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# THE INFLUENCE OF BREAKS AND TRANSITION STRATEGY ON HEART RATE VARIABILITY AND LACTATE IN HIGH-INTENSITY FUNCTIONAL TRAINING WORKOUTS

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## INTRODUCTION

**Break and transition strategy is key to managing fatigue and maintaining a faster pace during high-intensity functional training (HIFT) workouts (2).** Failing to select a strategy that reconciles relevant physiological traits (e.g., strength, endurance, skill, etc.) with the assigned workload can lead to excessive downtime (i.e., time when repetitions are not being completed). Examples of this might include using too fast a pace at the beginning of the workout, attempting to complete sets of an exercise unbroken, taking inadequate rest breaks, and rushing transitions between exercises. Although these are theoretically necessary for completing work as quickly as possible and earning the best score on a workout, they either elevate a workout's relative intensity or the duration a given intensity must be maintained and hasten the onset of fatigue.

Lactate is a metabolite of glycolysis that accumulates with prolonged high-intensity exercise and can be used as an indicator of fatigue (1). Its accumulation acts as a natural safety mechanism by lowering pH and impairing further energy production until it is sufficiently cleared. Lactate may also interfere with heart rate variability (HRV), an index of the coordinated effort of sympathetic and parasympathetic nervous systems attempting to maintain homeostasis in response to external stimuli (5). Waking and post-exercise HRV is thought to be indicative of recovery and readiness to perform (4, 5). Although lactate and HRV responses to HIFT have been reported, the timing of their measurement and relationships to pacing strategy have not (3). **Thus, this study's purpose was to examine the time course for relationships between break and transition strategy on post-exercise HRV and lactate responses to HIFT.**

## METHODS

Across two visits, nineteen experienced (≥ 6 months) adults randomly completed:

Low- (LV) or high-volume (HV) versions of 5 rounds of power cleans (PC x 5 or 10), toes-to-bar (TTB x 10 or 15), and wall balls (WB x 15 or 20) prescribed at standard loads.

Video recordings analyzed to quantify repetition completion rate, breaks (count, total and average time), and transition times.

### Heart Rate Variability

Collected for 10 minutes (PRE) exercise and 20 minutes (POST) exercise [0 – 5 minutes for IP, 5 – 10 minutes for 5P, and 15 – 20 minutes for 20P]

Root mean of the square of successive differences (RMSSD) and standard deviation of normal-to-normal (SDNN) intervals analyzed as slope from PRE to each time point.

### Blood Lactate Concentrations (mmol / L)

Collected at PRE, IP, 5P, and 20P.

Analyzed as area-under-the-curve from PRE to each time point.

