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PREVIEW

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**Effects of an 8-week aerobic training program on physical  
working capacity at heart rate threshold**

**Weir, Loree Lin, Ph.D.**

**The University of Nebraska - Lincoln, 1993**

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300 N. Zeeb Rd.  
Ann Arbor, MI 48106

PREVIEW

EFFECTS OF AN 8-WEEK AEROBIC TRAINING PROGRAM ON  
PHYSICAL WORKING CAPACITY AT HEART RATE THRESHOLD

by

Loree L. Weir

A DISSERTATION

Presented to the Faculty of  
The Graduate College at the University of Nebraska  
In Partial Fulfillment of Requirements  
For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Psychological  
and Cultural Studies

Under the Supervision of Professor Terry J. Housh

Lincoln, Nebraska

May, 1993

DISSERTATION TITLE

EFFECT OF AN 8-WEEK AEROBIC TRAINING PROGRAM ON PHYSICAL WORKING

CAPACITY AT HEART RATE THRESHOLD

BY

Loree L. Weir

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EFFECTS OF AN 8-WEEK AEROBIC TRAINING PROGRAM ON  
PHYSICAL WORKING CAPACITY AT HEART RATE THRESHOLD

Loree L. Weir, Ph.D.

University of Nebraska, 1993

Advisor: Terry J. Housh

The purpose of this investigation was to determine the effect of an 8-week aerobic training program on physical working capacity at the heart rate threshold (PWCHRT). Nineteen sedentary males and females volunteered for this investigation. The control group consisted of three females and four males ( $N = 7$ ), while the training group contained four females and eight males ( $N = 12$ ). The subjects were tested for  $VO_2$  MAX and PWCHRT before and after an 8-week aerobic training program. The training consisted of riding a cycle ergometer for 30 minutes at 85% of maximal heart rate (HR) three times per week. Two,  $2 \times 2$  repeated measures ANOVAs were performed for group (control versus training) by time (pre-training versus post-training) for  $VO_2$  MAX and PWCHRT. A significant ( $p < 0.05$ ) group by time interaction for PWCHRT was followed up by using t-tests to analyze the simple main effects. PWCHRT for the training group was significantly greater following the 8-week training program, whereas no change occurred for the control group. The results of this investigation demonstrate that PWCHRT is sensitive to an 8-week training program. The increase in PWCHRT was not accompanied by an increase in  $VO_2$  MAX.

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PREVIEW

## Chapter I

### INTRODUCTION

#### Introduction

This chapter contains information regarding the background for the study, statement of purpose, statement of hypothesis, definition of terms, assumptions of the study, and limitations of the study.

#### Background of Study

Maximal oxygen consumption rate (VO<sub>2</sub> MAX) is normally considered the most representative measure of cardiorespiratory fitness (Pollock & Wilmore, 1990). However, it has been suggested that the heart rate (HR) response at a submaximal workload and the physical working capacity (PWC) at a submaximal HR should be regarded as being as important as VO<sub>2</sub> MAX in determining the effectiveness of various exercise training programs (Pollock, 1973).

Recently, Wagner and Housh (unpublished data) developed a technique for estimating the fatigue threshold based on heart rate (HR) data called the physical working capacity at the heart rate threshold (PWCHRT) test. Briefly, this technique involves four, 8-minute constant power output (PO) rides on a cycle ergometer. The rate of rise (slope) in HR over the last five minutes of each workout is calculated

(Figure 1). The PO values are then plotted as a linear function of the slope coefficients with the y-intercept defined as the PWCHRT (Figure 1). This PO, theoretically, represents the highest exercise intensity sustainable without an increase in HR. However, a "steady state" (zero slope) HR is rarely observed even at very low workloads (Muller, 1950). Rohmert (1960) reported that a PO which elicits a rate of rise in HR of  $\leq 0.1$  bpm/min is the maximal level that can be maintained over an 8-hour workday. Therefore, the PWCHRT technique was validated by having subjects perform continuous 1-hour rides at PO values equal to 80, 100, 120, 140, and 160% of PWCHRT. The results indicated that the PWCHRT technique accurately estimated the PO associated with a HR slope of  $\leq 0.1$  bpm/min (Wagner & Housh, unpublished data). Power outputs which elicit a rate of rise in HR  $> 0.1$  bpm/min eventually result in exhaustion, with the duration of work related to the magnitude of the slope coefficient (Weiser et al., 1971).

The ability to estimate the PWCHRT may provide useful information for both industrial settings and in exercise testing. However, it is not yet known whether PWCHRT is sensitive to physical training. It would be expected that PWCHRT increases with training, thus allowing more work to be performed without signs of fatigue, and/or allowing the worker to operate at a lower relative load over the course of a workday.

The American College of Sports Medicine (1990) recommends performing aerobic exercise 3 to 5 days per week, 20 to 60 minutes per day, at 60 to 90% of maximal HR to improve cardiorespiratory fitness. The greatest improvements are made in the first 6 to 8 weeks of an exercise program (ACSM, 1991). Following training, HR is lower at a submaximal PO and it is expected that the slope of the HR versus time relationship would also decrease (Hartley, 1977; Astrand, 1952). However, Taylor (1941) and Ekblom (1969) reported that the slope value for HR versus time is independent of PO and decreases only slightly with training. Therefore, the sensitivity of the PWCHRT test to exercise training is presently unknown.

#### Statement of Purpose

The purpose of this investigation was to determine the effect of an 8-week aerobic training program on PWCHRT.

#### Statement of Hypothesis

There will be a significant increase in PWCHRT following the 8-week aerobic training program.

#### Definition of Terms

PWCHRT. The maximum power output that can be sustained with a rate of rise in HR of  $\leq 0.1$  bpm/min.

VO2 MAX. The maximum rate at which an individual can consume oxygen measured during severe dynamic exercise.

#### Assumptions of the Study

It is assumed, based on pilot data, that PWCHRT is a valid measure of the PO that can be maintained for an extended period of time with an increase in HR of  $\leq 0.1$  bpm/min. It is also assumed that all measurements are highly reliable and that the subjects represent a sample of sedentary college students.

#### Limitations of the Study

This sample was limited to sedentary but healthy subjects between the ages of 19 and 29 years who were recruited from the student body of the University of Nebraska-Lincoln. Therefore, the subjects represented a small sample of college age non-exercisers.

#### Summary

This chapter contained information concerning the background of the study, statement of purpose, statement of hypothesis, definition of terms, assumptions of the study, and limitations of the study.