



# WALKING/RUNNING OR A RECREATIVE SOCCER GAME PRESENTS SIMILAR EFFECTIVENESS IN INDUCING POST-EXERCISE HYPOTENSION

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## ABSTRACT

**Introduction:** Aerobic exercises are the most investigated and recommended for the promotion of blood pressure reduction. However, is not yet clear how acyclical modalities (volleyball, soccer and others) may promote the post-exercise hypotension (PEH). **Objective:** To compare the acute pressoric response of a soccer match with a walking/running session in recreational soccer practices. **Method:** Eight normotensive (59.7±5 years) and eight hypertensive subjects (57.3±7 years) had blood pressure (BP) monitored before the exercise sessions and during 30 minutes of recovery time. **Results:** Soccer and walking/running promoted reduction of systolic BP of -13.8±11 and -6.8±9 mmHg respectively among the hypertensive, and -13.3±6 and -5.8±7 mmHg among the normotensive individuals. Diastolic BP was reduced to -8.8±5 and -2.8±4.8 mmHg for hypertensives, and -6.5±5 and -4.4±2 mmHg for normotensives. There were no significant differences between soccer and walking/running. **Conclusion:** Recreational soccer presents the same efficacy in promoting PEH as walking/running.

**Keywords:** soccer, walking, blood pressure, physical exercise, hypotension.

## INTRODUCTION

It is already well-established that one session of aerobic physical exercise causes blood pressure (BP) decrease a few minutes after the exercise when compared with the baseline level in normotensive and hypertensive subjects<sup>1-2</sup>. Such phenomenon is called “post-exercise hypotension” (PEH)<sup>3</sup>. The PEH magnitude and duration are related to factors such as intensity, duration, muscular mass involved and the type of exercise<sup>4</sup>. Although it is well-known that aerobic exercise with moderate intensity and with 30 to 60 minutes of duration are the most recommended as anti-hypertensive treatment<sup>2, 5</sup>, recent evidence show that other exercise protocols with low<sup>6</sup>, high<sup>7</sup> and intermittent intensities<sup>7-8</sup>, as well as other very diverse modalities such as weight lifting<sup>9</sup> and Tai Chi Chuan<sup>10</sup> are also able to promote PEH. Thus, it is not completely clear which exercise modality and intensity promote hypotensive response or even if there is supremacy of a modality over another.

Investigations about the hypotensive effect of exercise in acyclical modalities (such as volleyball, handball, tennis, soccer and others) are limited, possibly due to the difficulty in controlling the volume, intensity and emotional fluctuations involved in the matches of these sports<sup>11</sup>. Despite of that, these types of exercise should not be disconsidered in studies. Soccer, for instance, is the most popular sport in the world and the most practiced in many countries. Moreover, many individuals adopt soccer as their only source of exercise<sup>12</sup>. Such fact justifies the effort for methodological outlining in an attempt to better clarify about the hypotensive response for such exercise modality. Thus, we tried to monitor soccer matches with recreational character, without emotional imbalance between players and we monitored the exercise intensity during

the matches. Such procedure made more accurate methodological technique possible to investigate the post-exercise blood pressure response for this acyclical modality. Thus, this study had the aim to compare the acute pressoric effect between a soccer match and a walking/running session in middle-aged men who practice recreational soccer.

## METHODS

### Subjects

In order to calculate the sample size, the lowest post-exercise systolic hypotension between aerobic and intermittent exercises was adopted, which was established in 8 mmHg for PD of 3 mmHg (13). Statistical power was established in 80%, considering significance level of  $p < 0.05$ . The *G\*power* 3.1.0 program was used. These arguments returned a minimum of 8 subjects to make part in this study. Thus, the study was developed with sixteen male subjects (eight normotensive and eight hypertensive), aged between 40 and 60 years, who practiced soccer as leisure on weekends and who practiced at last two other walking/running sessions or soccer during the week. Table 1 summarizes the subjects' characteristics. The goalkeeper was not included in this study. The research was approved by the Ethics Committee of the Lauro Wanderley University Hospital – Federal University of Paraíba (protocol # 271/09) and all subjects signed the Free and Clarified Consent Form.

