

Metabolic and Performance Effects of Different Warm-up Protocols on Aerobic Exercise in Physically Active Adults

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INTRODUCTION

- Pre-competition warm-up (WU) routines have long been prescribed as necessary components to optimize performance.¹
- Traditionally, WUs have consisted of moderate duration, moderate intensity exercise aimed to prime the system for competition. Benefits have been attributed to enhanced metabolic, neuromuscular and psychological responses.²
- WUs may increase aerobic efficiency and reduce substrate depletion, oxygen deficit and glycolytic rate. This would prove most effective prior to short-duration, high-intensity exercise.^{3,4}
- The current research project addressed gaps in knowledge through a focus on longer duration, high-intensity exercise.

PURPOSE

The purpose of the present investigation was to identify the extent to which WU of varied intensity, moderate vs. vigorous, prior to completion of a high-intensity time-to-exhaustion (TTE) exercise bout influences aerobic and anaerobic metabolism and performance in physically active adults.

METHODS

Participants
Healthy, active (exercise ≥ 30 min/d for 3 d/wk) adults (18 – 44 years) participated in a randomized, crossover protocol. The Georgia Regents University Institutional Review Board approved this study and all participants completed an informed consent and medical history questionnaire prior to commencement. Participants reported to the laboratory following a three-hour fast and had their resting blood pressure, heart rate and body fat measurements performed.

Exercise Testing
On three separate visits (≥ 24 hr rest), maximal aerobic capacity, ventilatory threshold and time-to-exhaustion tests were performed.

Ventilatory Threshold

Figure 1. Ventilation (VE) vs. oxygen uptake (VO₂) during maximal exercise.

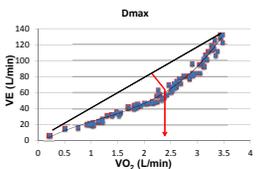
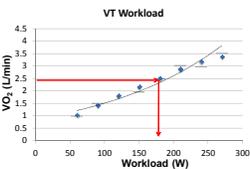


Figure 2. Oxygen uptake (VO₂) vs. workload during maximal exercise.

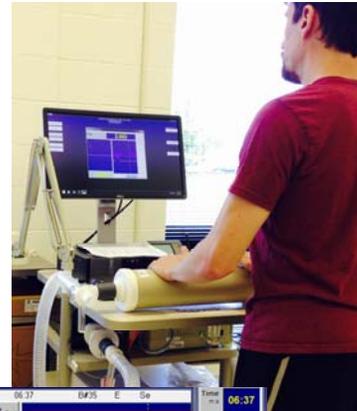


Maximal Aerobic Capacity

Participants performed a continuous incremental exercise test on an electronically braked cycle ergometer. Each stage lasted three minutes, the first stage started @ 60 W, after each stage the workload increased 30 W until volitional fatigue. Criteria for VO₂ peak (3 of the 4): a respiratory exchange ratio (RER) ≥ 1.10 , heart rate (HR) $\geq 85\%$ of an age predicted max, voluntary cessation of the test, and a rating of perceived exertion (RPE) ≥ 17 on the Borg Scale.

Warm-up (WU)

- Moderate WU (MOD):
10 min @ 50% of peak power output (PPO)
- Vigorous WU (VIG):
3 min @ 50% of PPO
4 min @ 60/70/80/90% of PPO
3 min @ 50% of PPO



Time-to-Exhaustion (TTE) Testing

Following a 15 minute rest, participants pedaled through workloads of varied intensity. The TTE test began at a workload equal to 100% of their ventilatory threshold (VT) power for 3 minutes then increased to 110% of their VT power for 1 minute. This pattern continued until total exhaustion.

Statistics

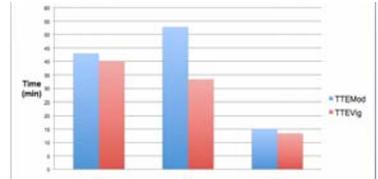
Descriptive statistics (mean \pm SD) were performed on demographic, performance and anthropometric variables.

RESULTS

Table 1. Descriptive characteristics of the participants.

ID	Age (yr)	Height (m)	Weight (kg)	BMI (kg/m ²)	Body Fat (%)	VO ₂ max (ml/kg/min)	VT (%)
WU1	24	1.75	71.8	23.4	10.7	40.8	70.7
WU2	27	1.75	68.4	22.3	13.8	50.3	69.7
WU3	22	1.75	93.0	30.4	23.2	29.5	69.3

Figure 3. Time-to-exhaustion performance following moderate and vigorous intensity warm-up protocols.



CONCLUSIONS

The moderate intensity warm-up was more effective than a vigorous warm-up to increase time to exhaustion when performed prior to high intensity aerobic exercise. Further research is needed to determine the metabolic and neuromuscular changes that contribute to the difference in performance.

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ACKNOWLEDGEMENTS

- Department of Kinesiology and Health Science
- College of Education
- Abigail M. Drescher
- Gretchen B. Caughman
- The Office of Academic & Faculty Affairs and Office of Research

