

HEMODYNAMIC RESPONSE AFTER CONCURRENT CROSS EXERCISE IN HYPERTENSIVE WOMEN



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RESPOSTAS HEMODINÂMICAS PÓS-EXERCÍCIO CONCORRENTE CRUZADO EM MULHERES HIPERTENSAS

RESPUESTAS HEMODINÁMICAS POST EJERCICIO CONCORRENTE CRUZADO EN MUJERES HIPERTENSAS

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ABSTRACT

Introduction: Systemic arterial hypertension is a disease that mainly affects women. **Objective:** This study aimed to verify the hypotensive effect and blood pressure reactivity in women submitted to a concurrent cross exercise (CC) session. **Methods:** Fifteen volunteers (54±3) performed aerobic exercise alternated with a series of weights exercises, for the analysis of blood pressure variation (by the oscillometric method) and pressure reactivity (by the Cold pressure test) before and after exercise. **Results:** The results demonstrated the occurrence of post-exercise hypotension in the systolic phase in the comparison between CC and C post-exercise (-11.65 mmHg). CC led to attenuation of 7mmHg and 4mmHg for SBP and DBP, respectively, in the blood pressure reactivity after one session. **Conclusion:** It is concluded that concurrent cross exercise ensures hypotension and positive reactivity of systolic blood pressure. **Level of evidence II; Therapeutic studies- Investigating the results of treatment.**

Keywords: Hypotension; Blood pressure; Exercise therapy; Acute exercise.

RESUMO

Introdução: A hipertensão arterial sistêmica é uma doença que acomete, principalmente, mulheres. **Objetivo:** O presente estudo teve como objetivo verificar o efeito hipotensor e a reatividade da pressão arterial em mulheres submetidas a uma sessão de exercício concorrente cruzado (CC). **Métodos:** Quinze voluntárias (54±3) realizaram exercício aeróbico alternado com uma série de exercícios com peso para a análise da variação da pressão arterial (através do método oscilométrico) e reatividade pressórica (através do Cold pressure test) pré- e pós-exercício. **Resultados:** Os resultados demonstraram a ocorrência da hipotensão pós-exercício na fase sistólica na comparação entre CC e C pós-exercício (-11,65mmHg). O CC provocou a atenuação de 7 mmHg e 4 mmHg para PAS e PAD, respectivamente, na reatividade pressórica após uma sessão. **Conclusão:** Conclui-se que o exercício concorrente cruzado garante hipotensão e reatividade positiva da pressão arterial sistólica. **Nível de evidência II; Estudos terapêuticos- Investigação dos resultados do tratamento.**

Descritores: Hipotensão; Pressão sanguínea; Terapia por exercício; Exercício agudo.

RESUMEN

Introducción: La hipertensión arterial sistémica es una enfermedad que afecta principalmente a las mujeres. **Objetivo:** El presente estudio tuvo como objetivo verificar el efecto hipotensor y la reactividad de la presión arterial en mujeres sometidas a una sesión de ejercicio concorrente cruzado (CC). **Métodos:** Quince voluntarias (54 ± 3) realizaron ejercicio aeróbico alternando con una serie de ejercicios con peso para el análisis de la variación de la presión arterial (a través del método oscilométrico) y reactividad presórica (a través del Cold Pressure Test) pre y post ejercicio. **Resultados:** Los resultados demostraron la ocurrencia de hipotensión post ejercicio en la fase sistólica en comparación entre CC y C post ejercicio (-11,65mmHg). El CC provocó la atenuación de 7 mmHg y 4 mmHg para PAS y PAD, respectivamente, en la reactividad presórica después de una sesión. **Conclusión:** Se concluye que el ejercicio concorrente cruzado garantiza hipotensión y reactividad positiva de la presión arterial sistólica. **Nivel de evidencia II; Estudios terapêuticos- Investigación de los resultados del tratamiento.**

Descriptorios: Hipotensión; Presión sanguínea; Terapia por ejercicio; Ejercicio agudo.

