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Acute Effects of Swimming on the Arterial Pressure of Hypertensive Adults

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Abstract

Aim. The purpose of this work was to verify the acute effects of a regular swimming programme on the arterial pressure of hypertensive adults.

Material and methods. The sample was composed of 26 individuals who presented mild to moderate hypertension. The subjects were divided into two groups: the Experimental Group (EG) comprising 13 subjects (four men and nine women) and the Control Group (CG) comprising 13 subjects (seven men and six women), with average ages of 38.40 ± 8.24 and 38.36 ± 8.96 years, respectively. GE individuals took part in a regular swimming programme consisting of three weekly fifty-minute sessions of training (ST) for 10 weeks, whereas GC individuals were instructed not to alter their physical activity and nutritional habits. The Kruskal-Wallis test was used to determine statistical significance ($p < 0.05$).

Results. At the end of the ten weeks, an increase of 4.8% in Systolic Blood Pressure at rest (from 133.67 ±2.26 to 138.56 ± 3.23) and an increase of 7.8% in Diastolic Blood Pressure (from 83.15 ± 1.50 to 89.67 ± 7.19) were observed.

Conclusion. The results allow us to conclude that a regular swimming programme, consisting of training sessions three times a week for 10 weeks, was not sufficient to significantly alter the acute pressure levels of hypertensive adults.

Introduction

Arterial hypertension (HTA) has become a major health problem throughout the world, affecting about one billion individuals worldwide. In the United States, an estimated 24% to 29% of working-age economically active adults suffer from this condition (1, 2, 13-16). When defining hypertension, based on a cut-off value of 140 mmHg (Systolic Blood Pressure- SBP) and/or 90 mmHg (Diastolic Blood Pressure - DBP), in Brazil, the figures are even more worrisome, with an estimated 22% to 44% of the Brazilian adult population being hypertensive (3, 4,19). Given the complications associated with arterial hypertension, such as cerebral-vascular and arterial coronary diseases and vascular disease of the extremities (3), these rates are particularly alarming, especially because they are increasing; as such, they are of great concern to health professionals and to the Brazilian authorities.

Classically, the treatment for HTA can take two different forms: a pharmacological (or medication-based) approach and a non-pharmacological (or non-medication-based) approach (3, 4-6). Eleotério da Silva et al., 2006 (19) cite a third method, consisting of a combination of the two previous approaches. The vast majority of professionals, as well as several national and international health care organisations, recommend the practice of physical activity as an adjuvant for the treatment of hypertensive individuals. Physical activity appears to be relevant at least in two aspects related to hypertension: first, it functions as a preventive factor and, second, it improves the efficacy of treatment and quality of life (3, 4, 19).

The practice of physical activity has been an efficient non-pharmacological treatment for arterial hypertension (3, 5-7, 28); this is especially true in regards to aerobic exercises (4, 5-12). Accordingly, swimming has been recommended by several international health organisations as a form of physical activity for the prevention and treatment of hypertension (13-16). This recommendation is because swimming is an aerobic activity, minimises impact and thus reduces the risks of injury, and also involves the large muscle groups. Despite its being recommended for the prevention and treatment of hypertension, few studies have used swimming in the treatment of hypertension in humans. According to Fagard (2001), only 3% of the studies in this field have utilised swimming as a treatment for hypertension (17).

Thus, the present study aimed to verify the acute effects of a regular swimming programme on the levels of arterial pressure in hypertensive adult subjects.

Materials and Methods

Sampling

In the present study, the sample was randomly selected and the subjects were sorted into groups. Initially, the sample comprised a total of 34 hypertensive individuals of both sexes. Among these, eight were eliminated for presenting cardiovascular problems or other diseases or because they were not released by their physicians. Thus, the final sample consisted of 26 subjects with mild and moderate hypertension who were divided into two groups: the experimental group (GE) composed of 13 subjects (four men and nine women) and the control group (GC) composed of 13 subjects (seven men and six women). The physical characteristics of the subjects are presented in Table 1.

The subjects were recruited through newspaper and radio advertisements and were previously evaluated by their own respective physicians, as participation in the study required a medical certificate. Inclusion in the study required the presence of arterial hypertension, an age between 27 and 55 years, and no participation in any regular physical activity during the previous 12 months. Exclusion criteria were presentation of any joint-related limitations or symptoms of other diseases that could compromise the practice of this physical activity or cardiovascular responses. Before participation, verbal and written explanations were provided to the participants regarding the experimental procedure and possible risks and benefits. Each subject signed a Term of Free and Informed Consent for participation in the experiment.

All stages of this study met the standards for the conduct of studies with human beings in accordance with the guidelines of the National Health Council and the Regulatory Guidelines and Norms of Research involving human beings, valid as of October 10, 1996 (Resolution No. 251), and were approved by the Ethics in Research Committee of UCB/RJ under reference number 0037/2007.

