INFLUENCE OF REGULAR SWIMMING ON PROFILE OF MOOD STATES IN OBESE SUBJECTS WITH ESSENTIAL HYPERTENSION

HIROFUMI TANAKA, Ph. D., GREGORY A. DALE, Ph. D., and DAVID R. BASSETT, Jr., Ph. D.

Abstract

There has been increasing emphasis on maintaining the patients' quality of life while on antihypertensive therapy (e.g., regular physical activity as a lifestyle modification). However, no information is available on the effects of regular swimming exercise on mental health despite the popularity and potential benefits of this lifestyle modification. To determine the efficacy of swim training on mood states, 19 obese subjects with stages 1 to 2 essential hypertension were randomly assigned to either a swim training (n=12) or control group (n=7). Subjects were assessed before and after a 10 week supervised swim exercise program with the Profile of Mood State (POMS) questionnaire. The swim training group completed an average of 94% of the scheduled exercise sessions, and were able to gradually and significantly (p<0.05) increase daily swim distance. Additionally, resting heart rate was significantly reduced (p<0.05). Swim training resulted in significantly higher (p<0.05) vigor-activity scores. In addition, anger and fatigue scores were 34 and 28% lower after the swim training period. No significant changes were observed in any of the POMS scores in the control group. The improved mood state observed after swim training may have a clinically important influence on the quality of life in these subjects with essential hypertension.

key words: swimming exercise, quality of life, essential hypertension

Introduction

Hypertension is a major risk factor for cerebrovascular and coronary complications. Antihypertensive treatment has been shown to decrease cardiovascular morbidity and mortality. In recent years, there has been increasing emphasis on maintaining or enhancing the patients' quality of life while on antihypertensive therapy. Improvement in patient's own perception of mood and mental health is clinically important as an outcome of the therapy for chronically high blood pressure.

Based on the data on walking and cycling, regular physical activity has been shown to result in a reduction in resting blood pressure. We have recently reported that regular swimming exercise also results in a reduction in resting blood pressure in subjects with essential hypertension.

Due to its non-weight-bearing nature of exercise, swimming has a clinically important application to individuals with cardiovascular disease when it is used as a lifestyle modification. Because as high as 80% of individuals with essential hypertension are classified as obese, obese individuals with hypertension are potential beneficiaries of this non-weight bearing activity. Obese individuals who are prone to orthopedic injury are often recommended or advised to undertake swimming as a form of physical exercise. Despite its potential benefits and the fact that that swimming is one of the most popular exercise modes in many industrialized countries, no information is currently available on the influence of regular swimming exercise on mental health or quality of life.

With this information as background, the purpose of the present study was to determine the effect of regular swimming exercise on mood.
states in obese subjects with essential hypertension.

Methods

Subjects: Obese subjects with uncomplicated essential hypertension were recruited via newspaper advertisements. Prior to baseline measurement, every subject had an average level of systolic blood pressure between 140 and 179 mmHg and/or diastolic blood pressure between 90 and 109 mmHg (i.e., stage 1 and 2 hypertension9) based on repeated casual blood pressure readings. Blood pressure values have been previously reported in a separate paper5). Most subjects were capable of swimming continuously for at least 10 minutes. However, none had participated in regular vigorous activity during the previous year. No subjects had clinical or electrocardiographic evidence of coronary heart disease, other than essential hypertension, based on a medical history, physical examination, and treadmill maximal exercise stress tests. None of the subjects were smoking or taking any hypertensive medications. Each subject was required to give informed written consent approved by the human subjects committee at the University of Tennessee at Knoxville.

Testing: The changes in mood state were monitored using the Profile of Mood States (POMS) questionnaire1. Because of the effectiveness to assess transient and responsive mood state changes, the POMS has been effectively used to evaluate the impact of cardiac rehabilitation after myocardial infarction11, controlled drug trials and quality of life for cancer patients10. The POMS is a well-validated 65-item psychological inventory rated on five-point scale. All POMS scales have internal consistency reliabilities of approximately 0.90, and exhibit evidence of construct and predictive validity10. The POMS provides measures of six affective or emotional dimensions: tension/anxiety, depression/dejection, anger/hostility, vigor/activity, fatigue/inertia, and confusion/bewilderment. A composite or total mood score was computed by subtracting vigor/activity score from the sum of the other five traits scores, and adding a constant of 100 to avoid negative numbers. The particular set used in this study asked the subjects to base their response on the question, "How have you felt during the past week including today?"10). To minimize the potential investigator bias, the POMS questionnaire was administered by the same investigator who was blinded to the group assignment. The measurements before and after each intervention were obtained at about the same time of day (±1 hour) and the same day of week for each subject.

Training: After completing baseline measurements, subjects were assigned to one of the two groups: swim training (n=12; 7 men and 5 women) or control group (n=7; 4 men and 3 women). Group assignments were made as randomly as possible, with some regard given to individual preference when subjects strongly objected to their group assignment. The main reason for the inclusion of the control group with a smaller number of subjects was to demonstrate the measurement stability in this study. The mean age, height, body mass, and body mass index of the training and control group were 47±3 and 47±4 yrs, 177±2 and 174±3 cm, 106.7±8.0 and 94.3±6.0 kg, and 34±2 and 32±3 kg/m², respectively. Prior to the study, there were no significant differences (p<0.05) in physical characteristics between two groups.

