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Analysis of Acute Cardiovascular Responses in Experienced Practitioners of Capoeira: A Brazilian Art Form

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ABSTRACT

Silva FF, Souza RA, Carvalho WRG, Costa RP, Jerônimo DP, Silveira Júnior L. Analysis of Acute Cardiovascular Responses in Experienced Practitioners of Capoeira: A Brazilian Art Form. **JEPonline** 2015;15(6):112-119. Capoeira is a Brazilian art form that combines elements of martial arts, sports, and dance. The aim of this study was to examine the acute cardiovascular responses (ACR) of three main rhythms of capoeira: Angola, Banguela, and São Bento. Thirty subjects participated in this study. These subjects were enrolled in an advanced capoeira class. Before the tests, subjects were kept 10 min at rest to ensure basal values regarding the cardiovascular parameters: arterial blood pressure (systolic and diastolic, SBP and DBP, respectively), heart rate (HR) and double product (DP). Subjects in pairs of the same gender were randomly assigned to the rhythms Angola, Banguela, and São Bento with a 1 wk interval between the tests. Each rhythm had duration of 3 min and all subjects were encouraged to develop their maximum performance during the test. After the tests, SBP, DBP, HR, and DP were determined. The findings suggest that capoeira can be used as an effective activity for promoting physical health.

Key Words: Martial Art, Heart Rate, Blood Pressure, Double Product

INTRODUCTION

Capoeira is a Brazilian art form that combines elements of martial arts, sports, and dance. It was created in the 16th century by descendants of African slaves with some influence from Brazilian natives. The practice incorporates quick and complex moves, using mainly power kicks and quick leg sweeps, with some ground and aerial acrobatics, knee strikes, take-downs, elbow strikes, punches, and head-butts. It requires balance, strength, agility, and endurance. Capoeira is a popular martial art that is practiced by thousands of participants of all ages (17).

It has been established that physical exercise can affect the cardiovascular system in many different ways depending on the health status of the exerciser and the type of exercise that is being executed (12). It is generally agreed that a better understanding of cardiovascular responses to strength or aerobic training in different situations is important for the safety of the practitioner, especially when their clinical conditions involving greater risk (14). However, as to the physiology of martial arts, only a few studies exist regarding practitioners of taekwondo, karate, kung fu, judo, and tai chi (1,3,5,8,18).

Maia et al. (10) evaluated hemodynamic responses in subjects engaged in capoeira versus sedentary individuals. The results suggest that capoeira has the potential to increase heart rate sufficiently to increase cardiorespiratory fitness. However, research on capoeira training has not provided data on which to base conclusions about the cardiovascular stress encountered by capoeira practitioners. Understanding the cardiovascular responses of different rhythms of capoeira would allow capoeira practitioners to accurately determine the intensity required to meet fitness goals and overall health.

Therefore, this study was conducted to examine the acute cardiovascular responses of the three main rhythms of capoeira: Angola, Banguela, and São Bento. The differences between systolic and diastolic blood pressure, heart rate (HR), and double product (DP) prior to and post the practice of capoeira will be analyzed. It will then be possible consider the need to structure capoeira training sessions based not only on the technical and tactical needs of practitioners, but also in a manner that enables sufficient cardiovascular conditioning and reducing cardiovascular risks.

METHODS

Subjects

Twenty four male and six female subjects (mean age 17.7 ± 8.25 yrs, weight 55.13 ± 15.78 kg, height 1.57 ± 0.15 m, BMI 21.61 ± 3.34 $kg \cdot m^{-2}$) were recruited from one capoeira school in the city of Guaranésia, MG, Brazil. The subjects were enrolled in an advanced capoeira class. Recruitment criteria were: (a) similar technical skill; (b) had practiced capoeira for ~5 yrs; (c) trained at least three times per week for 1 hr; and (d) a “no” response to all the Physical Activity Readiness Questionnaire (PAR-Q) questions. All subjects were informed of the purpose and protocol of the study, and each provided written informed consent. The study was approved by the ethics committee of the Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas Gerais, Muzambinho, Brazil.

Procedures

All testing was performed between 4 and 6 pm. Two hours before the test, subjects received a light snack. Coffee, tea, and alcohol intake was prohibited 12 hrs before, and subjects avoided formal and strenuous exercise for 48 hrs before testing. At the beginning of the study, subjects rested for 10 min. During the 10th min, SBP, DBP, HR, and DP were measured. The subjects’ values were considered prior-Acute Cardiovascular Responses (prior-ACR). Then, the subjects were randomly assigned to the rhythms Angola, Banguela, and São Bento in pairs of the same gender. The dance was 3 min in length, and all subjects were encouraged to develop their maximum performance during the test.