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INTRODUCTION

Systemic arterial hypertension (SAH) is a chronic disease that is caused by several factors, neurometabolic and hereditary.¹ It is characterized by permanent elevation of blood pressure (BP) that subjects the individual to risk of cardiovascular disease. Mozaffarian,² Heidenreich.³ SAH is predominant in men, but the frequency of the disease in menopausal women increases the evolution of the change in habits.⁴

Researchers have used an analysis of blood pressure reactivity (PR), which is the reactive response of blood pressure to physiological stress.¹ This variable is associated with an aortic pulse wave velocity, which is a surrogate measure of arterial stiffness and an acute predictor of cardiovascular disease risk.⁵ One of the testicles used to assess a critical pressure. Cold Pressor Test (CPT).⁶

As a way of reducing the exposure of individuals to the risks caused by SAH, treatment by drug intervention has been prioritized. The physical exercise is considered supplementary prescription non-pharmacological form of treatment because it presents a hypotensive effect after a training period or after an exercise session, known as post exercise exercise hypotension (PEH).^{7,8} Furthermore, according to a study made by Viegali et al.⁹ the regular practice of physical exercises can reduce resting blood pressure levels around 15 mmHg in SBP and 7 mmHg in DBP in hypertensive individuals, besides providing reductions in the doses of antihypertensive drugs.

Aerobic exercises (EA) act in the control of hypertension acutely and chronically. According to Cunha et al.,¹⁰ low-intensity training (45% of peak VO₂) and more intense and fractional training (70% VO₂ peak) significantly decrease systolic, diastolic and mean blood pressure. The resistance exercises (RE) have a positive influence, mainly on PR, since they can promote attenuations between 2 to 9 mmHg in SBP and 6 to 10 mmHg for DBP.^{11,12}

Some studies have shown the efficiency of EA performed in the same session of ER (concurrent exercise), on HPE and on PR response.^{13,14} However, a new methodological proposal of the crossing of EA with ER could produce greater protective vessel effect. Therefore, the present study aims to verify the post-exercise hypotensive effect and pressure reactivity, due to stressor agent, in hypertensive women submitted to cross-competitor exercise. In addition, the heart rate (HR) response to the pressure reactivity test was analyzed.

METHODS

Fifteen hypertensive women, aged between 40 and 60 years, who had been practicing AS and ER for three weeks, were selected. They were not included if they had coronary heart disease and / or orthopedic limitations that made physical assessments and exercise programs impractical. And the volunteers who missed any test and intervention sessions were excluded from the analysis.

All were informed of the study procedures and signed the Informed Consent term. The protocol was approved by the research ethics committee of the University Hospital of Aracaju of the Federal University of Sergipe under process number 67176817.7.0000.5546.

They performed a cross-concurrent exercise session (CC) and, after 48 hours, a control session (C), demonstrated in Figure 1. For CC, EA was divided and fractionated into distance, applied at the beginning, between each exercise and at the end of the session. They performed multi-articular exercises: leg press 45°, machine-padded, squatting with free bar and bench press in the machine, with intervals between

30 seconds to 1 minute between the 3 sets of 10 repetitions with a 200-meter walk between each exercise. For C, no type of exercise was performed, the volunteers remained seated within the same time period of the CC session. The sessions lasted one hour without considering the pre- and post-exercise moments.

The walk was performed at intensity considered "intense", controlled by the effort perception scale.^{14,15} For the prescription of the load in the ER, all of them performed a test of eight maximal repetitions (8 RM) of the proposed exercises. It was initiated by a heating of 20 unladen repetitions, being corrected and oriented the way of execution of the movements, then they had three attempts, with intervals of five minutes, to be able to effect eight repetitions in a maximum load. 75% of 8RM were used to perform each exercise during the CC session.

The BP measurement was performed by the digital oscillometric sphygmomanometer of the Microlife model Bp 3AC1-1 in the left arm. Before the sessions, the participants were seated in a chair for 20 minutes to check the BP every 5 minutes. After the sessions, the same BP measurement procedure was performed, but at 15-minute intervals, for one hour. The volunteers were then submitted to the Cold Pressor Test for RP verification. The CPT was applied after HPE, placing the right hand in a container containing cooled water, at a temperature of 4°, for one minute. The BP was measured at the end of the immersion time. The HR for CPT analysis was obtained at the pre-session and together with CPT measurement.