### Soccer match protocol

The soccer match was played on a turfed soccer field, took place in the morning and lasted 60 minutes, with no rest interval. The researchers were careful in observing if the match did not present

**Table 1.** Anthropometric characteristics of the normotensive and hypertensive subjects.

	Normotensive	Hypertensive	P value
Age (years)	59.7 ± 5	57.3 ± 7	0.44
Weight (kg)	71.5 ± 12	80.9 ± 9	0.11
Height (m)	1.66 ± 0.06	1.67 ± 0.05	0.64
BMI (kg/m <sup>2</sup> )	25.9 ± 3	28.9 ± 3	0.08
Waist circumference (cm)	90.5 ± 9	100.4 ± 8*	0.04

Values are mean and standard deviation. BMI: body mass index. \* Statistical differences between normotensive and hypertensive (p<0.05).

intense emotional imbalance (fights, arguments, violent plays or controversy), to guarantee that the recreational aspect of the match was not harmed.

### Walking/running protocol

On the week following the data collection of the soccer match, the subjects performed a walking/running session. This protocol was developed at the same time of the day and with the same duration of the soccer match (60 minutes). In order to guarantee similarity between the two exercise protocols, the walking/running exercise was done in a way to simulate the heart rate (HR) behavior during the soccer match, but keeping the values steady to characterize the continuous aspect of this kind of exercise. The subjects were told to keep mean of heart rate of ± 5% of mean intensity found in the soccer match. Once the intensity to be reached in the soccer match could not be previously determined, the game protocol of this modality needed to be applied before the walking/running exercise. Consequently, it was impossible to randomize the order of the exercise protocols.

### Heart rate monitoring

The subjects were equipped with HR monitors (Polar Electro, Kempele, Finland) before the match and were told to inform the HR values when asked by the researchers. HR was recorded at every five minutes. The researchers were placed along the field to facilitate the contact with the subjects and they were allowed to enter the field to communicate with the subjects in the study. If the subject was moving at the moment of the HR recording, he would read it immediately after his participation in the move.

Intensity which should be adopted in the walking/running exercise was calculated with record of the mean intensity of the soccer match. Therefore, a derivation of the equation proposed by Karvonen *et al.*<sup>14</sup> was used. For these calculations, maximum HR was estimated based on the equation for healthy individuals of both sexes aged between 20 and 70 years ( $MHR = 205.8 - 0.685 * \text{age}$ )<sup>15</sup>. The walking/running exercise was performed on the same field where the soccer was played, with the subjects wearing cleats and the researchers were placed inside the field to facilitate communication with the subjects at every five minutes, when they needed to inform the HR value.

### Blood pressure monitoring

The subjects were told not to practice exercise or ingest caffeinated drinks 24 h before the data collection. As soon as they arrived at the field where the exercise protocol would be held, the subjects were invited to remain seated for 10 minutes and the HR at rest was monitored. Immediately after the exercise, the subjects were invited to sit to initiate the protocol of post-exer-

cise BP measurement. BP was monitored immediately after the exercise, at 10, 20 and 30 min from the recovery period, precisely.

## STATISTICAL ANALYSIS

The data are presented as mean and standard deviations. The differences between the subjects characteristics (age, body mass, height and BMI) were evaluated through the Student's *t* test for independent samples. A two-way ANOVA test with Tukey *post-hoc* was used to compare the HR and BP responses to the soccer match and walking/running exercise between the normotensive and hypertensive groups, before and after exercise. The comparison of the PEH values between the soccer match and walking/running was done through the Mann-Whitney test. The significance level adopted was 5%. These procedures were done in the *Instat* program, version 3.06 (GraphPad Software Inc, San Diego, CA, USA).

## RESULTS

The subjects of the hypertensive and normotensive groups presented similar ages. The waist circumference of the hypertensive group was significantly wider than in the normotensive group. The other variables of body composition and HR at rest were similar in the two groups (table 1). The hypertensive group presented BP at rest with statistical tendency to be higher than in the normotensive group at the moments before each exercise protocol. The BP values at rest were similar on the days with soccer and the walking/running procedures, considering each group separately (hypertensive and normotensive) (table 2).