## RESULTS

**Table 1. Workout pacing performance during low- and high-volume HIFT workouts.**

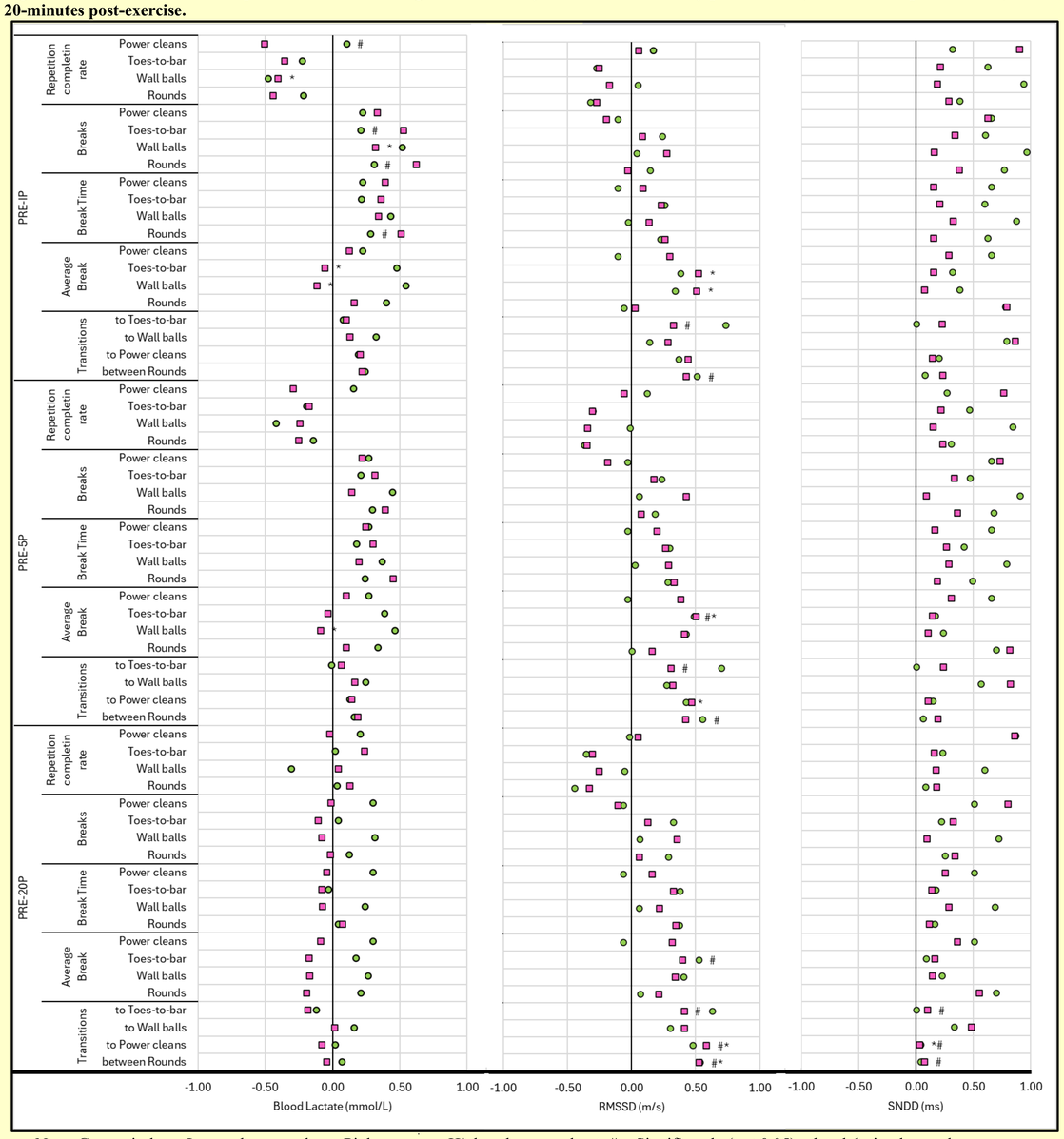
| | Low-volume | High-volume |
|---|---|---|
| Time (minutes) | 10.7 ± 3.7 | 21.0 ± 6.6 |
| Repetitions | 150 ± 0 | 225 ± 1 |
| Workout rate (repetitions/min) | 15.7 ± 5.5 | 11.8 ± 4.0 |
| Exercise rate (repetitions/sec) | | |
| Power clean | 0.44 ± 0.11 | 0.254 ± 0.058 |
| Toes-to-bar | 0.390 ± 0.199 | 0.243 ± 0.120 |
| Wall balls | 0.44 ± 0.10 | 0.371 ± 0.101 |
| Round | 0.277 ± 0.086 | 0.210 ± 0.068 |
| Break count | | |
| Power clean | 0.305 ± 0.844 | 2.11 ± 2.08 |
| Toes-to-bar | 1.87 ± 2.11 | 3.85 ± 3.28 |
| Wall balls | 0.579 ± 0.529 | 1.2 ± 0.79 |
| Round | 2.76 ± 2.6 | 7.16 ± 4.35 |
| Total break time (seconds) | | |
| Power clean | 2.07 ± 6.28 | 20.6 ± 19.5 |
| Toes-to-bar | 20.5 ± 20.6 | 78.1 ± 91.6 |
| Wall balls | 7.95 ± 8.45 | 35.7 ± 67 |
| Round | 30.6 ± 27.2 | 133 ± 118 |
| Average break time (seconds) | | |
| Power clean | 0.645 ± 1.784 | 9.71 ± 5.84 |
| Toes-to-bar | 8.21 ± 4.87 | 26 ± 45 |
| Wall balls | 7.99 ± 5.46 | 26.5 ± 46 |
| Round | 6.25 ± 6.64 | 21.4 ± 31.2 |
| Transition time to (seconds) | | |
| Power clean | 13.9 ± 8.0 | 21.7 ± 11.4 |
| Toes-to-bar | 16.8 ± 7.7 | 28.5 ± 12.6 |
| Wall balls | 11.9 ± 4.3 | 16.7 ± 6.1 |
| Next Round | 39.8 ± 16 | 62.6 ± 25.3 |