The data were submitted to descriptive statistics and normality test of Shapiro Wilk. Then, with the means of the pre and post moments of the C and CC sessions, the ANOVA Two Way 2:2 was used for repeated measurements (for hypotensive effect analysis after exercise). ANOVA Two Way was performed to analyze the pre and CPT values in order to observe the PR response, comparing between sessions. Both analyzes had the homogeneity evaluated by the Levene test and compared the main effects with Bonferroni Post Hoc. The level of significance was set at $p < 0.05$ and all analyzes were performed in the IBM SPSS version 22 program.

RESULTS

After analysis of ANOVA Two Way (2,2), the effects test between subjects of SBP (Figure 2 A) showed a difference of 11.65 mmHg between CC and C 60 min after exercise. There was a significant difference in the pre and post moments ($F(4,52) = 3.09, p < 0.02, \eta = 0.43$) and in the relation between sessions and moments ($F(1,13) = 18,76, p < 0.01, \eta = 0.76$), and significant effect size was observed for the CC session (η value). In the DBS (Figure 2 B) there was no effect or statistical difference between sessions with the ratio $F(1,13) = 0.459; p < 0.51$;

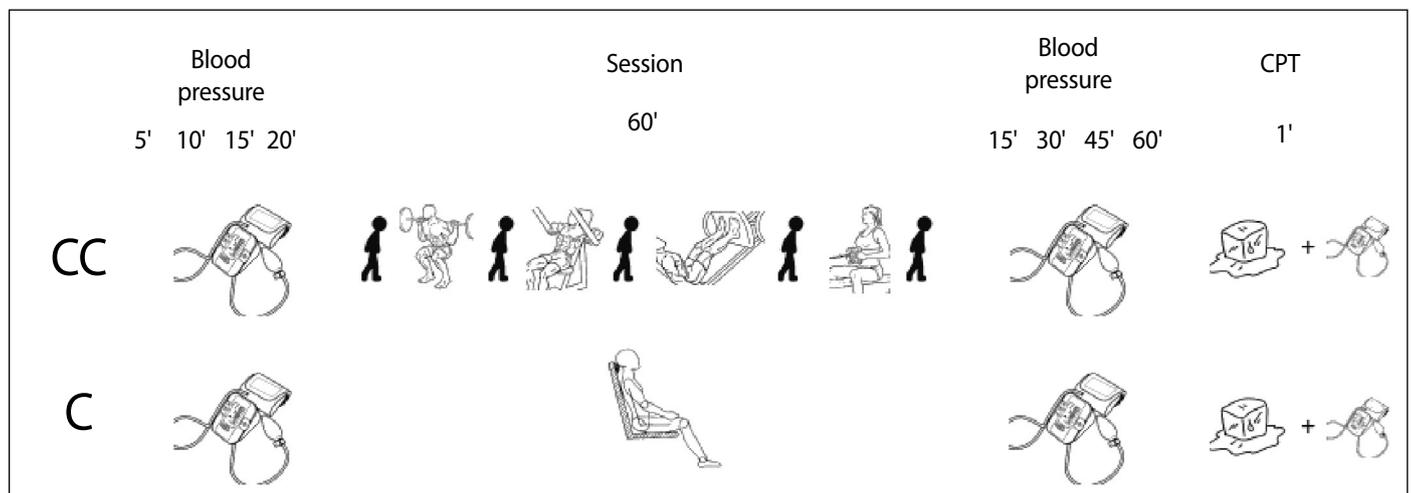


Figure 1. Study design.

$\eta = 0.58$; between pre and post moments with $F(4.52) = 0.55$; $p < 0.69$; $\eta = 0.184$; and in the relation between sessions and moments ($F(4,52) = 0.905$; $p < 0.468$; $\eta = 0.254$). In HR (Figure 2 C) there was an increase of 13 bpm, 22.99 bpm, 11.64 bpm and 10.785 bpm, comparing CC and C ($F(1,13) = 44.67$, $p < 0.01$; $\eta(F(4.52) = 27.81$, $p < 0.01$, $\eta = 0.82$), and ($F(4.52) = 0.88$), there was also a difference in time and session and time) = 15.32, $p < 0.01$, $\eta = 0.73$).

