Subacute Blood Pressure Response in Elderly Hypertensive Women after a Water Exercise Session
A Controlled Clinical Trial

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Abstract

Background: There are few studies relating the practice of water exercises and blood pressure responses.

Aim: The objective of this study was to evaluate the subacute blood pressure behaviour in elderly hypertensive women after a water exercise session.

Methods: This was a controlled clinical trial, carried out with 16 hypertensive elderly women with the following characteristics (mean ± SD): age 66 ± 2.94 years, bodyweight 68.43 ± 12.08 kg, height 158 ± 5.34 cm and body mass index 27.32 ± 4.30 kg/m². The study occurred on 2 days, 48 hours apart, with an experimental protocol and a control protocol. The experimental protocol underwent a moderately intense and predominantly aerobic 40-minute session with water exercises for the upper and lower limbs. The control protocol did not enter the pool and did not exercise, but all other procedures were similar to those of the experimental protocol. The blood pressure measurements were performed at times before and every 10 minutes for 30 minutes after the protocols. Student’s t-test was used to determine if the averages of the two samples were significantly different.

Results: Blood pressure increased significantly but not greatly after the water exercise session, but this did not happen with the control protocol. Systolic blood pressure in the experimental protocol decreased significantly only 30 minutes after the exercise session, which did not occur in the control protocol. Diastolic blood pressure, on the other hand, decreased significantly at minutes 10, 20 and 30. This also did not occur with the control protocol, but an intergroup analysis showed that diastolic blood pressure was similar for the two protocols.

Conclusions: The results of this study show that a prescription of water exercises can be carried out in relative safety with this group of patients, and that systolic blood pressure tended to decrease, as shown by the measurement at minute 30.

Received for publication 25 May 2012; accepted for publication 2 July 2012.

Keywords: blood pressure, elderly, hypertension, water exercise, post-exercise hypotension.

Background

As world life expectancy increases, the incidence and prevalence of certain age-related diseases, particularly cardiovascular diseases, also increase.\(^1\)

Among these, high blood pressure (HBP) has gained visibility and represents an independent, linear and continuous risk factor for both heart and vascular diseases. It is responsible for 40% of the mortality rate for stroke and 25% of that for coronary artery disease.\(^2-4\)

Aging-related changes make the individual more likely to develop HBP. This is the main chronic disease affecting the elderly.\(^1\) In old age, changes such as arterial stiffening are more pronounced and this makes these individuals more prone to developing this disease.\(^5\)

One way of treating HBP is the regular practice of physical exercises. Several studies show a hypotensive effect on blood pressure after aerobic exercise (post-exercise hypotension).\(^6-10\)

As an alternative to prescribed exercises in gyms, elderly patients are frequently prescribed exercises in water.
The practice of water exercises can improve the physical capacity of the elderly by increasing muscle strength and aerobic endurance\(^\text{[1]}\) and decreasing low-density lipoproteins (LDL) and total cholesterol,\(^\text{[2]}\) in addition to being used as a treatment for HBP.\(^\text{[3]}\)

However, there are few studies relating the practice of water exercises and blood pressure. A systematic review was conducted on aerobic post-exercise hypotension and reported that of all the studies surveyed, only one, concerning water running, was related to aquatic activity.\(^\text{[9]}\) This confirms the small number of studies relating to this type of exercise.

On the basis of previous research and to our knowledge, this is the first study that addresses blood pressure behaviour after a water exercise session in elderly hypertensive patients receiving pharmacological treatment. Thus, the objective of this study was to evaluate the subacute blood pressure of elderly hypertensive women receiving pharmacological treatment, after a water exercise session.

**Participants and Methods**

This is a controlled, crossover, clinical trial, developed at the AP Aquatic Center and Exercise Physiology Laboratory (LAPEX) of the School of Physical Education and Physiotherapy of Goiás, Goiás, Brazil. The study protocol was approved by the Research Ethics Committee of the Federal University of Goiás (FUG – n. 272). The study conforms to the provisions of the Declaration of Helsinki.

The study population consisted of 16 randomly chosen elderly hypertensive women enrolled in health facilities in the region. The sample was calculated on the basis of values obtained by Mediano et al.\(^\text{[14]}\) to detect a difference of 4.5% in the blood pressure level with a 95% confidence interval and a power of 80%.

To be included, subjects were required to sign the informed consent form (ICF), were aged between 60 and 70 years, were in regular treatment with stable blood pressure for the previous 3 months, had practiced water exercises for at least 3 months, were not participating in any other type of exercise, and in the previous 3 months, had practiced water exercises for at least 3 months, and physical or mental limitations that would make it impossible to carry out the exercises. To make sure that subjects met these criteria, we used data from the medical records of the institution.

