AEREBIC EXERCISE IMPROVES CARDIORESPIRATORY FITNESS BUT DOES NOT REDUCE BLOOD PRESSURE IN PREHYPERTENSIVE AFRICAN AMERICAN WOMEN

Quiona Stephens, PhD; Timothy Kirby, PhD; Janet Buckworth, PhD; Steven Devor, PhD; Robert Hamlin, PhD

INTRODUCTION

Recently, the Joint National Committee (JNC) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure identified a new blood pressure category termed prehypertension. Prehypertension, formerly considered a "normal" blood pressure, is associated with an increased risk of developing full-scale hypertension (HTN) and associated co-morbidities. Prehypertension is defined as systolic (SBP) of 120–139 mm Hg or diastolic (DBP) of 80–89 mm Hg and indicates an increased need for frequent followup and lifestyle modifications.1 Hypertension and prehypertension currently affect nearly 60 million Americans and close to one billion people worldwide. The prevalence of hypertension and perhypertension among African American women (45%) is higher than among Caucasian and Mexican American women (25% and 29%, respectively).2 The JNC has recommended several behavioral interventions that include consistent physical activity as a treatment for HTN.1 Structured physical activity is an effective nonpharmacologic intervention to improve cardiovascular health and slow the progression of chronic illnesses, such as hypertension.3 In 1998, Duey et al4 concluded that a consistent aerobic exercise-training regimen was effective in improving cardiorespiratory fitness (maximal oxygen consumption, or VO2 peak) in African American women. Additionally, in a cohort of 215 obese African Americans, Randall et al found that aerobic exercise resulted in significant reductions in SBP (7 mm Hg) and pulse pressure (5 mm Hg).5 Although these studies support the hypothesis that aerobic exercise is an effective treatment in African Americans, no studies have identified the effects of an exercise program in persons classified as prehypertensive. Therefore, the purpose of this investigation was to determine the effectiveness of a 10-week aerobic exercise-training regimen on resting blood pressure, cardiorespiratory fitness, and workload in prehypertensive African American women. We hypothesized that this intervention would significantly reduce blood pressure levels while increasing aerobic capacity and workload achieved.

METHODS

Subjects

Twelve sedentary, African American women volunteered to participate. A power analysis revealed that an N of 10 would be sufficient to detect differences in blood pressure and fitness-related variables as a result of exercise training. Subjects were required to meet the following inclusionary criteria: African American woman, 30–45 years of age, body mass index (BMI) 25–35 kg/m2,
nonsmoking status, sedentary, free from medication use, absence of known disease, and prehypertensive blood pressure status. Each participant was screened to assure that she met all inclusionary criteria and completed the Baecke Physical Activity Questionnaire to determine her initial physical activity level. Additionally, subjects were required to attend an orientation session and provide informed consent before participating in the study. (Figure 1) This investigation was approved by The Ohio State University Institutional Review Board.

Establishing Prehypertension

To establish prehypertension, resting blood pressure was taken on three different occasions. An experienced and certified exercise specialist took two resting blood pressure measurements in the exercise physiology laboratory before beginning the 10-week exercise-training intervention. A third resting blood pressure assessment was also done in a physician’s office before the exercise regimen. Participants were classified as prehypertensive if two of the three blood pressure measurements, one of which was taken in the physician’s office, was SBP 120–139 mm Hg or DBP 80–89 mm Hg.

Blood Pressure Assessments

Blood pressure was measured by using a calibrated mercury sphygmomanometer and an appropriate size cuff (Gen-Med, American Diagnostic Group, New York, NY). Subjects were seated for five minutes with their arms supported at heart level and their feet flat on the ground before each blood pressure assessment. All blood pressure measurements were taken in the subject’s dominant arm. A certified American College of Sports Medicine exercise specialist manually measured all resting blood pressures. Blood pressure measurements were conducted before and after the intervention with identical methods.

Cardiorespiratory Fitness Assessment

To determine each subject’s initial cardiorespiratory fitness level and workload ability, a VO₂ peak test was conducted on an electrically braked cycle ergometer (Cybex, Division of Lumex Ronkonkoma, NY). The cycling protocol began with a work rate of 25 watts, which increased an additional 25 watts every two minutes until the test ended. The test was terminated when subjects could not maintain the prescribed pedal rate of 60 rpm, reached volitional fatigue, or demonstrated a plateau in VO₂ with an increase in workload. The VO₂ peak value was measured as the highest value reached during the last minute of exercise based on 15-second readings. The maximal workload achieved was measured as the highest wattage that the subject reached before the test was terminated. During the VO₂ peak test, indirect calorimetry with the True One Metabolic System (OUSW version 3.5, East Sandy, Utah) was used to measure VO₂ and associated variables. Before each test, gas and flow meter calibrations were done to maintain equipment equilibration and measuring sensitivity (Parvo MMS-2400, Computer/DAC & Adapter PCL 177B, East Sandy, Utah).