After the tests, SBP, DBP, HR, and DP were obtained again to register post-ACR values. Figure 1 illustrates the design of the experimental protocol. A new rhythm was assigned for each pair after one week interval and a new set of measurements were performed. The same procedure was used for the 3rd rhythm in the 3rd wk.

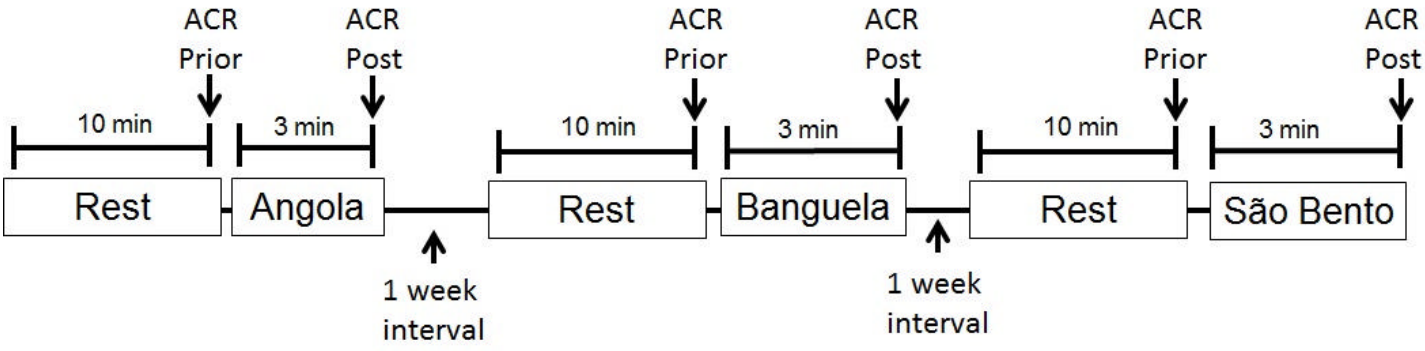

Figure 1 Overview of the Test-Day Procedure. All subjects were submitted to the three rhythms. ACR means moment of measurement of acute cardiovascular responses.

Capoeira Rhythms

The capoeira rhythms (Angola, Banguela, and São Bento) differ in speed of execution (17). Angola is a slower-paced rhythm that usually begins with a "ladainha," a dramatic solo that serves to open the "roda." Ladainhas can be instructive and narrative and, typically, it ends with a "canto de entrada" (song of entry) that plays tribute to renowned *capoeiristas*, historical places, and respected "mestres" (masters). The Angola game is generally considered to be most like capoeira in its earliest and most historical form, incorporating elements of "malícia" (trickery or treachery) that reflect the deceptive relationship between slaves and owners.

Banguela is used as an intermediary rhythm usually played between the Angola and São Bento. This rhythm focuses on malícia and creativity without the incorporation of traditional rituals and theatrics found in Angola. It is played at a medium to fast pace, and is often used as a method of training technical kicks, take-downs, cunning sweeps, and fakes.

São Bento is essentially the fight of all capoeira rhythms. This rhythm is used to develop the martial aspect of capoeira, focusing on the "pé quente e cabeça fria" mentality, meaning to practice performing aggressive movements while keeping a cool head. The rhythm is generally played at a medium to fast pace and is marked by upright movements, take-downs, cunning sweeps, and strong defenses. Acrobatic movements are not customary, but can be performed at a player's will, assuming he is prepared to risk a counter-attack.

Acute Cardiovascular Responses

Blood pressure was measured by auscultation using a mercury column sphygmomanometer (Heidji, São Paulo, Brazil) and a stethoscope (Sprague Rappaport, Omron, USA). For the measurement, each individual placed his left arm in a relaxed position on a flat surface at shoulder height. The fixation of the arm cuff was approximately 2.5 cm distance between its lower end and the antecubital fossa. After inflating the cuff, began the emptying process to distinguish the 1st and 5th Korotkoff sounds corresponding to SBP and DBP values, respectively. This procedure was adopted based on recommendations from the American Heart Association (13). Heart rate was measured continuously,

and recorded at the prior and post moments, using a frequency meter (Polar, S810, Kempele, Finland). Double product was calculated using the formula: DP = SBP x HR. This variable is a surrogate measure of myocardial oxygen demand (MVO_2) and cardiac work (6).

Statistical Analyses

Mean values for delta (? = post minus prior values) for SBP, DBP, HR, and DP were calculated. A one-way Analysis of Variance (ANOVA) was used to compare changes among the three rhythms (alpha = 0.05). Were appropriate, a post-hoc analysis with Tukey-Kramer test was used to determine the location of the significant differences. Statistical evaluations were analyzed using SPSS software version 19.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

Figure 2 shows the acute cardiovascular changes among the three rhythms. The SBP and DBP showed no statistically significant differences among the three rhythms (P>0.05) (Figures 2A and 2B). Both HR and DP (P=0.0001) were significantly lower during the Angola rhythm compared to the Banguela rhythm and the São Bento rhythm (Figures 2C and 2D). Heart rate was 26% increased when compared to the Angola rhythm, and DP was 45% increased when compared to the Angola rhythm, respectively.