The soccer match and the walking/running protocols resulted in similar HR behavior, indicating success in using the walking/running exercise intensity in order to mimetize the behavior during the soccer match (figure 1). During the soccer match and the walking/running exercise the subjects obtained mean intensity of  $80 \pm 12\%$  and  $71 \pm 6\%$  of reserve HR, respectively, without statistical difference between these values.

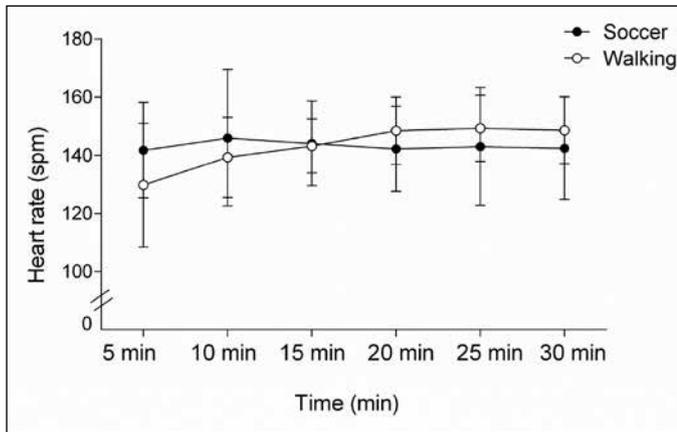
BP significant decrease in the 20 and 10 post-exercise minutes for systolic and diastolic values, respectively for the hypertensive group was observed in the soccer match (figure 2). The walking/running protocol promoted BP reduction, but none statistical difference was observed in rest and post-exercise values in the normotensive or hypertensive groups. Although intragroup differences have been observed for the post-exercise BP in the soccer match, no significant difference occurred when post-exercise values between the soccer match and walking/running were compared.

Concerning the PEH, the results are presented in figure 3. It was observed that the magnitude for the soccer match was  $-13.8 \pm 11.7$  and  $-8.8 \pm 5.8$  mmHg for systolic and diastolic values among hypertensive subjects and  $-13.3 \pm 6.7$  and  $-6.5 \pm 5.6$  mmHg for systolic and diastolic values among normotensive subjects. The walking/running exercise promoted PEH of  $-6.8 \pm 9.0$  and  $-2.8 \pm 4.8$  mmHg for systolic and diastolic values among hypertensive individuals and  $-5.8 \pm 7.6$  and  $-4.4 \pm 2.4$  mmHg for systolic and diastolic values among normotensive ones. None significant difference was found in the comparison between the exercise protocol (soccer match and walking/running exercise), or between groups (hypertensive and normotensive).

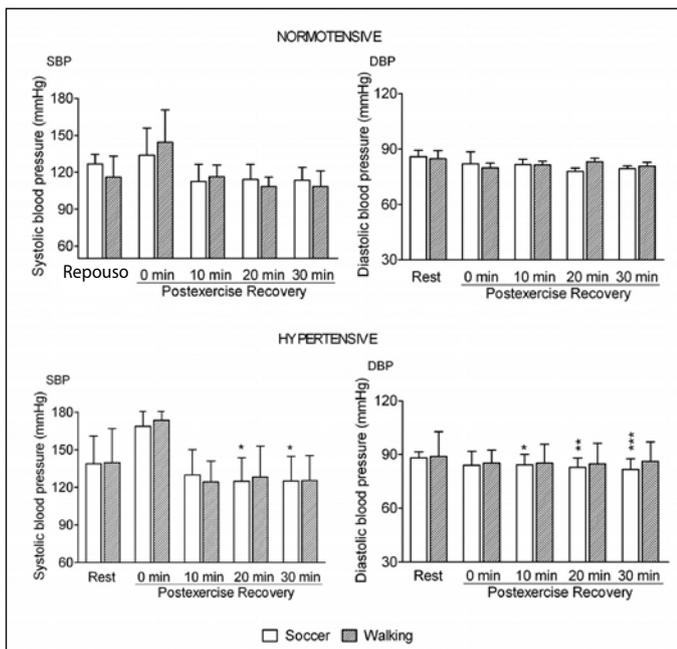
**Table 2.** Hemodynamic characteristics at rest of the subjects prior to the soccer and walking/running sessions.

