Research Square

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Impact of Low-Intensity Occlusive Cardiorespiratory Training on Office Blood Pressure and Physical Fitness in Adults with Hypertension

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Abstract

Background

Hypertension is the leading modifiable risk factor for cardiovascular morbidity and mortality, underscoring the need for non-pharmacological strategies such as exercise to optimize blood pressure control. Although moderate-intensity continuous training (MICT) and high-intensity interval training (HIIT) are supported by substantial evidence, blood flow restriction (BFR) combined with low-intensity cardiorespiratory training (LICT) has emerged as a promising alternative because it imposes a lower workload.

Objective

To compare the effects of three cardiorespiratory training modalities—high-intensity interval training (HIIT), moderate-intensity continuous training (MICT), and low-intensity continuous training with blood flow restriction (LICT-BFR)—with those of a control group on office blood pressure and physical fitness in patients with hypertension.

Methods

This randomized controlled clinical study was conducted at the Cardiometabolic Diseases Unit of Hospital Interzonal General de Agudos San Martín in La Plata, Argentina. Sixty participants were assessed (mean age, 60 ± 6 years). After eight participants were excluded for clinical reasons, 52 participants remained: a control group (n = 15) and three exercise groups—HIIT (n = 10), MICT (n = 13), and LICT-BFR (n = 14). The intervention comprised 36 sessions, three times per week for 12 weeks.

Results

Loss to follow-up was 26.9%, and 38 participants completed the study. Compared with the control group, the exercise groups combined showed significant improvements in physical fitness and office blood pressure ($p < 0.05$), with no changes in body weight or waist circumference. All three protocols improved physical fitness; however, only LICT-BFR produced a statistically significant reduction in office diastolic blood pressure (DBP; $p = 0.044$).

Conclusion

Cardiorespiratory training is important for improving functional capacity and hemodynamic control in people with hypertension. LICT-BFR provided functional benefits comparable to those of traditional aerobic training and was associated with a statistically significant reduction in office DBP.

Introduction

Hypertension is the leading modifiable risk factor for cardiovascular disease and premature mortality worldwide [1]. Despite the availability of effective pharmacological treatments, blood pressure (BP) control among people with hypertension remains inadequate, increasing the risk of myocardial infarction, stroke, heart failure, and chronic kidney disease [2]. Accordingly, non-pharmacological strategies are an essential component of comprehensive treatment [3].

Regular physical exercise is one of the non-pharmacological interventions with the strongest evidence for lowering BP in both prehypertensive and hypertensive individuals. Major international guidelines recommend regular aerobic exercise, resistance training, and reduced sedentary behavior as part of the initial treatment and ongoing management of all patients with hypertension [4–8].

Cardiorespiratory training in general, and improvements in functional capacity among people with hypertension in particular, are independently associated with a lower risk of cardiovascular mortality [3, 9]. Although MICT has traditionally been the most widely recommended modality and is supported by substantial evidence, studies over recent decades have examined the benefits and safety of HIIT, reporting similar and sometimes greater benefits for functional capacity and selected cardiovascular risk factors compared with MICT [10].

More recently, blood flow restriction (BFR) training has emerged as a potentially useful option for patients with functional limitations, particularly for improving muscular fitness while using lower loads [11–13]. BFR has also begun to be incorporated into cardiorespiratory training, with favorable findings for several components of physical fitness and cardiometabolic health. Available evidence suggests that aerobic exercise combined with BFR may improve functional capacity and muscle strength and may favor changes in body composition, particularly body-fat reduction, at substantially lower exercise intensities than conventional aerobic training [12, 14]. However, few studies have investigated the effect of LICT-BFR on BP in adults with hypertension or compared this approach with MICT and HIIT using clinical and functional outcomes within the same intervention protocol [15].

Therefore, can low-intensity continuous cardiorespiratory training with BFR be an effective and safe non-pharmacological strategy for BP management in adults with hypertension? The aim of this study was to assess the safety and effects of a 12-week supervised low-intensity cardiorespiratory exercise program with BFR on office BP and physical fitness in adults with hypertension, and to compare these changes with those produced by two established cardiorespiratory training modalities: MICT and HIIT.