In CPT applied to SBP there was no difference between C and CC with $F(1,13) = 0.914$; $p < 0.35$; $\eta = 0.256$. However, there was a significant effect and difference in the comparison of rest with CPT in the F ratio (1.13) = 28.31; $p < 0.001$; $\eta = 0.827$, and in the comparison of the sessions with moments ($F(1,13) = 19.545$; $p < 0.001$; $\eta = 0.775$). In the DBP there was no difference between C and CC with $F(1,13) = 0.531$; $p < 0.479$; $\eta = 0.196$. However, there was difference in the comparison of rest with CPT in the ratio of $F(1,13) = 25.23$; $p < 0.001$; $\eta = 0.812$, with no difference comparing sessions with moments ($F(1,13) = 0.005$, $p < 0.94$, $\eta = 0$), presented in Table 1.

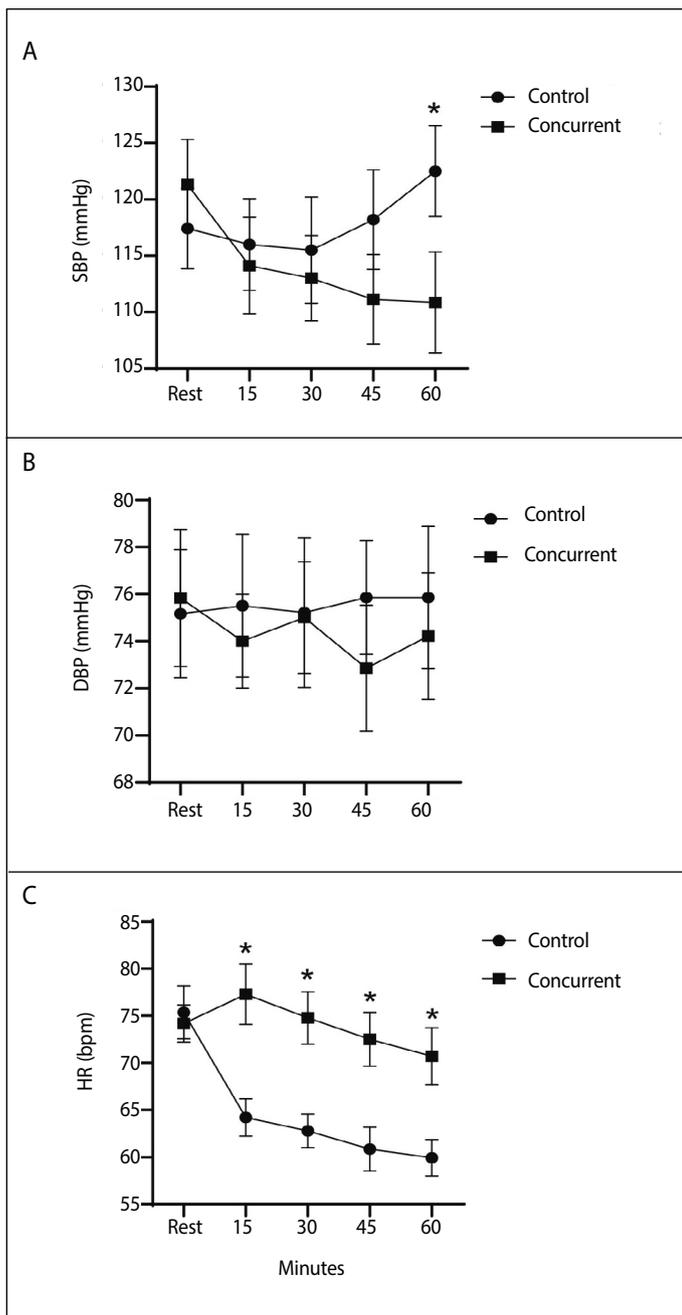


Figure 2. Mean values of diastolic blood pressure of SBP, DBP and FC, comparing rest with moments 15 min, 30 min, 45 min and 60 min after control and concurrent session.

Table 1. Variables obtained from moments of rest and CPT in the control and exercise sessions.

