# Active Recovery Enhances Blood Lactate Clearance Regardless of Specialty or Distance in Male NCAA Division I Swimmers

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## ABSTRACT

**BACKGROUND:** Competitive swimming leads to high blood lactate accumulation and often demands repeated performances in a single day. While active recovery in the pool is well-known to accelerate blood lactate clearance and maintain optimal performance across repeated efforts, the impact of swim specialty and distance on lactate kinetics is less established.
**PURPOSE:** This study sought to determine whether male NCAA Division I (DI) swimmers of differing specialties and distances differ in blood lactate clearance during passive or active recovery following a high-intensity, event-specific swimming bout.
**METHODS:** Twenty male NCAA D1 swimmers (age=21.1 ± 1.9 years; height=184.9 ± 5.9 cm; weight=82.5 ± 8.0 kg) were divided according to their event specialty by distance and stroke and made to complete a "broken swim" of their respective events (100 back, n=1; 100 free, n=2; 200 fly, n=2; 200 back, n=4; 200 breast, n=3; 200 free, n=2; 400 individual medley- IM, n=2; 500 free, n=4). Swimmers were grouped by event distance and randomized to either a passive (passive; n=10) or active (active; n=10) recovery group post-swim. The active recovery consisted of a 1,000-yard, self-paced swim consistent with their typical swim process. After a standardized warm-up, baseline blood lactate concentration (mmol) was measured via finger prick and recorded. Blood lactate was subsequently measured and recorded at 0 min, 2 min, 5 min, 10 min, 15 min, and 20 min post-swim. A repeated measures ANOVA was used to assess changes in blood lactate from baseline (α = 0.05). Post-hoc tests were completed with the Holm correction factor. ANCOVAs were also conducted to account for event distance and stroke. Effect sizes (Cohen's d) were calculated.
**RESULTS:** Blood lactate increased from baseline in both groups (p<0.001) but returned to baseline at 15 min and 20 min post-swim in the active group only (p>0.05). There were large differences between conditions at 10 min (p=0.015; d=2.180), 15 min (p=0.018; d=2.202), and 20 min (p=0.004; d=2.290) post-swim. There was no impact of stroke or event distance on clearance (p>0.05).
**CONCLUSIONS:** Active recovery enhances blood lactate clearance following a high-intensity event-specific swimming bout regardless of specialty or distance in male NCAA DI swimmers.
**PRACTICAL APPLICATIONS:** These findings highlight the need for active recovery measures in swimmers, particularly when they may have to swim multiple events in relatively quick succession in competition settings. This may suggest that event distance and stroke have little impact on blood lactate clearance, and, therefore, active recovery methods should be considered for all swimmers, independent of event specialty. Future work should examine whether non-swimming recovery methods, such as walking or cycling out of the pool, can similarly enhance blood lactate clearance since in-pool active recovery may not always be feasible in some competition settings.

## INTRODUCTION

- **Competitive swimmers** often complete multiple high-intensity events in a single day.

- In-pool **active recovery** is known to accelerate blood lactate clearance and is commonly implemented between efforts to optimize performance.

- However, it is unclear whether **lactate kinetics** are influenced by **swim specialty** and **event distance**.

- **Purpose**: To determine if blood lactate clearance rates differ between **swim specialty** and **event distance** during passive or active recovery following a high-intensity bout of swimming.

- **Practical Importance**: Findings may inform customized recovery protocols for competitive swimmers.

# CONCLUSIONS

❖ Active recovery significantly enhanced blood lactate clearance following high-intensity, event-specific swimming efforts.
❖ Neither stroke specialty nor event distance influenced lactate clearance, suggesting a consistent benefit of active recovery.

# PRACTICAL APPLICATIONS

❖ In-pool active recovery should be prioritized between events to support optimal performance and may not need to be tailored to stroke specialty or event distance in competitive swimmers.
❖ Given that in-pool recovery strategies may not always be feasible in competitive settings, future research should compare in-pool and dryland recovery methods (e.g., cycling or walking) to determine the relative effects on lactate kinetics.

## METHODS

**Participants**
- Male NCAA Division I swimmers (n = 20)
  - Age: 21.1 ± 1.9 years
  - Height: 184.9 ± 5.9 cm
  - Weight: 82.5 ± 8.0 kg
  - Events included:
    - 100-yard backstroke (n=1), 100-yard freestyle (n=2)
    - 200-yard butterfly (n=2), 200-yard backstroke (n=4), 200-yard breaststroke (n=3), 200-yard freestyle (n=2)
    - 400-yard individual medley (IM) (n=2), 500-yard freestyle (n=4)

**Protocol**
- All swimmers performed a standardized team warm up
- Swimmers then performed a "broken swim" simulating their primary competitive event
- Swimmers then engaged in either active or passive recovery

**Recovery Groups**
- Active recovery (n=10): 1,000-yard self-paced swim (typical team protocol)
- Passive recovery (n=10): no activity post-swim

**Blood Lactate Sampling**
- Measured via finger prick at:
  - Baseline (post-warm-up)
  - 0-, 2-, 5-, 10-, 15-, and 20-minutes post-swim