Materials and Methods

This prospective controlled study used pre- and post-intervention assessments over 12 weeks in sedentary adults of both sexes, aged 55–76 years, with hypertension. Participants had been sedentary during the preceding three months and were consecutively recruited at Hospital Interzonal General de Agudos (HIGA) General San Martín in La Plata, Argentina. The study included a non-randomized convenience control group and three randomized intervention arms: HIIT, MICT, and LICT-BFR.

Hypertension was defined as either (1) receiving specific pharmacological treatment or (2) having a previous diagnosis and an office BP of ≥ 140/90 mmHg, calculated as the mean of three office measurements in accordance with international standards.

At the initial interview, personal history was assessed using a validated Spanish version of the 2014 National Health Interview Survey (NHIS) risk-factor questionnaire [16]. Body weight, height, waist circumference, and the mean of three office BP measurements were recorded in accordance with guideline recommendations [1].

Participants were excluded if they were receiving beta-blockers or anticoagulants for any reason; had a history of cardiovascular disease; had office BP > 180/100 mmHg; had varicose veins and/or a risk of venous thromboembolism; were unable to exercise independently; or had a history of active malignant neoplastic disease under treatment.

Patients who did not wish or were unable to attend the supervised exercise program at the hospital because of distance or other personal reasons were invited to participate in the study and received physical-activity advice based on the latest World Health Organization recommendations for adults; they constituted the control group.

Before the exercise program, participants were assessed by physical education professionals specializing in this field. Physical fitness assessments included handgrip strength, the 30-Second Sit-to-Stand test, the Five-Times Sit-to-Stand Test, and the submaximal Åstrand–Ryhming cycle-ergometer test. Potential functional limitations that could prevent participation were also assessed.

Data Collection

At the initial visit, personal and family history was assessed using a standardized questionnaire, and anthropometric measurements and BP were obtained. The questionnaire was a validated Spanish version of the 2014 NHIS risk-factor questionnaire [16]. The protocol used for each patient had been published previously [17]. The approximately 15-minute initial interview collected personal, epidemiological, and social information; personal and family cardiovascular history; current or previous smoking status; dyslipidemia; diabetes; use of antihypertensive drugs; and chronic diseases.

Anthropometric and Blood Pressure Measurements

Body weight was measured in kilograms using a CAM scale, with participants barefoot and wearing underwear. Height was measured in meters using the scale's stadiometer. Body mass index (BMI) was calculated as weight divided by height squared. Waist circumference was measured with a Roscraft metal anthropometric tape while the participant stood with the abdomen relaxed; the measurement was taken 2 cm above the umbilicus [18].

After the risk-factor and epidemiological interview, specially trained nurses measured BP. Participants wore no clothing that compressed the arm, sat with their backs supported and legs uncrossed, and kept their feet flat on the floor. Neither the participant nor the operator spoke during the measurements. Three BP readings were obtained using validated automated devices (OMRON HEM 7120/7121) and a cuff appropriate for each participant's arm circumference. Office BP was defined as the mean of the three readings.

Maximum Isometric Upper-Limb Strength (Handgrip)

A hydraulic hand dynamometer was used for this assessment; this instrument has high validity and reliability in clinical settings [19]. The protocol was standardized according to recommendations from the American Society of Hand Therapists (ASHT). The dynamometer was adjusted to each participant's hand, and the handle position was recorded to ensure consistency between pre- and post-intervention measurements. Participants stood with the elbow alongside the trunk and flexed to 90°, the forearm in a neutral position between pronation and supination, and the wrist in a neutral position. They were instructed to squeeze the dynamometer with maximal isometric effort for 2–3 seconds while receiving verbal encouragement. Both hands were tested, with two alternating attempts per hand and a 60-second rest between attempts. The highest value for each hand, in kilograms, was recorded.