Aerobic Exercise Training Intervention

The exercise training protocol required each participant to attend three supervised, 30-minute sessions per week for 10 consecutive weeks. Each training session took place in The Ohio State University exercise physiology training facility. Subjects were free to select any preidentified time slot to complete all of their sessions. The training facility was available six days per week from 6:30 am to 6:30 pm. Because schedules varied, most participants trained without other research participants present. A standardized exercise prescription was developed for each subject based on results from her pretraining cardiorespiratory fitness test. The initial training intensity was 70% of each individual’s previously determined VO₂ peak value and was progressively increased by 5% every 2.5 weeks (Table 1) to match the physiologic cardiovascular adaptation expected to occur with exercise training. In order to maintain a relative intensity of 70%, training increases were based on each subject’s initial VO₂ peak value.7,8 During each training session, subjects wore a Polar heart rate monitoring unit (Polar Electro Inc., Polar 8A1, Woodbury, NY) and were frequently asked to rate their perceived exertion to ensure that the appropriate training intensity was being maintained. Additionally, subjects were verbally encouraged to exert their best effort to remain within the prescribed training intensity. All exercise sessions were monitored by an experienced and trained member of the exercise physiology laboratory staff. To further promote consistency and accuracy among the
training sessions, an exercise log was completed and signed by all laboratory staff after each exercise session. The modes of exercise used during the training sessions were the treadmill, cycle ergometer, and air-dyne cycle.

STATISTICS

To assess the effectiveness of our exercise program on cardiorespiratory fitness and resting blood pressure, before and after the intervention period, a Wilcoxon signed rank test was used. A P value ≤.05 was set to establish statistical significance. All statistical analyses were conducted with the SPSS statistical package (Windows version 13.0).

RESULTS

Physical characteristics of the subjects are presented in Table 2. No significant differences were seen in SBP, DBP, mean arterial pressure (MAP), or body weight before and after exercise training (Table 3). Our results did show a significant increase in cardiorespiratory fitness (Fig. 2) and workload (Fig. 3) after the intervention.

DISCUSSION

The major findings of this study indicate that a 10-week aerobic exercise training protocol of 30-minute sessions at 70% of the VO$_2$ peak three days per week is a sufficient stimulus to improve cardiorespiratory fitness and workload. However, this exercise regimen was not sufficient to reduce blood pressure in this cohort of prehypertensive, African American women. These results suggest that the amount and level of exercise required to improve cardiorespiratory fitness/workload and reduce blood pressure are not necessarily the same. According to Fattirolli et al$^9$ improvements in cardiorespiratory fitness are easy to achieve in low-fit individuals with only mild-to-moderate levels of exercise. However, improvements in health-related variables, like blood pressure, seem to require specific exercise guidelines in order to be effective. Although a relationship between exercise and health benefits has been identified in the literature, little is known about the optimal level of exercise required to improve specific health conditions, which may partially account for the lack of blood pressure reductions seen in the present study.$^{10,11}$ Systolic blood pressure (SBP) tended to decrease; however, the de-

### Table 1. Example exercise training protocol

<table>
<thead>
<tr>
<th>Subject ID #</th>
<th>000</th>
<th>Wt: 180 lbs</th>
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<tbody>
<tr>
<td>Pre VO$_2$ peak</td>
<td>20.1 mL kg$^{-1}$ min$^{-1}$</td>
<td></td>
</tr>
<tr>
<td>70% VO$_2$ peak</td>
<td>14.1 mL kg$^{-1}$ min$^{-1}$</td>
<td></td>
</tr>
<tr>
<td>80% VO$_2$ peak</td>
<td>16.1 mL kg$^{-1}$ min$^{-1}$</td>
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</tbody>
</table>

### Table 2. Baseline physical characteristics of participants (N=12)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>38.2 ± 1.5</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>86.9 ± 10.7</td>
</tr>
<tr>
<td>Height (inches)</td>
<td>65.6 ± 0.82</td>
</tr>
<tr>
<td>Body mass index (kg/m$^2$)</td>
<td>30.8 ± 1.1</td>
</tr>
<tr>
<td>Physical activity status</td>
<td>5.8 ± 0.27</td>
</tr>
</tbody>
</table>

All values presented as the mean ± standard error.

### Table 3. Hemodynamic measurements before and after the intervention

<table>
<thead>
<tr>
<th>Hemodynamic Measurement</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td>127 ± 3</td>
<td>122 ± 3</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm Hg)</td>
<td>83 ± 1</td>
<td>82 ± 2</td>
</tr>
<tr>
<td>Mean arterial pressure (mm Hg)</td>
<td>97 ± 2</td>
<td>93 ± 3</td>
</tr>
<tr>
<td>Body weight (lbs)</td>
<td>191 ± 11</td>
<td>193 ± 10</td>
</tr>
</tbody>
</table>

All values presented as the mean ± standard error (P<.05).
The lack of change in body weight and blood pressure in our study could suggest that exercise training that does not result in decreases in body weight is not an effective treatment to lower blood pressure in obese, prehypertensive, African American women.

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REFERENCES