WEBER STATE UNIVERSITY

A Comparison of Active and Passive Recovery Strategies Between Repeated Bouts of Submaximal Exercise

Nolan Hardiman, MS, Matthew Donahue, PhD, LAT, ATC, Bryan Dowdell, PhD.
Weber State University, Ogden, UT.

— MASTER OF SCIENCE —
ATHLETIC TRAINING

INTRODUCTION

Athletes and coaches are constantly looking for strategies to employ to improve athletic performance. One common strategy is to decrease recovery time while maintaining optimal performance.

To measure recovery, a multitude of variables are employed. Cardiovascular, respiratory, and metabolic data was used in the current study. Heart rate recovery (HRR), ventilation (VE), relative VO_2 (VO_2), and blood lactate concentration level (BLL) were the four chosen dependent variables to measure recovery. Posture and activity level are hypothesized to be the most influential factors to recovery. Posture can affect cardiovascular measures through altering venous return. It can also affect respiratory measures by changing the available space in the chest cavity therefore decreasing tidal volume. Activity level affects respiratory measures such as VO_2 through increasing the oxygen demand. Activity level also changes heart rate recovery by changing the minimum heart rate for recovery.

The current investigation was modeled to imitate post-practice sprints for conditioning. The two recovery strategies were an active, walking, hands-on-head recovery (AR), and a passive, stationary, hands-on-knees recovery (PR). We hypothesized that AR would cause lower blood lactate levels, but the PR will cause greater heart rate recovery(HRR), and total ventilation. The purpose of this study was to determine the more effective recovery strategy between bouts of submaximal exercise in healthy active, college aged individuals.

METHODS

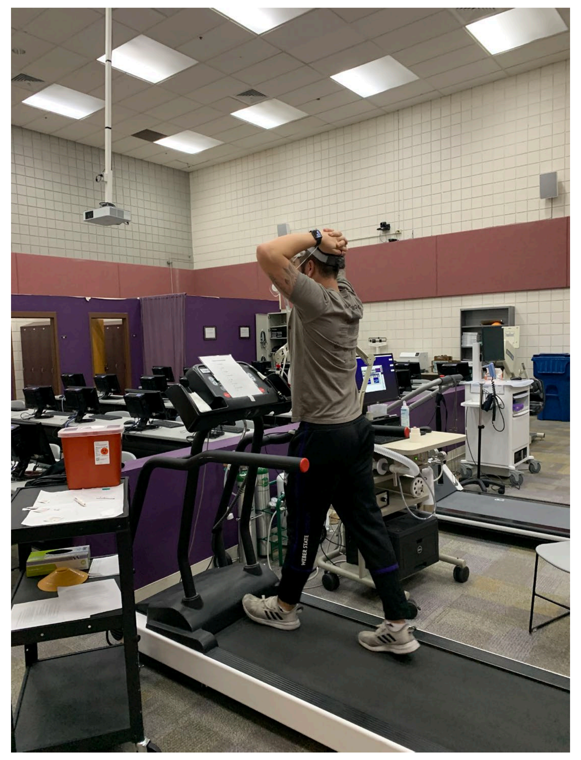
Design & Setting: The study was a crossover study where participants performed an exercise protocol with either recovery strategy on two days separated by at least one week. The study took place in the exercise physiology lab at Weber State University.

Participants: A total of nineteen healthy, recreationally active volunteers (11 men, 8 women; 25.6±2.2 years; 74.3±14.2 kg; 172.2±8.3 cm) enrolled in this study

Inclusion and Exclusion Criteria: Participants had to be ages 18-35 and recreationally active. Recreationally active was defined as participating in physical activity three times per week. Subjects were excluded if they did not meet the ACSM guidelines for maximal exercise testing or had a history of smoking or bleeding pathologies.

Procedures: The experimental protocol occurred over the course of three days, each separated by one week. Subjects performed a treadmill based maximal exercise test utilizing a ramp protocol on day 1. The participants' VO2max was calculated and then used to determine their treadmill speed for the exercise protocol on days 2 and 3. Day 2 and 3 followed the same protocol as each other with the only difference being the recovery strategy. Both days began with baseline testing and an active warmup. On day 2 and 3, baseline testing consisted of the subject sitting quietly in a chair for five minutes while cardiovascular and respiratory measurements were taken. Blood lactate was measured at the end of the baseline period. After baseline measurements, subjects performed a 5-minute active warmup consisting of walking on the treadmill at 30% of VO2max. Immediately after the active warmup, subjects performed 6 45-second sprints at 70% of VO2max, each followed by a 2-minute recovery interval. Day 2 and 3 ended with a 5-minute active cooldown of slowly walking on the treadmill for 5 minutes.