Experimental protocol

The GE individuals participated in a regular swimming programme consisting of three weekly fifty-minute training sessions (ST) for a period of 10 weeks. All training sessions were divided as follows: five minutes of stretching and warm-ups and 40 minutes of swimming, with 20% of the total time dedicated to exercises specific to the lower limbs. To this end, a swimming board was used. The last 5 min served as the cooling down period.

Anthropometric measurements were obtained while the subjects were barefoot and wearing the least amount of clothing possible. Body mass (in kilograms) and height (in centimetres) were measured on a scale with a stadiometre (Filizola®, Brazil). Arterial pressure was measured with a digital arterial pressure monitor (Omrom® HEM-741C model, Japan). The validity of this equipment was recognised by the two most internationally accepted protocols: the British Hypertension Society (BHS) and the Association for Advances in Medical Instruments (AAMI) (20-23). The measurements for arterial pressure were taken in the sitting position, in a comfortable environment, and always at the same time of day. Before training, the subjects were at rest for at least 10 minutes prior to the measurement of arterial pressure. Soon after the training session, the subjects remained at rest again for about 10 minutes before measurement. The protocol used was that recommended by the Brazilian Guidelines for Arterial Hypertension (3). The intensity of exercise was monitored three times by session using a heart rate monitor (HR) Polar® brand, F5 model, 2005 (Polar Electro OY, Finland)). The subjects came against the side of the swimming pool for reading.

For the swimming programme, the subjects did not require prior swimming ability. Those who could not swim were taught to swim and crawl at the beginning of the programme. Based on the assumption that the participants were physically inactive, the initial sessions had an intensity of around 40% of Maximum Heart Rate. The water temperature of the pool was kept around 27°C to 28°C throughout the duration of the experiment, as recommended by the Aquatic Exercise Association (AEA). The subjects in the control group remained physically inactive during the study period.

Statistical analyses

Statistically significant differences were determined by Kruskal-Wallis test. When a significant interaction effect was detected, Mann-Whitney or Wilcoxon test with the Bonferroni correction was used to identify significant differences between mean values. Results with $P < 0.05$ were considered as statistically significant. Values are expressed as means ± SEM.

Results

The mean ages of subjects in the training and control groups were 38.4 ± 8.2 and 38.3 ± 8.9 years respectively. Prior to the study there were no significant differences (P>0.05) in age and physical characteristics between the groups (Table 1).

Table 1: Physical characteristics of the subjects.

Variables	EG (n=13) Average ± DP	CG (n=13) Average ± DP	p-value
Age	38.4±8.2	38.3±8.9	0.691
Height (cm)	149±9	156.5±7.4	0.492
BMI			
Before	23.9±3.4	26.4±4.1	0.503
After	23.7±3.3	26.3±3.9	0.499
BM (kg)			
Before	59.2±12	76.7±16.3	0.051
After	59.3±12.4	76.4±16.3	0.064

Average = arithmetic average of the results; DP = standard deviation; n = number of subjects in the group; *p-value* = significance level; BM = body mass; IMC = Body Mass Index.

Comparisons of the pressure levels observed before and after the intervention revealed no statistically significant differences. In fact, a slight increase in arterial pressure was detected. Data analysis showed an increase of 4.89 mmHg (4.9%) for SBP and 6.52 mmHg (7.8%) for DBP in the exercise group (Table 2). Measurements were taken at least 10 min after the end of the swimming practice.

Table 2: Systolic (SBP) and diastolic (DBP) arterial pressures before and after swimming practice.

Variables	EG (n=13) Average ± DP	%	Z	p-value
SBP				
Pre-Exercise	133.67±2.26			
Post-Exercise	138.56±3.23	4.87%	-5.355	0.000
DBP				
Pre-Exercise	83.15±1.50			
Post-Exercise	89.67±7.19	7.85%	-2.738	0.023

Average = arithmetic average of the results; DP = standard deviation; n = number of subjects; SBP= systolic blood pressure; DPB= Diastolic blood pressure; % = increases after exercise; *P*-value = significance level after exercise.

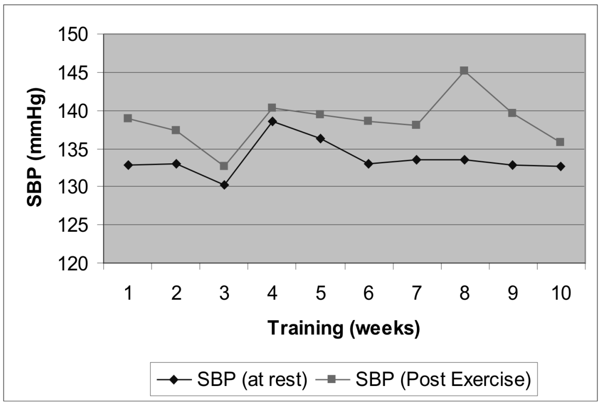

Figure 1: Acute behaviour of systolic blood pressure (SBP).