30-Second Sit-to-Stand Test

The 30-Second Sit-to-Stand test, part of the Senior Fitness Test battery [20], was used to assess lower-limb muscular strength and endurance in older adults. A chair with a 43.2-cm seat height was placed against a wall. Participants began seated with their trunk upright, arms crossed at the wrists against the chest, and feet flat on the floor approximately shoulder-width apart. They stood up and sat down as many times as possible within 30 seconds, measured with a stopwatch. The total number of correctly completed repetitions was recorded in a single trial.

Five-Times Sit-to-Stand Test

This test assesses the time required to complete a specific functional task and complements the 30-Second Sit-to-Stand test by focusing on movement speed and power. A standard 43-cm-high chair without armrests was placed firmly against a wall. Participants sat in the middle of the seat with their feet on the floor and arms crossed over the chest to prevent use of the hands for momentum. Following the standardized protocol described by Whitney et al. [21], at the signal "go," participants stood up and sat down five consecutive times as quickly as possible, fully extending the hips and knees with each rise and making full contact with the seat on descent. Time was measured from the start signal until the participant contacted the chair after the fifth repetition and was recorded in seconds.

Submaximal Åstrand–Ryhming Test

The Åstrand–Ryhming submaximal test (1954) was performed using a mechanical cycle ergometer (Zuccolo®) to indirectly estimate maximal oxygen uptake (VO_2max). A nomogram was used based on the mean heart rate recorded at the end of minutes 5 and 6 and the workload, expressed in kilopond-meters per minute (kpm·min^{-1}), over the six-minute test. Initial workload was selected according to sex and fitness level: untrained men, 300–600 kpm·min^{-1}; trained men, 600–900 kpm·min^{-1}; untrained women, 300–450 kpm·min^{-1}; and trained women, 450–600 kpm·min^{-1}. Pedaling cadence was maintained at 50 rpm throughout the test. Mean heart rate and workload were entered into the nomogram to estimate absolute oxygen uptake, which was then corrected using the age-specific factor to estimate VO_2max.

Training Protocols

Participants were assigned randomly to one of the three intervention groups—MICT, HIIT, or LICT-BFR—using a simple computerized randomization procedure and a tool developed by the National University of La Plata [22], with the aim of minimizing selection bias. The control group comprised patients who did not participate in the exercise groups because of time, distance, personal or financial constraints, or lack of interest in attending the hospital gym.

The intervention lasted 12 weeks, with three sessions per week on non-consecutive days. Adherence was defined as attendance at ≥ 75% of scheduled sessions.

Moderate-Intensity Continuous Training (MICT)

Participants in the MICT group performed continuous cardiorespiratory exercise on a mechanical cycle ergometer. Exercise intensity remained constant within each session, and the program followed the principle of progression. Training duration gradually increased from 15 to 30 minutes over the intervention, while intensity increased from 50% to 70% of VO_2max. Exercise intensity was monitored as a percentage of heart-rate reserve (HRR), calculated using the Karvonen equation [23]: target HR = (maximum HR − resting HR) × intensity (%) + resting HR (Supplementary Table 1).

High-Intensity Interval Training (HIIT)

Participants in the HIIT group performed interval-based cardiorespiratory exercise on a mechanical cycle ergometer, alternating high-intensity intervals (80–95% of VO_2max) with low-intensity active-recovery periods (40–50% of VO_2max). In accordance with the principle of progression, training volume, intensity, and the work-to-recovery ratio were gradually increased over the 12-week intervention. Intensity was monitored as a percentage of HRR according to the Karvonen equation (Supplementary Table 2).

Low-Intensity Continuous Training with Blood Flow Restriction (LICT-BFR)

Participants assigned to LICT-BFR performed continuous cardiorespiratory exercise on a cycle ergometer combined with BFR. Pneumatic cuffs were applied to the proximal region of both thighs, immediately below the gluteal fold, to partially restrict arterial blood flow and impede venous return from the exercising muscles.

Medium-width pneumatic cuffs (10–12 cm) were used, and occlusion pressure was determined using the equations proposed by Loenneke et al. [6]. Inflation progressively compressed the underlying vasculature, partially reducing arterial flow and restricting venous return distal to the cuff. The training prescription followed the principle of progression, with gradual increases in exercise volume, intensity, and the percentage of blood-flow restriction over the intervention (Supplementary Table 3).