Subjects in the swim training group participated in a ten-week swim training program of 60-minute sessions, three days per week on alternate days. Each training session consisted of a warm-up phase of 5 minutes stretching and 5 minutes swimming followed by 45 minutes swim workout. The last 5 minutes served as a cooling down. The duration of the swim workout was gra-
dually increased from 30 minutes the first week to the required 45 minutes during the fourth week. The exercise intensity during the 45-minute swim workout was set at a 60% of maximum heart rate reserve recorded during a graded exercise stress test on a treadmill. However, the target heart rate was adjusted based on the observation that maximal heart rate during swimming is approximately 10 to 13 beats/min lower than running\(^{12}\). Each subject was instructed to swim continuously during the 45-minute swim workout, except when checking a 10-second target heart rate. Each subject was closely monitored for swimming distance and the target heart rate by a supervisor. Subjects assigned to the control group remained sedentary. In the course of this investigation, subjects in both groups were instructed to maintain their usual lifestyle.

Statistics: Differences in the dependent variables were assessed by two-way (treatment x time) analysis of variance (ANOVA) with repeated measures. The variables that had significant group differences in baseline POMS scores were also analyzed with analysis of covariance (ANCOVA) as baseline values as covariates. In the case of a significant interaction effect, a post-hoc test using Newman-Keuls methods was used to identify significant differences among mean values. Descriptive statistics were expressed as means±SE. The significance level was set \textit{apriori} at p<0.05.

Results

The swim training group completed an average of 94% of the scheduled exercise sessions. They were also able to gradually increase daily swim distance from the first week (879±54 m) to the final week (1591±80 m). In addition, swim training resulted in a significant reduction in resting heart rate (81±4 vs 71±3 bpm) whereas the mean heart rate value for the control group was not altered (76±4 vs 75±5 bpm). No significant changes were observed in body mass and body mass index in either group after 10 weeks of respective intervention.

Figure 1 presents the mean POMS subscale scores in the swim training group. Swim training induced a significantly (p<0.05) higher vigor/activity scores. Although there were no significant changes (p>0.05) in negative mood state subscales (tension, depression, anger, fatigue, and confusion), anger and fatigue scores decreased by 34 and 28%, respectively, after the training period. No significant changes were observed in any of the POMS scores in the control group. Because the training group was characterized by significantly (p<0.05) lower depression, tension, and confusion scores than those of the control group at the beginning of this study, we performed ANCOVA to account for the baseline differences. However, the same results were obtained. The total mood disturbance scores did not change in the training or control group during the study.

Discussion

The primary new finding of this study was that swim training resulted in improved vigor-activity score using the POMS as an outcome measure. The POMS is primarily composed of negative scales (e.g., depression, confusion, and tension), and the only positive scale is vigor-activity. In the present study, the significant effects of swim training appeared primarily on this positive scale. This result reinforces the statement that among the psychometric measures, the positive affect appears to be more consistently linked to physical activity\(^{13}\). It is possible that the elevated vigor-activity score has a clinically significant implications for the improved quality of life in the patients with hypertension. Vigor-activity score represents a mood of vigorousness, ebullience and
Figure 1. Baseline POMS scores and changes in POMS scores after swim training. * indicates a significant change from baseline (before training).

Baseline Scores

<table>
<thead>
<tr>
<th></th>
<th>5.5±0.9</th>
<th>3.6±1.5</th>
<th>4.9±1.2</th>
<th>17.6±1.7</th>
<th>6.1±1.4</th>
<th>3.8±0.6</th>
</tr>
</thead>
</table>

Mean Change

Tension | Depression | Anger | Vigor | Fatigue | Confusion |

POMS Subscale

high energy\(^{10}\), which are some of the central components of health-related quality of life.

Previous studies reported that "land-based" aerobic training (i.e., walking and cycling) did not elicit improvements in psychological functioning\(^{14}\) or quality of life variables\(^2,^{15}\) in individuals with essential hypertension. The failure of exercise training to alter one's psychological states has been attributed to the nature of essential hypertension as an asymptomatic disease. It has been reported that approximately one thirds of adults who were found to have high blood pressure were unaware of a diagnosis of hypertension\(^1,^{16}\). Similarly, untreated mild to moderate hypertension has not been associated with any significant changes in well-being\(^{17}\). It is also noted that improvements in psychological states are most likely to be obtained in psychologically disturbed individuals\(^{14}\). As such, evidence based on runners indicates a lack of long-term psychological benefits when a normal population is used for subjects\(^{14}\). However, the present study differs from previous studies utilizing land-based exercises (e.g., running) in that swim training intervention resulted in significant increases in vigor-activity scores and \(\sim30\%\) reductions in anger and fatigue scores despite the fact that obese hypertensive subjects had a normal psychological profile.

Our present results are in agreement with previous studies suggesting that regular swimming may be advantageous in enhancing mental health. It has been reported that an "acute" bout of swimming significantly reduces tension, depression,
anger, and confusion, and increases vigor in college students enrolled in beginning or intermediate swimming classes. Additionally, swimming has been effectively used as a corrective therapy program for psychiatric patients in mental institutions. Furthermore, obese women who were assigned to 6 months of swimming training gave the highest rating to the enjoyment of their exercise sessions compared with those in jogging or cycling training. These previous observations and our present findings collectively suggest that recreational swim training can be a useful mode of physical activity to enhance psychological mood states. Moreover, considering antihypertensive effects of regular swimming, this lifestyle modification appears to be highly suitable for individuals with essential hypertension.

In summary, the present study showed that swim training resulted in significantly higher vigor-activity scores. In addition, anger and fatigue scores were 34 and 28% lower after the swim training period. The improved mood state observed after swim training may have a clinically important influence on the quality of life in obese individuals with essential hypertension.

Acknowledgement
The authors would like to thank Shane Best for his technical assistance.

(Accepted Apr. 8, 1999)

References
18) Berger BG, Owen DR. Anxiety reduction with swimming: relationships between exercise and state,