	Soccer	Walking/running	p value
HR (beats/min)			
Normotensive	71,4 ± 5	69,3 ± 7	0,47
Hypertensive	75,0 ± 15	80,0 ± 16	0,53
SBP (mmHg)			
Normotensive	126,8 ± 8	116,0 ± 17	0,13
Hypertensive	146,3 ± 20	140,9 ± 29	0,93
DBP (mmHg)			
Normotensive	85,7 ± 3	84,7 ± 4	0,69
Hypertensive	90,6 ± 7	90,6 ± 14	0,78

Valores expressos em média e desvio-padrão. FC: frequência cardíaca, PAS: pressão arterial sistólica, PAD: pressão arterial diastólica.



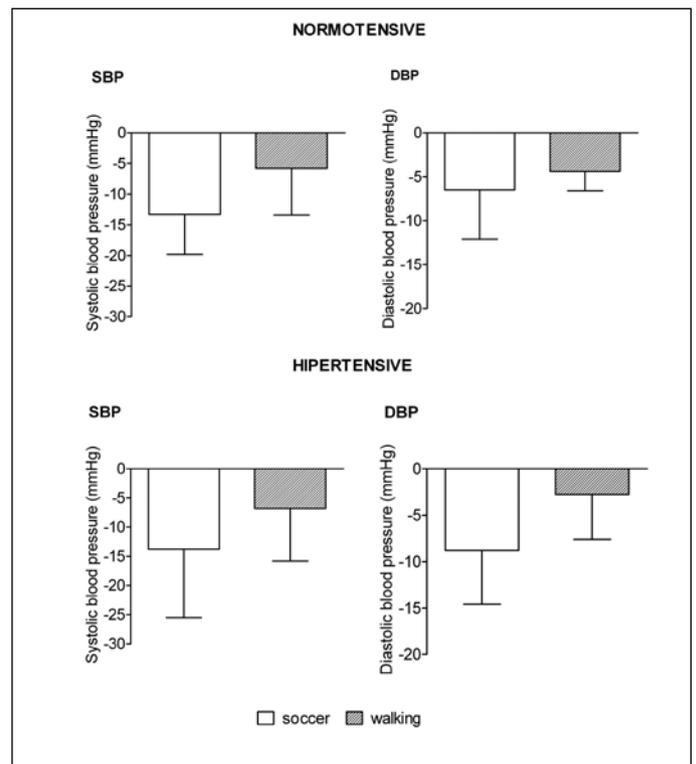
**Figure 1.** Heart rate behavior during the soccer match and walking/running exercise at every five minutes during the 30 minutes of exercise duration. None significant difference was found between exercises



**Figure 2.** Systolic blood pressure behavior in normotensive and hypertensive subjects in the soccer match and walking/running exercise. 0 min: immediately after the end of the exercise; 10 min, 20 min and 30 min: exercise recovery in 10, 20 and 30 minutes. \*  $p < 0,05$  concerning the values at rest. None statistical difference was found between the soccer x walking/running exercise values. No difference was found either between values in the hypertensive x normotensive groups.

## DISCUSSION

The data in this study reveal that a soccer match was slightly more efficient in reducing BP than a walking/running session in hypertensive subjects. Despite the absence of statistical signifi-



**Figure 3.** Absolute reduction of systolic and diastolic blood pressure in normotensive and hypertensive subjects in the soccer match and walking/running exercise. No significant difference was found between the soccer and walking/running values. No difference was found between normotensive and hypertensive subjects.

cance, the PEH magnitude in soccer was consistently higher than in walking/running in SBP and DBP, both for normotensive and hypertensive subjects.