In all groups, each session began with an 8–10-minute general warm-up and ended with a 5–8-minute cool-down comprising stretching and relaxation exercises.

Clinical Follow-up

Three months after the initial visit, following completion of the exercise or control period, participants attended a second visit at which the same data collected at baseline were recorded, including anthropometric measurements, office BP, and physical-fitness tests.

Statistical Analysis

The statistical analysis followed the intention-to-treat principle. Continuous variables were expressed as mean ± standard deviation or median and interquartile range, depending on their distribution, which was assessed using the Shapiro–Wilk test and inspection of histograms and Q–Q plots. Categorical variables were described as counts and percentages.

Baseline characteristics of the exercise and control groups were compared using the independent-samples Student t test or Mann–Whitney test, as appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test. Absolute changes (Δ = final value − baseline value) were calculated to assess the effects of training on continuous variables. Within-group comparisons used the paired Student t test or Wilcoxon test.

Differences in changes between the exercise and control groups were analyzed using general linear models for repeated measures (two-way group × time ANOVA). Equivalent non-parametric tests were used when normality assumptions were not met. The three training modalities (HIIT, MICT, and LICT-BFR) were compared using one-way ANOVA on delta values, followed by Bonferroni-corrected post hoc comparisons. For non-normally distributed data, the Kruskal–Wallis test followed by Dunn's procedure was used. All p values were two-sided, and $p < 0.05$ was considered statistically significant. Analyses were performed using SPSS version 29 (IBM Corp., Armonk, NY, USA).

All participants provided written informed consent before the study began. The study was designed and conducted in accordance with international ethical standards and was approved by the Institutional Research Ethics Committee of our hospital (Protocol No. HSMLP2024/0137).

Results

A total of 60 participants were assessed (57% women; age, 53 ± 5.2 years). Overall, 25% had diabetes mellitus, 67% were receiving antihypertensive treatment, 27% were receiving lipid-lowering treatment, and 10% were current smokers. Eight participants were excluded before group allocation: one because of beta-blocker treatment and seven because baseline BP was ≥180/100 mmHg. The final sample comprised 52 participants. Fifteen were assigned to the convenience control group because they were unable or unwilling to participate in the training program; the remaining 37 were randomly allocated to HIIT (n = 10), MICT (n = 13), or LICT-BFR (n = 14).

Table 1 presents baseline characteristics by study group (control vs. exercise groups). No statistically significant between-group differences were observed for any of the variables analyzed ($p > 0.05$).

Of the 52 participants who began the study, 14 (26.9%) did not complete follow-up. Six were in the control group and eight were in the intervention groups: one in HIIT, two in MICT, and five in LICT-BFR (Figure 1).

The training protocol comprised 36 sessions over 12 weeks, with three sessions per week. All participants in the exercise groups attended at least 50% of scheduled sessions (>18 sessions). Mean attendance was 27 ± 4 sessions, and 75% of participants achieved adequate adherence, defined as attendance at ≥75% of scheduled sessions. No statistically significant between-group differences were found in variables related to adherence ($p > 0.05$).

Table 2 shows changes from baseline to final assessment among participants who completed the study, comparing the control group with all exercise groups combined. Participants who exercised showed statistically significant improvements in all physical-fitness variables assessed and in office BP. In contrast, no significant changes were observed in body weight or waist circumference. Participants in the control group showed a significant improvement only in the 30-Second Sit-to-Stand test, with no statistically significant changes in the other variables analyzed.

Table 3 shows changes in physical-fitness and clinical variables by training protocol (HIIT, MICT, and LICT-BFR). All three protocols produced significant improvements in the 30-Second Sit-to-Stand test. The MICT and LICT-BFR groups also showed significant improvements in the Five-Times Sit-to-Stand test. For clinical variables, only LICT-BFR showed a significant reduction in office diastolic blood pressure (DBP; $p = 0.044$).

