group had statistically significant improvement with their perceptions of their performance (p = 0.003) and perceptions of their appearance (p = 0.01).

Table 8. Change in Mind-Body Wellness Surveys by Group.

Variables	CWIT group	CT group
Stress	-2.19 ± 0.65 (p = 0.002)*	-0.99 ± 0.68 (p = 0.15)
Spiritual well-being	2.52 ± 1.37 (p = 0.07)	4.23 ± 1.44 (p = 0.005)*
Worth Index:		
Basic human worth	1.30 ± 0.90 (p = 0.16)	0.42 ± 0.94 (p = 0.66)
Personal security	1.21 ± 0.55 (p = 0.03)*	0.32 ± 0.57 (p = 0.57)
Performance	1.03 ± 0.61 (p = 0.10)	2.01 ± 0.64 (p = 0.003)*
Appearance	0.93 ± 0.83 (p = 0.27)	2.23 ± 0.87 (p = 0.01)*

Results are described as mean ± standard error
*Significant at $p < 0.05$

DISCUSSION

This study examined the effects of CWIT and CT on resting blood pressure, resting HR, and mind-body wellness. The data obtained from the study displayed a trend of reduced SBP for both CWIT and CT, but CT led to significantly lowered SBP when compared to CWIT. No consistent change in HR was found in either group, but mind-body wellness improved for both CWIT and CT. Hence, the results of the present study add to the current literature comparing IT and CT protocols.

Research comparing various IT protocols with CT protocols has found conflicting blood pressure results. Many have found IT and CT equally effective at decreasing blood pressure (mean SBP/DBP decrease of 6/4 and median SBP/DBP decrease of 2/4 mmHg) (3, 6, 10, 26, 28) or both exercise protocols showing no change in blood pressure (16, 25, 31, 32, 34). Nybo et al., however, found CT lowered blood pressure more than IT with a SBP/DBP mean decrease of 8/5 mmHg (19). The results of the current study are similar in that CT lowered blood pressure more than CWIT, but with a SBP/DBP decrease of about 4/2 mmHg. Having a greater number of participants with blood pressure in pre-hypertensive or hypertensive ranges could potentially lead to a larger reduction in resting blood pressure levels with CT or CWIT. It has been established in the literature that when normotensive and hypertensive participants follow the same exercise program, blood-pressure reduction is greatest in the hypertensive participants (21).

With both groups combined, the female participants had a significant reduction in blood pressure while the male participants' blood pressure increased. Many IT studies have included both female and male participants, but did not report a significant difference between genders (6, 15, 16, 25, 26, 28, 29, 31, 34). Nybo et al. (19) and Whyte et al. (33) included only male participants in their IT studies and saw a 8/5 mmHg reduction and 2/7 mmHg reduction in blood pressure, respectively. On the other hand, Ciolac et al. included only female participants and found only a 2/2 mmHg reduction in blood pressure (3). The findings of the present study adds to the inconsistency in the literature regarding blood pressure change difference between genders, suggesting a need for further investigation into gender differences with IT and CT.

Resting HR levels did not change in either the CWIT or CT groups. Other studies' results were similar, indicating no change in resting HR (25, 32, 34). However, some research found IT to be more effective than CT (mean decrease of 3.4 bpm) (15, 16) while others found CT more effective than IT (mean decrease of 6.0 bpm) (19). All participants in this study had baseline resting HR levels that were normal. If the participants had higher baseline resting heart-rate levels, training effects for lowering HR may have been noted.

Both groups' mind-body wellness survey results showed positive improvement. The CT group had a statistically significant increase in spiritual well-being while the CWIT group had a statistically significant reduction in stress. A unique component of CWIT is lowering the heart rate to the lowest attainable point during the recovery interval. This is meditative in nature due to the practice of ridding the conscious mind of stressors in order to lower HR (13). One study found IT improved quality of life more than CT (34) whereas another found both IT and CT equally improved quality of life (15), which is consistent with this study. Further research is needed to clarify the effect of IT and CT on stress, spiritual well-being, and one's perceptions of self-worth.

There were notable strengths regarding this study, including the unique design. The study was a randomized controlled experimental study, which allows for possible inference to a similar population of that used in the study. The recovery interval of CWIT and the moderate-intensity of CT made it possible for almost anyone to participate independent of their current fitness level or age. ABPDs were used to measure resting blood pressure levels, which gave a complete accounting of blood pressure fluctuations over a long period of time, from which a more representative blood pressure mean was calculated. This was advantageous because one-time clinical assessment is subject to variation due to situation-specific influences on blood pressure (7). The ability to monitor blood pressure over 24 h accounted for possible outside influences that could have artificially altered blood pressure outcomes.

There were also limitations with this study. Because the questionnaires used in this study were self-reported, there was limited control over the accuracy of individual's responses. Also, the participants completed their exercise protocol under free-living conditions; therefore the researchers had very little, if any, control over other confounding factors that may have influenced the study outcome. One hope for this study was to recruit mostly participants with baseline pre-hypertensive blood pressure levels to increase potential for determining a blood-pressure lowering effect for the different training protocols. The medical clearance form was used to verify baseline blood pressure levels and other inclusion criteria required to accept each participant into the study. Because this baseline blood pressure measurement was taken by a medical professional at one point in time (either with a manual or automatic blood pressure cuff) some of the participants' resting pre-ABPD measurements did not match up with their reported baseline levels, meaning there were more participants with lower true baseline blood pressure levels than was hoped for. This finding is in accordance with Pickering et al. who state ABPD measurements are typically lower than clinical blood pressure measurements (24). For future studies, using ABPD measurement as part of the screening process of potential participants will ensure participants' baseline blood pressure is within pre-hypertensive or hypertensive ranges.

In conclusion, this study revealed that CWIT and CT exercise programs reduced resting blood pressure, with CT having a greater effect. Additionally, both CWIT and CT improved mind-body wellness which adds to the current minimal amount of literature on exercise and mind-body wellness. Individuals similar to the population in this study, especially females, may experience lowered blood pressure and improved mind-body wellness with participation in CWIT and CT. These positive results may reduce risk for cardiovascular disease and improve quality of life. Further research of CWIT is recommended to understand gender differences in blood pressure reduction and to investigate the null result of resting heart rate change seen in this study. Also, further examination of exercise and its effect on mind-body wellness may provide depth into possible reasons for the improvement experienced.

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