Figures 1 and 2 show the results for the systolic and diastolic pressures measured.

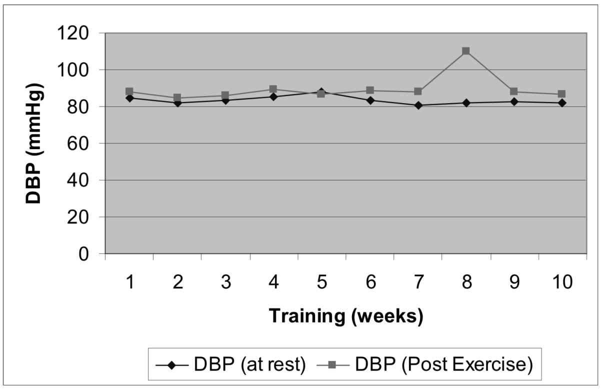

Figure 2: Acute behaviour of diastolic blood pressure (DBP).

Discussion

The present study aimed to verify the acute effects of regular swimming on arterial pressure in hypertensive individuals. Although some studies (13-16) recommend swimming as a form of physical activity to be used in the prevention and treatment of hypertension, very few studies involving human beings have verified the relationship between the practice of physical activity and hypertension (17). One aspect of this study that represents a possible limitation is the size and type of the sample. The small number of subjects and the fact that they were not randomly selected limit the external validity of the results. However, it is important to note that the number of subjects used as a sample in this study was not very different from the sample sizes of other similar studies (5, 17, 18, 27,).

In relation to the acute behaviour of arterial pressure at the end of the intervention, there were, on average, discrete increases of 4.87% for SBP and 7.85% for DBP between the measurements taken before and after each session. The results were SBP 133.67 ± 2.26 and 138.56 ± 3.23; DBP 83.15 ± 1.50 and 89.67 ± 7.19.

It is important to highlight there was a peak on the 8th week of training that can be explained by two reasons. One possibility could be related to the intensity of the exercise or it is also possible that some subjects could have forgotten to take their medication.

The latest studies aimed at verifying the effects of swimming on hypertension in humans reported results similar to those found in our study. However, Tanaka et al., 1997 (18) and Eleotério da Silva et al., 2006 (19) focused their studies on the chronic effects of the practice of swimming in hypertensive individuals.

Other authors, such as Pescatello (2), have reported a reduction in arterial pressure after dynamic exercise (acute effect). This event was designated as post-exercise hypotension (HPE) by Kenney and Seals (25). The present study did not detect a reduction in blood pressure because the arterial pressure measurement was performed immediately after the swimming practice, which did not allow time for the hypotensive effect to manifest itself. It is known that acute responses to exercise and chronic adaptation resulting from training cannot be viewed in isolation. In other words, there is an interaction between the acute and chronic responses related to exercise (27).

Several mechanisms explain the reduction of arterial pressure in individuals after the practice of exercise and physical activity. These mechanisms include (a) an interaction of acute and chronic effects resulting from the practice of exercise and physical activity (24-27) and (b) neuro-humoral adaptations such as a decrease in activity of the sympathetic nervous system and, simultaneously, increased activity of the para-sympathetic nervous system, reductions in the renin-angiotensin system, and decreases in peripheral vascular resistance (2).

Conclusion. The purpose of this study was to verify the acute effects of a regular swimming programme on the arterial pressure of hypertensive adults, and several conclusions were reached. Regarding the behaviour of the arterial pressure variable, no significant differences were detected in either Systolic Blood Pressure or Diastolic Blood Pressure in the experimental group. This result provides evidence of the viability of regular swimming for hypertensive individuals. Although no decreases in systolic (SBP) and diastolic (DBP) arterial pressure were observed in this study, the results seem to indicate a mechanism of interaction between the acute and chronic effects resulting from the practice of swimming in hypertensive individuals. The results described above become even more important when taking into account the absence of significant differences in BMI and Body Mass between the two groups.

Finally, despite evidence demonstrating the benefits of swimming for arterial pressure, it is necessary to emphasise the need for further studies to determine the optimal parameters for the prescription of physical activity for hypertensive individuals. Variables such as the type of activity, intensity, frequency, and duration are fundamental requirements for the assessment, development, guidance, and prescription of exercise for hypertensive individuals. Thus, the activities or forms of exercise can be selected to meet the personal characteristics of each individual in order to enhance the prevention, treatment, and control of hypertension.

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