Figure 2 presents the mean peak BP, heart rate (HR), and myocardial oxygen consumption (MVO_2) values recorded during exercise sessions for each training protocol. Mean exercise systolic BP (SBP) was 179 mmHg in HIIT, 176 mmHg in MICT, and 163 mmHg in LICT-BFR. The difference between HIIT and LICT-BFR was statistically significant ($p < 0.05$); the other comparisons were not significant. Mean exercise DBP was 84 mmHg in HIIT, 87 mmHg in MICT, and 82 mmHg in LICT-BFR, with no significant differences among the three groups ($p = 0.471$).

For exercise HR, a statistically significant difference was observed between HIIT and MICT ($p = 0.007$). Mean HR was 129 beats/min in HIIT, 114 beats/min in MICT, and 121 beats/min in LICT-BFR; the other between-group comparisons were not significant. Mean exercise MVO_2 values were 23,104, 20,461, and 19,955 in the HIIT, MICT, and LICT-BFR groups, respectively. Significant differences were found between HIIT and MICT ($p = 0.029$) and between HIIT and LICT-BFR ($p = 0.006$), but not between MICT and LICT-BFR.

Discussion

This study showed that a 12-week supervised cardiorespiratory training program significantly reduced office BP and improved physical fitness in adults with hypertension compared with a control group. Participants in the different exercise modalities experienced a clinically relevant decrease in BP, accompanied by improvements in functional capacity and lower-limb muscle strength, without significant changes in BMI or waist circumference. Taken together, these findings support supervised exercise as an effective non-pharmacological intervention for hypertension management.

The magnitude of the BP reduction is clinically relevant. The intervention group showed an average decrease of approximately 5 mmHg in SBP and 4 mmHg in DBP. Epidemiological studies and meta-analyses have shown that a reduction of only 5 mmHg in SBP is associated with an approximately 10–15% lower risk of major cardiovascular events [24, 25]. In this respect, the antihypertensive effect observed in our study is comparable to that reported for a first-line antihypertensive drug and is consistent with findings from Cornelissen and Smart [24], who reported mean reductions of 5–8 mmHg after aerobic training programs in patients with hypertension.

In addition to its antihypertensive effect, training significantly improved functional capacity, as indicated by increased metabolic equivalents (METs) estimated during the submaximal Åstrand–Ryhming test and better performance on the 30-Second Sit-to-Stand test. These findings reflect favorable cardiovascular and neuromuscular adaptations. Cardiorespiratory fitness is one of the strongest independent predictors of cardiovascular and all-cause mortality. Studies have shown that each 1-MET increase in functional capacity is associated with a 10–20% reduction in mortality risk in adults with or without cardiovascular disease [7, 26]. Thus, the observed improvements in cardiorespiratory fitness may have prognostic as well as functional significance.

A relevant finding was the absence of significant changes in BMI and waist circumference after the intervention. This is consistent with evidence that many cardiovascular benefits of exercise can be achieved independently of substantial changes in body weight or central adiposity [27]. The observed BP reduction may therefore have been mediated by physiological mechanisms such as improved endothelial function, increased nitric oxide bioavailability, reduced sympathetic activity, improved insulin sensitivity, and structural and functional vascular adaptations, which together may lower BP even without clinically significant weight loss [7, 28].

When the training modalities were compared, no statistically significant between-group differences were observed for most variables. However, the HIIT group showed the largest numerical reductions in BP: 8 mmHg in SBP and 5 mmHg in DBP, compared with 4 and 0 mmHg, respectively, in MICT and 3 and 4 mmHg in LICT-BFR. Although the sample size limits statistical power to detect differences between protocols, these findings are consistent with previous studies suggesting that HIIT may produce greater vascular and autonomic adaptations than MICT [29, 30].

One of the most relevant findings was the significant reduction in office SBP and DBP reported in the LICT-BFR group, with an effect magnitude similar to that obtained with conventional continuous training. Although the effects of BFR training on BP have been described previously, available evidence has focused mainly on resistance-exercise protocols [13], and few studies have evaluated this approach during continuous aerobic training in people with hypertension. Our findings therefore provide additional evidence regarding the potential therapeutic value of low-intensity aerobic exercise combined with BFR for BP control.