**Statistical Analysis**
- A repeated measures ANOVA was used to assess changes over time (α = 0.05) with Holm-corrected post hoc comparisons. ANCOVAs were also performed to account for specialty and distance with effect sizes calculated (Cohen's d).
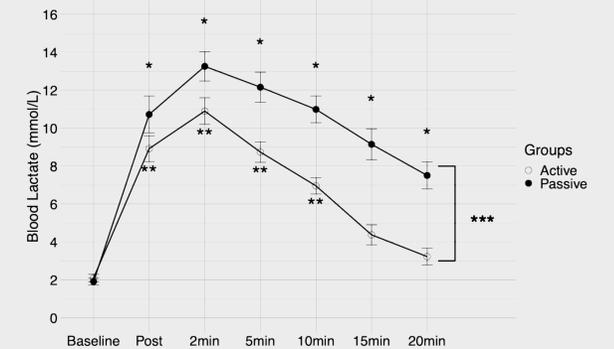
## RESULTS



Figure 1. Average blood lactate concentrations (mmol/L) at each timepoint grouped by recovery modality. Values presented as mean ± standard error.
*Significant difference from baseline for the passive group.
**Significant difference from baseline for the active group.
*** Significant difference between groups.

| | Active Recovery | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stroke | Butterfly | | Backstroke | | Breaststroke | | Freestyle | | IM | |
| Timepoint | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Baseline | 2.0 | 1.1 | 2.7 | 0.6 | 2.0 | 0.2 | 2.0 | 0.8 | 1.9 | - |
| 0 min | 11.1 | 2.3 | 8.1 | 0.2 | 6.6 | 1.7 | 9.4 | 2.4 | 9.6 | - |
| 2 min | 9.4 | 2.3 | 9.0 | 3.1 | 11.1 | 2.2 | 12.5 | 1.2 | 12.4 | - |
| 5 min | 7.2 | 1.9 | 6.8 | 0.9 | 9.4 | 0.3 | 10.2 | 0.5 | 10.1 | - |
| 10 min | 7.4 | 3.0 | 5.6 | 0.1 | 7.3 | 0.8 | 7.4 | 1.0 | 7.0 | - |
| 15 min | 3.2 | 0.4 | 4.2 | 2.8 | 5.3 | 2.8 | 4.7 | 1.5 | 4.9 | - |
| 20 min | 2.6 | 0.4 | 2.5 | 1.0 | 3.8 | 2.4 | 3.9 | 1.7 | 2.8 | - |

| | Passive Recovery | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stroke | Butterfly | | Backstroke | | Breaststroke | | Freestyle | | IM | |
| Timepoint | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Baseline | - | - | 2.4 | 0.6 | 1.3 | - | 1.7 | 0.5 | 1.9 | - |
| 0 min | - | - | 10.7 | 4.7 | 14.5 | - | 10.3 | 3.0 | 9.3 | - |
| 2 min | - | - | 15.2 | 2.4 | 15.0 | - | 11.7 | 2.0 | 13.4 | - |
| 5 min | - | - | 12.8 | 2.7 | 14.2 | - | 11.0 | 2.5 | 14.2 | - |
| 10 min | - | - | 11.5 | 2.8 | 13.0 | - | 10.1 | 2.2 | 12.1 | - |
| 15 min | - | - | 9.9 | 3.6 | 10.0 | - | 8.1 | 2.3 | 11.1 | - |
| 20 min | - | - | 7.9 | 3.2 | 7.9 | - | 6.7 | 2.0 | 9.9 | - |

Table 1. Average blood lactate concentrations (mmol/L) at each time point grouped by stroke specialty (n=20).

| | Active Recovery | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Distance | 100yd | | 200yd | | 400yd | | 500yd | |
| Timepoint | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Baseline | 3.0 | 0.2 | 2.0 | 0.6 | 1.9 | - | 1.5 | 0.5 |
| 0 min | 7.5 | 2.3 | 8.6 | 2.7 | 9.6 | - | 10.7 | 1.1 |
| 2 min | 11.3 | 0.1 | 9.6 | 2.4 | 12.4 | - | 13.1 | 1.0 |
| 5 min | 9.1 | 2.3 | 7.9 | 1.7 | 10.1 | - | 10.0 | 0.3 |
| 10 min | 6.9 | 2.0 | 7.0 | 1.8 | 7.0 | - | 6.9 | 0.7 |
| 15 min | 2.2 | - | 4.6 | 1.9 | 4.9 | - | 4.7 | 1.5 |
| 20 min | 3.8 | 2.8 | 3.2 | 1.4 | 2.8 | - | 3.0 | 0.8 |

| | Passive Recovery | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Distance | 100yd | | 200yd | | 400yd | | 500yd | |
| Timepoint | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Baseline | 2.2 | - | 1.9 | 0.7 | 1.9 | - | 1.9 | 0.3 |
| 0 min | 10.9 | - | 11.2 | 4.1 | 9.3 | - | 10.1 | 2.0 |
| 2 min | 10.9 | - | 14.2 | 2.7 | 13.4 | - | 11.7 | 1.2 |
| 5 min | 10.7 | - | 12.6 | 2.9 | 14.2 | - | 10.6 | 1.3 |
| 10 min | 10.3 | - | 11.5 | 2.6 | 12.1 | - | 9.2 | 0.3 |
| 15 min | 8.6 | - | 9.6 | 3.0 | 11.1 | - | 7.2 | 0.2 |
| 20 min | 8.2 | - | 7.4 | 2.7 | 9.9 | - | 6.3 | 0.4 |

Table 2. Average blood lactate concentrations (mmol/L) at each time point grouped by distance (n=20).

## Acknowledgements

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