Passive Recovery Strategy


Active Recovery Strategy

Statistical Analyses: Separate two-way repeated measures ANOVAs were calculated for each dependent variable. Alpha level was set to 0.05. Statistical Package for the Social Sciences (SPSS) was used perform statistical analysis. One outlier was found in both the blood lactate data and the VO2 data. Removing the subjects from the data pool did not change results so they were kept in the data pool.

RESULTS

There was a significant main effect of recovery condition for ventilation, VO2, and heart rate recovery. Active recovery had greater average ventilation during recovery (32.0 L/min) compared to passive recovery (25.3 L/min). Active recovery had greater average VO2 during recovery (15.6 mL/kg/min) compared to passive recovery (12.0 mL/kg/min). Passive recovery had greater heart rate recovery (44.4 bpm) when compared to active recovery (27.4 bpm). There was no main effect of recovery condition for change in blood lactate level.

Table 1: Average Ventilation

Recovery Time Point	Passive Recovery (L/min)	Active Recovery (L/min)
Recovery 1	24.64 ± 5.84	30.55 ± 6.26
Recovery 2	24.66 ± 6.12	31.91 ± 7.26
Recovery 3	25.44 ± 6.11	32.32 ± 7.12
Recovery 4	25.42 ± 4.88	32.42 ± 7.01
Recovery 5	25.18 ± 5.68	32.12 ± 6.87
Recovery 6	26.13 ± 5.68	32.78 ± 7.27
Overall Mean	25.25 ± 5.54	32.02 ± 6.89

Table 2: Average VO_2

Recovery Time Point	Passive Recovery (mL/kg/min)	Active Recovery (mL/kg/min)
Recovery 1	12.04 ± 1.99	15.51 ± 2.61
Recovery 2	11.92 ± 1.79	15.57 ± 2.51
Recovery 3	12.06 ± 1.95	15.71 ± 2.57
Recovery 4	12.08 ± 1.65	15.63 ± 2.49
Recovery 5	11.87 ± 1.81	15.59 ± 2.43
Recovery 6	12.30 ± 1.74	15.67 ± 2.34
Overall Mean	12.04 ± 1.76	15.60 ± 2.47

Table 3: Average HRR

Recovery Time Point	Passive Recovery (bpm)	Active Recovery (bpm)
Recovery 1	45.34 ± 15.33	28.18 ± 7.32
Recovery 2	46.82 ± 12.99	27.32 ± 7.65
Recovery 3	44.74 ± 14.66	29.47 ± 7.54
Recovery 4	43.21 ± 14.64	24.95 ± 6.23
Recovery 5	43.21 ± 14.17	26.26 ± 6.48
Recovery 6	43.03 ± 13.14	28.24 ± 6.29
Overall Mean	44.39 ± 12.89	27.40 ± 5.72

Table 4: Average Change in BLL

Recovery Time Point	Passive Recovery (mmol/L)	Active Recovery (mmol/L)
Recovery 3	0.49 ± 1.49	0.77 ± 1.08
Recovery 6	0.56 ± 1.87	0.98 ± 1.25

DISCUSSION

VO_2 was greater when AR was utilized. This greater need for oxygen is likely due to the increased activity level required to perform the recovery strategy. The present study is in agreement with previous research which also found increased VO_2 when AR is utilized.[1]

VE was greater when AR was utilized. There are two hypotheses for the increased ventilation. The first is derived from the greater VO_2. If the subject needed more oxygen, they had to breathe a greater volume of air per minute. The second hypothesis is related to body position.

The subjects had a greater VE during AR because the lungs had more space to expand into when assuming an upright posture. That theory is disputed by one previous study that found bent over posture increases tidal volume and maximal voluntary ventilation.[2,3] The finding of this study was consistent with one previous study that also found AR caused greater VE than PR.[4]

HRR was increased when PR was utilized. This is likely due to the decreased intensity of the recovery strategy. PR is a stationary recovery, whereas AR is a walking recovery. The walking required an elevated HR compared to the standing recovery. This is in agreement with previous research that also found increased HRR when PR is utilized.[5,6]

There was no difference for AR and PR for the change in blood lactate concentration level. This is possibly due to subjects not achieving the goal VO_2 during exercise. The intensity was not high enough to cause an increase in BLL. Our data did not agree with previous research that found utilization of AR caused BLL to be lower than PR utilization.[5,7]

Future research should utilize two passive recovery strategies: upright standing with arms on the subjects' head, and bent over, with hands on knees. Future research should also utilize tidal volume and respiration rate instead of ventilation. The exercise portion of the protocol also needs to be adjusted so subjects reach the goal VO_2.

CONCLUSIONS

Recovery strategy had no effect on blood lactate levels. Heart Rate returned closer to baseline during PR when compared to AR. AR caused greater average VO2 and greater average ventilation compared to PR. We believe this indicates that PR is a preferential recovery strategy to AR. Future research should investigate alternative PR positions to determine if increased ventilation indicates a greater need for oxygen or infers positional lung capacity restrictions.

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