To the best of our knowledge, this is among the first studies to show that a supervised program of low-intensity continuous aerobic exercise on a cycle ergometer combined with BFR produces clinically meaningful reductions in both SBP and DBP in people with hypertension. These effects were accompanied by improvements in functional capacity and lower-limb muscle strength, suggesting that this training modality may be a useful alternative for hypertensive patients with low physical fitness, functional limitations, or poor tolerance of higher exercise intensities.

Our findings should be interpreted in light of several limitations. First, the sample size was relatively small, particularly for comparisons among the three training modalities, which may have limited statistical power to detect between-protocol differences. Second, the control group was not randomized, and selection bias cannot be ruled out. Third, the intervention lasted 12 weeks, so the long-term persistence of the observed benefits cannot be established. In addition, outcomes did not differ significantly according to adherence level. Overall adherence was high, with a mean of 27 ± 4 completed sessions, and although there were 8 dropouts in total throughout the study among the participants in the different exercise groups. The threshold used to define good adherence (≥ 75% of sessions) may not have been sensitive enough to detect clinical differences between participants. Finally, dietary intake was not strictly controlled during follow-up. The absence of significant changes in BMI and waist circumference suggests that the BP and fitness effects may primarily reflect the training program, although this cannot be established definitively from these data.

Despite these limitations, the study has important strengths. It was prospective, included baseline and post-intervention assessments, and all training sessions were supervised, supporting appropriate prescription and execution of the exercise protocols. Objective tests were used to assess functional capacity, muscle strength, and hemodynamic responses to exercise. In addition, three cardiorespiratory training modalities with limited comparative evidence in people with hypertension were evaluated concurrently. Baseline characteristics were similar across groups, reducing the likelihood of confounding by initial differences.

Conclusion

A 12-week supervised cardiorespiratory training program was associated with lower office BP and improved functional capacity and lower-limb muscle strength in adults with hypertension. Although most outcomes did not differ significantly among training modalities, HIIT showed a trend toward a greater BP reduction. Low-intensity continuous training combined with BFR produced clinically relevant BP reductions comparable to those achieved with conventional continuous training, together with a favorable hemodynamic profile during exercise and no reported adverse cardiovascular events. This modality may represent a promising alternative for people with hypertension who have low physical fitness and/or limitations that prevent them from performing higher-intensity exercise. Larger studies with longer follow-up are needed to confirm these findings and clarify the role of aerobic exercise with BFR in non-pharmacological hypertension management.

Declarations

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

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Tables

Table 1. Baseline characteristics of participants with and without intervention.

Variable	Control (n=15)	Exercise (n=37)	p-value
Age (years)	60 ± 4	62 ± 6	0.267
Female, n (%)	8 (53%)	24 (65%)	0.534
Smoking, n (%)	3 (20%)	2 (5%)	0.137
Statins, n (%)	4 (27%)	7 (19%)	0.217
Hypoglycemic agents, n (%)	6 (40%)	6 (16%)	0.081
Antihypertensive therapy, n (%)	11 (73%)	23 (62%)	0.532
BMI (kg/m^2)	33.90 ± 7.3	31.11 ± 5.2	0.912
WC (cm)	103 ± 13	97 ± 12	0.167
SBP (mmHg)	138 ± 18	136 ± 13	0.715
DBP (mmHg)	86.45 ± 7.13	84.59 ± 12.91	0.368
HR (bpm)	70.27 ± 9.48	70.47 ± 9.81	0.954
30-Second Sit-to-Stand (reps)	13.36 ± 2.82	14.24 ± 3.12	0.350
5-Times Sit-to-Stand (s)	9.14 ± 1.74	8.25 ± 1.36	0.057
Right HG (kg)	22.7 ± 8.8	21.5 ± 9.9	0.699
Left HG (kg)	26.6 ± 16.8	19.5 ± 9.2	0.067
Baseline METs	6.6 ± 1.4	6.9 ± 2.0	0.708

Abbreviations: WC, waist circumference; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; HG, handgrip.