Subjects visited the laboratory twice before the experiment. On the first visit, the study procedures were explained to potential participants and those who agreed to participate signed the ICF. On the second visit, the patients' medical history was taken and a physical assessment was carried out. After this phase, participants were divided into four groups and were scheduled to undergo either the experimental protocol (EP) or the control protocol (CP), alternating between small groups of four individuals, and with an interval of 48 hours between procedures. Thus, all participants served as their own controls since they were alternately participating in both the EP and the CP.

The EP was carried out at the AP Aquatic Center, in a 1.4 m-deep swimming pool with a mean temperature of 28.5°C. Participants entered and exited the pool using a stairway at the side of the pool. A 40-minute, predominantly aerobic water exercise session was carried out. The EP started with a 5-minute stretching period. The main part of the session, lasting 30 minutes, featured light- and moderate-intensity exercises on the conventional Borg scale,\(^\text{[15]}\) working near point 13 on the scale. The exercises involved basic flexing, extension, abduction and adduction movements of the upper and lower members. The session was continuous, without pauses between exercises. Immediately after, there was a 5-minute cooling down session with slow movements ending with localized stretching.

The CP also occurred in the AP Aquatic Center, under conditions similar to those for the EP, for the same length of time (40 minutes) but without any physical exercise being performed. CP patients were allowed to sit or stand, drink water, go to the bathroom or talk. In both protocols, the participants were prohibited from ingesting any type of food or caffeine.

Blood pressure was taken with the patient sitting, using an Omron 705 CP semi-automatic machine (Omron Healthcare, IL, USA), validated by international organizations\(^\text{[16]}\) and following the techniques adopted by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure.\(^\text{[3]}\) Blood pressure was always measured out of the water: before the protocols (Pre), immediately after completion of the protocols (minute 0), 10 minutes after completion (minute 10), 20 minutes after completion (minute 20) and 30 minutes after completion of the protocols (minute 30). For the minute 0 measurement, the patients left the water, dried their arms, sat down and were evaluated. They were encouraged to change their clothes (average of 5 minutes) and sit down for the other measurements (minutes 10, 20 and 30). All blood pressure measurements in this study...
were repeated at 2-minute intervals and the mean of two measurements was calculated for analysis.

The Statistical Package for Social Sciences (SPSS) 18 was used for statistical analysis. To assess the distribution of numerical data the Shapiro-Wilk test was adopted. Student’s t-test for paired samples was used to compare intragroup blood pressure prior to performing the protocols (Pre) with the various timepoints after the protocols: minutes 0, 10, 20 and 30. This same test was used to compare intergroup blood pressure (EP vs CP). The results were presented as means ± standard deviation and statistical significance was set at p < 0.05.

**Results**

The characteristics of the participants are described in Table I.

There was a significant increase in intragroup SBP at minute 0, a significant reduction only at minute 30 for the EP and at minute 10 for the CP. In the intergroup comparison, there was a significant difference in SBP at minutes 0 and 30 (Table II).

A significant increase in intragroup DBP occurred in the EP at minute 0, with decreased blood pressure at all other times in the same group. In the CP, there was no significant variation at any of the times. In the intergroup comparison, there was a significant difference at minute 0 only (Table III).

**Discussion**

There was a significant change in the elderly women’s SBP and DBP immediately after the water exercise session when compared with the pre-exercise period. However, this response did not appear very large. In the CP, there was no change in pressure at that point. Stein et al.[17] and Lowenthal et al.[18] reported that antihypertensive medications that reduce resting blood pressure can also reduce blood pressure increase during hand-grip exercises. These data suggest that antihypertensive treatment can reduce the concern that physical exercise can produce an extreme and acute hypertensive response in hypertensive subjects.

<table>
<thead>
<tr>
<th>Table I. Participant characteristics</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>66 ± 2.94</td>
</tr>
<tr>
<td>Bodyweight (kg)</td>
<td>68.43 ± 12.08</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>1.58 ± 5.34</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>27.32 ± 4.30</td>
</tr>
<tr>
<td>Percentage body fat (mm)</td>
<td>44.06 ± 8.35</td>
</tr>
</tbody>
</table>

**Table II. Systolic blood pressure (SBP) behaviour before sessions, immediately after and every 10 minutes for 30 minutes**