	Control		Concurrent	
	Rest	CPT	Rest	CPT
SBP (mmHg)	117.4 ± 13.3	142.5 ± 19.3	121.3 ± 15	132.3 ± 19.8*
DBP (mmHg)	75.1 ± 10.1	89.2 ± 11.5	75.8 ± 10.9	88.3 ± 16.1
HR	75.35 ± 10.5	63.7 ± 9.17*	74.16 ± 7.37	71 ± 11.6

CPT: Cold pressure test; SBP: Systolic blood pressure; PAD: Diastolic blood pressure; HR: Heart rate; * $p < 0.05$ between sessions for the whole group.

DISCUSSION

The cross - competitive exercise, as a new exercise proposal for hypertensive patients, caused a reduction of SBP with mean decay value of - 9.03 mmHg. It has been shown to be effective in attenuating RP in hypertensive women for both SBP and DBP. Other studies have also analyzed the behavior of PA under the application of concurrent exercise (EC) in hypertensive patients, but sequentially between AE and ER.¹⁶⁻¹⁸

Azevêdo et al.¹⁷ submitted hypertensive women, adapted with CD, to four multi-articular resisted exercises, with intensity of 75% of 8RM, and 20min of bicycle with moderate to severe intensity. In agreement with the results of this study, the authors found a reduction of approximately 10 mmHg for SBP, while there was no significant result for DBP. According to Menezes et al.,¹⁸ the concurrent exercise does not cause changes in SBP and DBP in postmenopausal sedentary hypertensives. The sample underwent treadmill walking between 50-60% of reserve HR and seven exercises for large and small muscle groups at 50% of maximal repetition.

The conflict of these studies allows us to analyze whether exercise intensity can influence the occurrence of PEH. Corso et al.¹⁹ indicates that the concurrent exercise of moderate intensity exhibits a higher dose-response relationship in hypertensive (5/6 mm Hg) than in prehypertensive (3/4 mm Hg). For Eicher et al.,²⁰ the higher the intensity of aerobic exercise (60% to 100% of VO_{2Pico}), the greater the decrease in SBP in middle-aged men. However, in the present study, moderate exercise was chosen because of better adherence and equity in the exercise program aimed at the population of hypertensive women with drug control, which explains the lower values resulting, however, that the present study demonstrated in relation to blood pressure values.

According to Souza Junior et al.,²¹ acute physical exercise promotes an increase in NO concentration, which may induce positive adjustments in the cardiovascular system. Likewise, according to Asano et al.,²² this concentration of NO results in endothelial vasodilation during and after exercise, which could explain the mechanism of PEH.

The cross- concurrent exercise was also efficient in attenuating PR for both SBP and DBP. According to Brindle et al.²³ individuals who are reactive to psychological stress have the capacity to respond positively to cardiovascular diseases. In agreement with the results found, the concurrent exercise applied by Azevêdo et al.¹⁷ attenuated the SBP response -23.7 ± 16.0 and DBP -16.7 ± 13.9 mmHg. Our results showed attenuation of -10.2 ± 3.9 in SBP, which, although lower, was in fact enough to move individuals considered hypertensive medicated to the prehypertension zone. In another study, twenty healthy subjects performed three circuits of six multiarticular exercises and five minutes of up and down in a box of 15cm of height, with 2 minutes of recovery between each circuit. The CPT was applied pre and post exercise, which caused attenuation of approximately 7mmHg and 4mmHg for SBP and DBP, respectively.¹³

In addition, the present study highlights the attenuating response of BP in the concurrent exercise crossed only in SBP and also highlights the elevation of HR in CPT in response to the moderate volume exercise.

The results of the present study were significant, providing a beneficial contribution to the practice of EC in the community since the important reduction in blood pressure post exercise (SBP: - 10.5 ± 9.7 mmHg), as well as vascular protection to a stressor agent, in population hypertension.

CONCLUSION

It is concluded that cross-concurrent exercise is able to cause post-exercise hypotension, especially in systolic blood pressure, in hypertensive women. It also ensures vascular protection by attenuating the increase in blood pressure at stressor time.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: ECW: writing, intervention, statistical analysis, intellectual concept and preparation of the whole study; ACS: intervention, data analysis, and writing; LESS: data analysis, and writing; AFP, PDPC, RENS, and LSN: writing and revision; RBW: intellectual concept, revision; EP: intellectual concept, statistical analysis, writing, and revision. All the authors revised and approved the final version of the manuscript.

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