Table 2. Pre–post changes in variables in the control group versus the exercise intervention groups.

Variable	Control (n=9) Baseline	Control (n=9) Final	Control Intra-group p	Exercise (n=29) Baseline	Exercise (n=29) Final	Exercise Intra-group p	Between-Group Δ Difference	Between-Group p-value (Δ)
BMI (kg/m^2)	32.51	32.36	0.757	31.34	31.26	0.737	0.17	0.898
WC (cm)	102	102	0.966	98	98	0.997	0.003	0.989
SBP (mmHg)	131	133	0.699	135	130	0.049	4.84	0.220
DBP (mmHg)	85	86	0.910	82	78	0.048	3.45	0.284
30-Second Sit-to-Stand (reps)	13.1	15.00	0.030	14.5	18.00	<0.001	1.97	0.119
5-Times Sit-to-Stand (s)	8.9	8.2	0.081	8.4	7.29	0.003	0.39	0.702
Right HG (kg)	25.7	24.6	0.257	23.2	20.7	0.046	1.37	0.715
Left HG (kg)	23.9	21.3	0.591	21.2	19.0	0.013	1.12	0.342
METs	6.6	6.0	0.280	6.3	7.56	0.038	0.29	0.068

Abbreviations: WC, waist circumference; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; HG, handgrip.

Table 3. Pre–post changes in blood pressure and physical fitness according to the three exercise modalities.

	HIIT (n = 9)				MICT (n = 9)				LICT-BFR (n = 11)				
	Pre	Post	Change	p	Pre	Post	Change	p	Pre	Post	Change	p	P val for chan
BMI	31.4	31.1	0.3	0.507	30.4	30.9	0.5	0.289	32.0	31.5	0.5	0.062	0.876
Waist circumference	100	100	0	0.999	98	97	1	0.468	98	97	1	0.545	0.201
SBP	136	128	8	0.108	134	130	4	0.501	134	131	3	0.088	0.638
DBP	80	75	5	0.123	79	79	0	0.861	85	81	4	0.044	0.794
30-second chair stand test	15.7	17.9	2.2	0.001	14.4	19.4	5	0.005	13.7	17.0	3.3	<0.001	0.089
Five-repetition sit-to-stand test	7.78	7.80	0.02*	0.363	8.4	6.7	1.7*	0.012	8.2	7.2	1	0.043	0.012
Right-hand grip strength (second trial)	20.3	23.9	3.6	0.253	22.5	25.8	3.3	0.226	19.7	20.8	1.1	0.358	0.637
Left-hand grip strength (second trial)	17.9	20.8	2.9	0.090	20.9	24.0	3.1	0.108	18.4	19.4	1	0.415	0.499
METs	7.0	7.7	0.7	0.317	6.8	7.3	0.5	0.377	6.7	7.1	0.4	0.182	0.92

* MICT versus HIIT, p = 0.008.

Figures

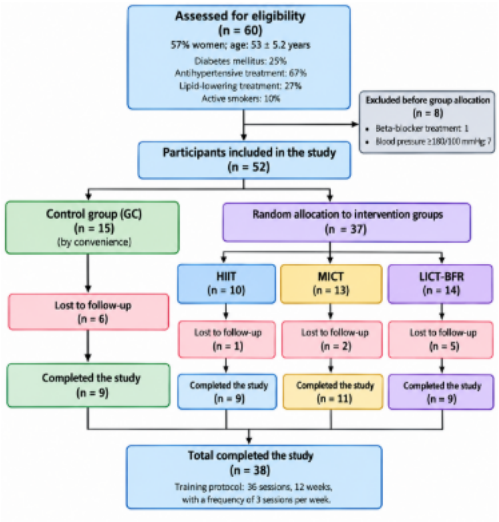


Figure 1

Flow diagram.