<table>
<thead>
<tr>
<th>Timepoint</th>
<th>EP (n=16)</th>
<th>CP (n=16)</th>
<th>p-Value (between groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-exercise</td>
<td>135.46 ± 7.42</td>
<td>138.25 ± 12.78</td>
<td>0.362</td>
</tr>
<tr>
<td>Minute 0</td>
<td>149.37 ± 13.51b</td>
<td>136.28 ± 14.99</td>
<td>0.013</td>
</tr>
<tr>
<td>Minute 10</td>
<td>135.71 ± 12.38</td>
<td>135.31 ± 13.46b</td>
<td>0.912</td>
</tr>
<tr>
<td>Minute 20</td>
<td>129.81 ± 16.43</td>
<td>134.31 ± 15.91</td>
<td>0.308</td>
</tr>
<tr>
<td>Minute 30</td>
<td>126.93 ± 11.51b</td>
<td>137.06 ± 16.20</td>
<td>0.014</td>
</tr>
</tbody>
</table>

a Values expressed as means ± SD.

b Change in SBP to relation to the pre-exercise timepoint, intragroup (p < 0.05).

CP = control protocol; EP = experimental protocol.

Dutra et al.[10] studied the effects of a water aerobics session on the blood pressure of adult normotensive women and noted that in the first blood pressure measurement after the session, blood pressure had increased, as in the first measurement in this study, but not significantly.

This immediate increase in blood pressure is probably related to the increase in post-exercise temperature[19] and sudden haemodynamic changes that occur when the elderly person leaves the water (causing decreased venous return, decrease in stroke volume and increase in heart rate).[16]

Blood pressure behaviour at subsequent points in the EP showed a significant decrease in inter- and intragroup SBP only at minute 30. A study with a similar protocol to ours was carried out with pregnant non-hypertensive women who were observed after a session of water exercises, indicating a significant blood pressure reduction at minutes 45 and 60.[20] In another study, with adult normotensive women after a water session, significant changes in blood pressure at minute 45 were found; however, this was not confirmed by intergroup analysis. Although our study did not analyse ambulatory blood pressure, a current study[21] found a day and night reduction in ambulatory blood pressure after a water exercise session. This suggests that a longer subacute analysis in the present study could have found post-exercise hypotension in subsequent minutes, since a significant reduction was found in the EP at minute 30.

The blood pressure reduction found in the EP at minute 30 probably would have continued decreasing if the blood pressure had been measured, as in other studies.[6,8,14,22] This event is known as post-exercise hypotension. However, the objective of the present study was to evaluate the subacute effects (in the first minutes) after exercise. Any exercise can increase blood
pressure, \cite{23} a risk factor for hypertensive patients, but this was not seen after EP in this study, showing a possible cardiovascular safety.

Other comparisons are hampered by the lack of studies with this type of exercise in elderly hypertensive individuals receiving pharmacological treatment with an exercise protocol similar to the one used in this research, since this would seem to be the first study to address such methodological peculiarities.

The DBP reduction after a water exercise session (EP) found in this study was not significant when compared with the CP. The different subacute blood pressure responses to exercise found in different studies\cite{10,20,22} may be associated with innumerable variables involved in the research, such as how blood pressure was measured, presence or absence of HBP in the study group, age, drug use or nonuse, post-exercise follow-up period, type of exercise prescription and training status. For this reason, comparing investigations whose methodologies are so different becomes a difficult task and prevents further conclusions on the subject.

The data obtained in this study show that elderly hypertensive patients receiving pharmacological treatment may benefit from a water exercise session with a certain level of cardiovascular safety. It is also worth emphasizing the importance of research conducted in the environment where the physical exercise is performed (as in the aquatic centre in this research where the EP and CP were carried out) since we can work with data based on easily replicated practices and materials.

Conclusions

A significant increase in blood pressure immediately after the water exercise session (EP) was found in the present study. Although the increase is not very large, it underlines the importance of blood pressure measurement and attention to blood pressure after water exercise sessions.

A significant reduction of SBP at minute 30 and of DBP at minutes 10, 20 and 30 occurred in the EP; however, when compared with the CP, only the SBP drop was significant. More studies of this type with similar methodologies, also using control protocols with different (medium- and long-term) follow-up periods and longer periods of post-exercise blood pressure measurement should be carried out in order to better understand the pressure response to exercise and provide a stronger basis for the safe prescription of exercises of this type for hypertensive patients in physical exercise environments such as fitness and aquatic centres.

Acknowledgements

The authors wish to acknowledge the support of Fundação de Amparo a Pesquisa do Estado de Goiás – FAPEG and the ESEFFEGO/UEG. The authors have no conflicts of interest that are directly relevant to the content of this study.

References


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