Previous studies present reduction of up to 15 mmHg for SBP and 4 mmHg for DBP after a single session of aerobic exercise for normotensive and hypertensive individuals<sup>1,16-17</sup>. In our study, not only data from the walking/running session (aerobic/continuous exercise), but also of the soccer modality (intermittent exercise), confirmed these SBP values. Concerning the DBP, the PEH magnitude in this study is higher than the ones mentioned in previous studies. The parameters for exercise prescription which interfere in the PEH magnitude are very well-established, but they are only based on continuous and aerobic exercises. In these kinds of exercises, the PEH is influenced by intensity, duration, type of exercise and the population which performs it. The exercise intensity seems to be the parameter which mostly determines the PEH magnitude. Studies report more remarkable pressoric decrease after exercises performed with low intensity and moderate intensity<sup>18-19</sup>. However, some studies evidence that even in exercises with high intensity, there is PEH<sup>7,20</sup>.

Although aerobic exercise is classically accepted as the most efficient in promoting PEH, Macfarlane *et al.*<sup>8</sup> and Quinn *et al.*<sup>21</sup> observed more remarkable decrease of SBP and DBP after training with intermittent exercise, suggesting hence that this training protocol is better in cardiovascular conditioning and other health-related variables. Despite of that, such studies have only been conducted with walking/running exercise. Meanwhile, we chose to consider a great number of individuals who adopted sports modalities practice with recreational aspect in their exercise routine.

As far as we know, there are no acute comparative studies between practice of continuous and systematic exercises versus social and recreational activities, such as team sports modalities. The reason may be that since it is an investigation, the authors prefer activities as walking or running performed at laboratory conditions, where the training variables (intensity and duration), and environment variables (temperature, air humidity) may be more easily controlled. However, due to the significant number of people who adopt sports practice instead of walking or running, we understand that studies of this nature are very important to contribute with information on the anti-hypertensive treatment, clarifying about the importance for healthy physical habits according to their preferred modalities.

The psychosocial characteristic of soccer recreational practice may justify the discretely higher PEH than in walking, which is the classically recommended modality for hypertension treatment. Highly stressing situations such as competitive sports promote increase of the anxiety level both in elite and amateur athletes<sup>22</sup>, consequently, increasing the sympathetic nervous activity. On the other hand, when played in a non-competitive manner, amateur practitioners present lower values in the components of the low frequency aspect, which implies in lower sympathetic activity compared to elite athletes<sup>23</sup>. Therefore, some studies showed that sport modalities such as Tai Chi Chuan, are efficient in promoting PEH<sup>10</sup> and improving the regulation of the vagal reflex and sensitivity of the baroreflex after some training weeks<sup>24</sup>. Moreover, another modality as yoga may promote BP reduction in subjects with risk for cardiovascular disease after a training period<sup>25</sup>, despite being a low-intensity physical activity, which is a point in favor of the exercise psychobiological influence on blood pressure.

We also considered the hypothesis that differences in the vascular blood flow originated in intermittent and continuous

exercises which characterized soccer and walking/running may create differences in the production of endothelial nitric oxide with consequent differences in the pressoric response between these exercises. However, the hypotensive mechanisms of the two studied modalities were not studied. Therefore the investigation of possible differences in the hypotensive mechanisms between soccer matches and walking/running sessions becomes needed.

In order to compare the two modalities of this study, it was necessary to guarantee control of other involved variables (duration and intensity were the same for the two exercise protocols). In order to make this happen, we had to abandon the random order of the protocols. Thus, soccer modality was firstly performed for the impossibility to standardize the game's intensity. Based on individual HR data in the soccer match, the intensity of the walking/running session was then determined. This methodological procedure was important to minimize the information gap on the capacity of recreational soccer matches to substitute systematized exercises such as walking/running as hypertension prevention and treatment in middle-aged and older men.

## CONCLUSION

Our findings evidenced that the soccer modality may be used as an efficient instrument in the hypertension treatment, as an alternative to walking or running exercise, which are the most researched up to the present moment. Moreover, the soccer recreational aspect may be involved in the blood pressure decrease, in a way that hypertensive practitioners should be encouraged to keep less competitive and more friendly matches in this sport.

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All authors have declared there is not any potential conflict of interests concerning this article.

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