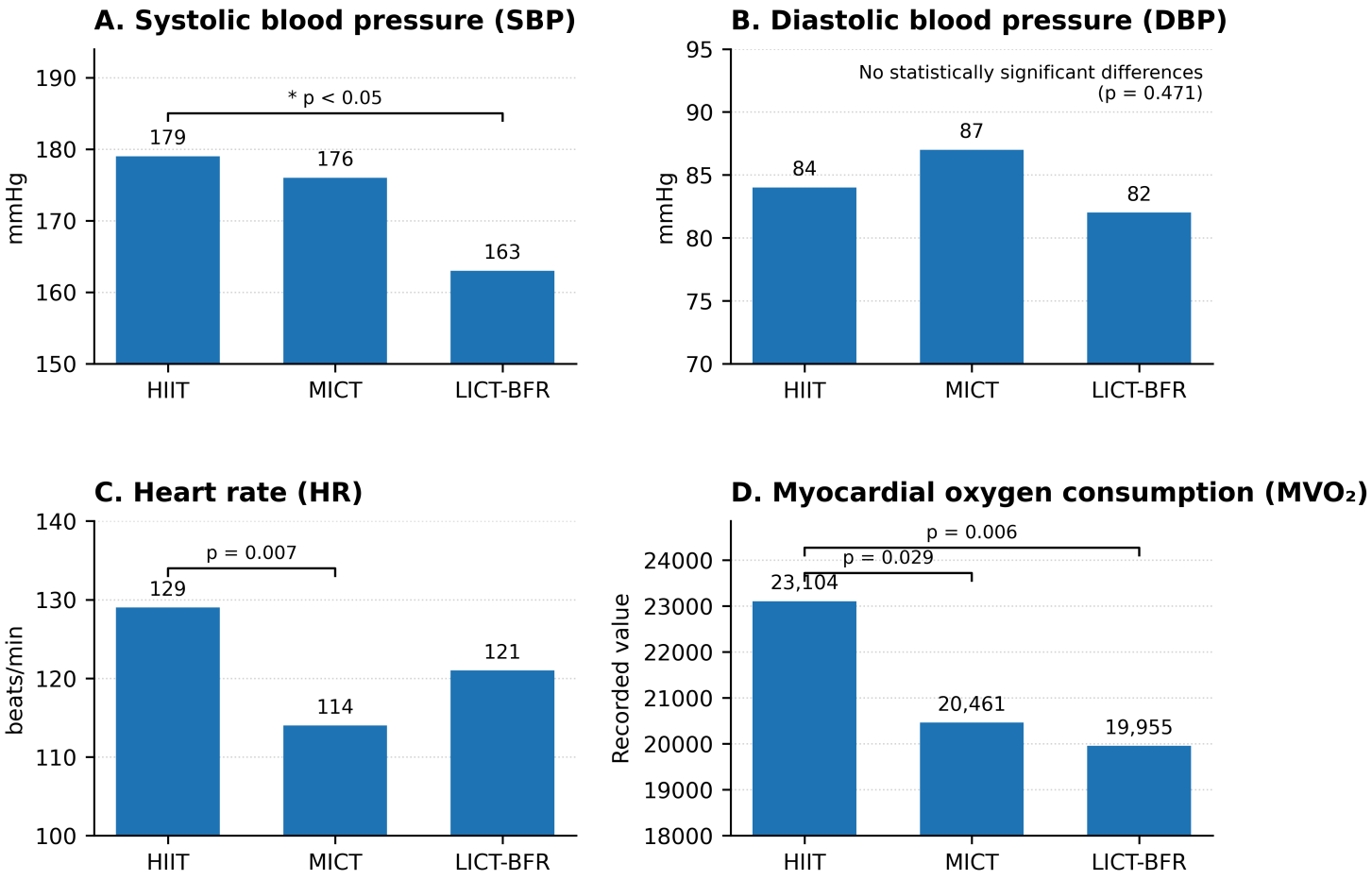


Figure 2

Peak cardiovascular responses during exercise sessions according to training protocol.

(A) Systolic blood pressure (SBP); (B) diastolic blood pressure (DBP); (C) heart rate (HR); and (D) myocardial oxygen consumption (MVO_2). Mean values recorded during exercise are shown for the HIIT, MICT, and LICT-BFR groups. Statistically significant differences are indicated with the corresponding p values.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTables.docx