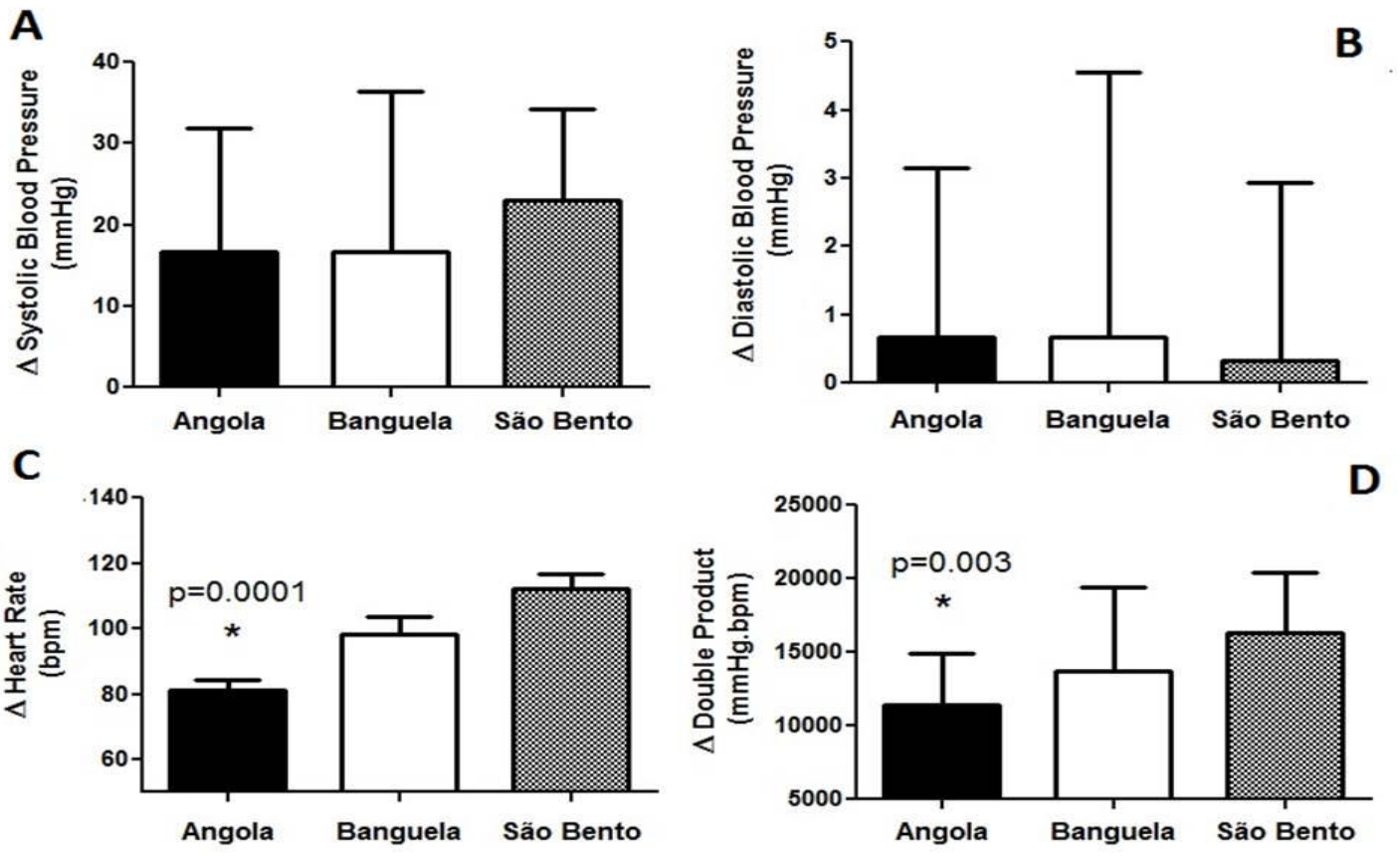

Figure 2. The Mean Values for Delta (? = post – prior values) Relationed with Acute Cardiovascular Responses during Practice of Capoeira (n=30). * Indicates P<0.05.

DISCUSSION

Several studies have investigated the effects of physical exercise on cardiovascular responses. Basically, these responses are monitored in the acute (e.g., SBP, DBP, HR, DP) or chronic (effects of training) phases. There is little scientific information related to cardiovascular stress of exercise promoted by martial arts and dance. Thus, the purpose of this study was to provide some insight by evaluating the acute cardiovascular responses of capoeira players submitted to the three principal rhythms of capoeira: Angola, Banguela, and São Bento. This is the first investigation to determine the precise ACR in response to practice of capoeira at different rhythms of execution in experienced practitioners. The data presented in this study suggest that this form of physical activity can be used to generate important health benefits generally produced by aerobic exercise.