**Table 2. Lactate and heart rate variability responses to low- and high-volume HIFT workouts.**

| | Lactate (mmol) | | RMSSD (ms) | | SNDD (ms) | |
|---|---|---|---|---|---|---|
| | Low Volume | High Volume | Low Volume | High Volume | Low Volume | High Volume |
| **Pre-exercise** | 1.9 ± 0.9 | 1.7 ± 0.7 | 63.3 ± 32.2 | 61.8 ± 38.3 | 65.9 ± 27.8 | 68.8 ± 29.4 |
| **Immediately post-exercise** | 13.5 ± 2.6 | 13.5 ± 2.8 | 9.9 ± 15.6 | 6.1 ± 6.0 | 8.64 ± 9.3 | 6.48 ± 3.5 |
| **5 minutes post** | 12.5 ± 2.7 | 19.6 ± 35.8 | 6.1 ± 7.2 | 5.9 ± 5.4 | 8.07 ± 5.9 | 7.88 ± 4.4 |
| **20 minutes post** | 8.4 ± 2.5 | 8.4 ± 2.6 | 13.3 ± 15.5 | 12.4 ± 12.5 | 17.2 ± 15.3 | 16.6 ± 11.9 |
| | **Lactate response (auc)** | | **RMSSD (slope)** | | **SNDD (slope)** | |
| **Pre-IP** | 311 ± 60 | 392 ± 54 | -53.4 ± 27.7 | -55.6 ± 37.3 | -57.3 ± 25.3 | -62.3 ± 28.4 |
| **Pre-5P** | 376 ± 68 | 475 ± 109 | -28.6 ± 14.9 | -27.9 ± 17.4 | -28.9 ± 13.5 | -30.4 ± 13.6 |
| **Pre-20P** | 533 ± 93 | 685 ± 373 | -15.4 ± 8.7 | -14.8 ± 11.8 | -14.6 ± 8.4 | -15.5 ± 8.7 |

## RESULTS, cont.

**Figure 1. Relationships between pace and indices of fatigue and recovery collected immediately post-exercise, at 5-minutes post-exercise, and at 20-minutes post-exercise.**




Note: Green circles = Low-volume workout; Pink squares = High-volume workout; # = Significantly ($p < 0.05$) related during low-volume workout; * = Significantly ($p < 0.05$) related during high-volume workout.

## CONCLUSIONS and PRACTICAL APPLICATIONS

**Relationships between the blood lactate response and pacing were primarily seen immediately post-exercise.** The study design allowed for training status to vary across individuals, and this could have impacted lactate clearance and the return of HRV metrics to baseline (3). Nevertheless, the data support existing recommendations for when each should be measured post-exercise. Lactate pacing relationship suggests participants, despite varying fitness levels, intensity workouts.
**Practical Application:** To best assess lactate as a fatigue marker in HIFT, measurements should be taken immediately.

**Although relationships were seen throughout the entire post-exercise period for RMSSD, those associated with SNDD were only seen at 20-minutes post-exercise.** Consistent with existing recommendations (%), the data suggest tracking HRV may require a longer post-exercise window to reflect autonomic recovery.
**Practical Application:** To assess post-HIFT recovery using HRV, data should be collected 15-20 minutes post-exercise.

## REFERENCES

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