The subjects during the Banguela and São Bento rhythms had a more pronounced response in the cardiovascular variables HR and DP compared to Angola, suggesting that results are rhythm-dependent. Basically, the main difference between the three rhythms is the speed of the executions. Angola is the slowest of the three rhythms. Although Angola had the lowest values, the rhythm did increase HR and DP when compared with the basal condition. Thus, we suggest that beginners in capoeira and people with higher cardiovascular risks perform preferably Angola before engaging rhythms with higher speed to minimize the cardiovascular stress.

We speculated that the greater the speed of the rhythm, greater the increment of the sympathetic nervous system activity, which, by enhancing the release of catecholamines promotes: (a) increase in HR and stroke volume; and (b) consequently increases cardiac output, which increases DP and MVO_2 (16). Thus, in terms of the HR and DP responses during Banguela and São Bento rhythms, it is appropriate to state that capoeira promoted a cardiovascular stress of low- to moderate-intensity to either improve or maintain cardiorespiratory fitness. In agreement, Maia et al. (10) showed better cardiovascular adaptation in the subjects who practiced capoeira than their sedentary counterparts.

Similar methodologies used in this study have been employed in other studies involving martial arts. Milanez and colleagues (11) studied nine athletes with continuous monitoring of HR to determine the distribution of intensity during a session of karate training. The authors concluded that the training session was consistent with standard training recommendations concerning intensity, duration, and frequency. Karate is recognized as alternative form of exercise to promote cardiorespiratory fitness. Hui et al. (7) showed that a 12-wk tai chi or walking exercise intervention produced significant and similar beneficial effects on body composition, aerobic fitness, muscular fitness, fasting blood glucose, resting metabolic rate, and perceived health in middle-aged Chinese. While tai chi and walking both elicited significant cardiorespiratory responses and energy expenditure to the moderate intensity level, walking exercise elicited about 46% higher metabolic cost than tai chi exercise.

Numerous health problems are associated with sedentary lifestyle. Although the exact mechanisms responsible for the benefits of regular physical activity are still unknown, there is a vast literature that supports the recommendation of the corporal movement to improve human health conditions (2,9,20). Thus, any tool that aims to improve the physical activity level of the population, especially in social and recreational activities, should be investigated. Our results are a starting point to demonstrate the feasibility of capoeira as a sport practice for health promotion. However, it should be emphasized that the capoeira practice alone may not be sufficient to replace all methods. Capoeira should be seen as one of many training tools to help reduce the effects of mind-body stress associated with a sedentary lifestyle.

Some limiting factors can be cited in this study, such as more sensitive physiological monitoring of oxygen consumption (VO_2) and energy expenditure. However, the contribution to the state of the art and especially the initial understanding of acute cardiovascular responses during capoeira practice overcomes its limitations. At best, it is obvious that future studies should investigate the role of capoeira using more complex cardiovascular assessment tools and the analysis of the physiology relative to the sedentary and/or sick population.

Overall, there are very few studies involving capoeira. Reifel Saltzberg et al. (15) investigated the strategies used to learn the control of new movements. Five novices were taught a capoeira kick that involved both the upper and lower body for balance and coordination. It was showed gradual change in initial posture to facilitate both the equilibrium and the goal directed components of the kick. Calvo-Merino et al. (4) used functional magnetic resonance imaging to study differences in brain activity between watching an action that practitioners must learned to do and an action that one has not learned in order to assess whether the brain processes of action observation are modulated by the expertise and motor repertoire of the observer. To this end, expert dancers, including capoeira dancers were recruited. The authors suggested that the human brain understands actions by motor simulation (19).

To finalize, it is important to acknowledge that capoeira is not only a martial art, but an active exporter of Brazilian culture all over the world. Present in many countries in every continent, every year capoeira attracts to Brazil thousands of foreign students and, as is often the case, foreign *capoeiristas* work hard to learn the official Brazilian language, Portuguese, in an effort to better understand and become part of the art. Capoeira presentations, normally theatrical, acrobatic, and with little martiality, are common sights in the whole world (17).

CONCLUSIONS

The results of the current study add to the growing body of knowledge regarding acute cardiovascular responses during three main rhythms of capoeira. If the objective is to improve cardiovascular fitness during capoeira, this study supports the importance of different rhythms of capoeira. We found statistically significant differences between performing Banguela and São Bento versus Angola in regards to an increase in both HR and DP. Further studies are necessary to clarify the entire role of capoeira on the practitioners' well-being and health promotion.

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