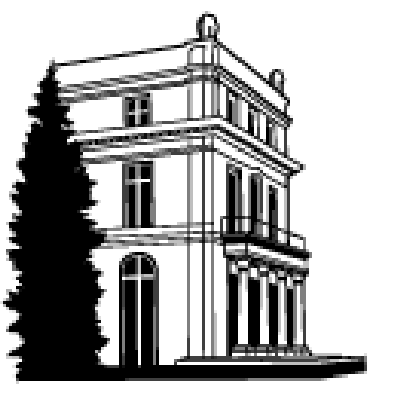




Feasibility of a Suspension-Training Warm-Up Protocol before Maximal Cardiopulmonary Exercise Testing: A Single-Participant Pilot Study

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INTRODUCTION

Treadmill walking is a commonly used warm-up strategy before maximal cardiopulmonary exercise testing (CPET). However, dynamic warm-up protocols may be a suitable alternative for highly physically active subjects. Before equivalence testing of a dynamic suspension-training warm-up protocol, preliminary evaluation of feasibility, tolerability, and physiological comparison is warranted. Our main objective was to evaluate the feasibility and tolerability of a novel suspension-training warm-up before CPET and whether a suspension training warm-up produced comparable physiological cardiopulmonary outcomes to a maximal CPET protocol for physically active subjects compared to traditional treadmill walking.

METHODS

A single-participant randomized crossover pilot design was employed. One highly physically active adult participant (41 years of age and 21.3 BMI score) completed two 6-minute warm-up conditions: a) treadmill walking (WW), and b) five bodyweight suspension training exercises (SW) before CPET at the Human Performance Lab of Monmouth University. Primary cardiometabolic variables such as heart rate (HR) and oxygen consumption (VO₂) were assessed via a metabolic portable analyzer (Vo₂ Master pro) during the warm-up, transition phase (2 min), and during the CPET protocol. Feasibility outcomes included protocol completion, total time to exhaustion, and tolerability, which was assessed via rate of perceived exertion (RPE) and adverse events.

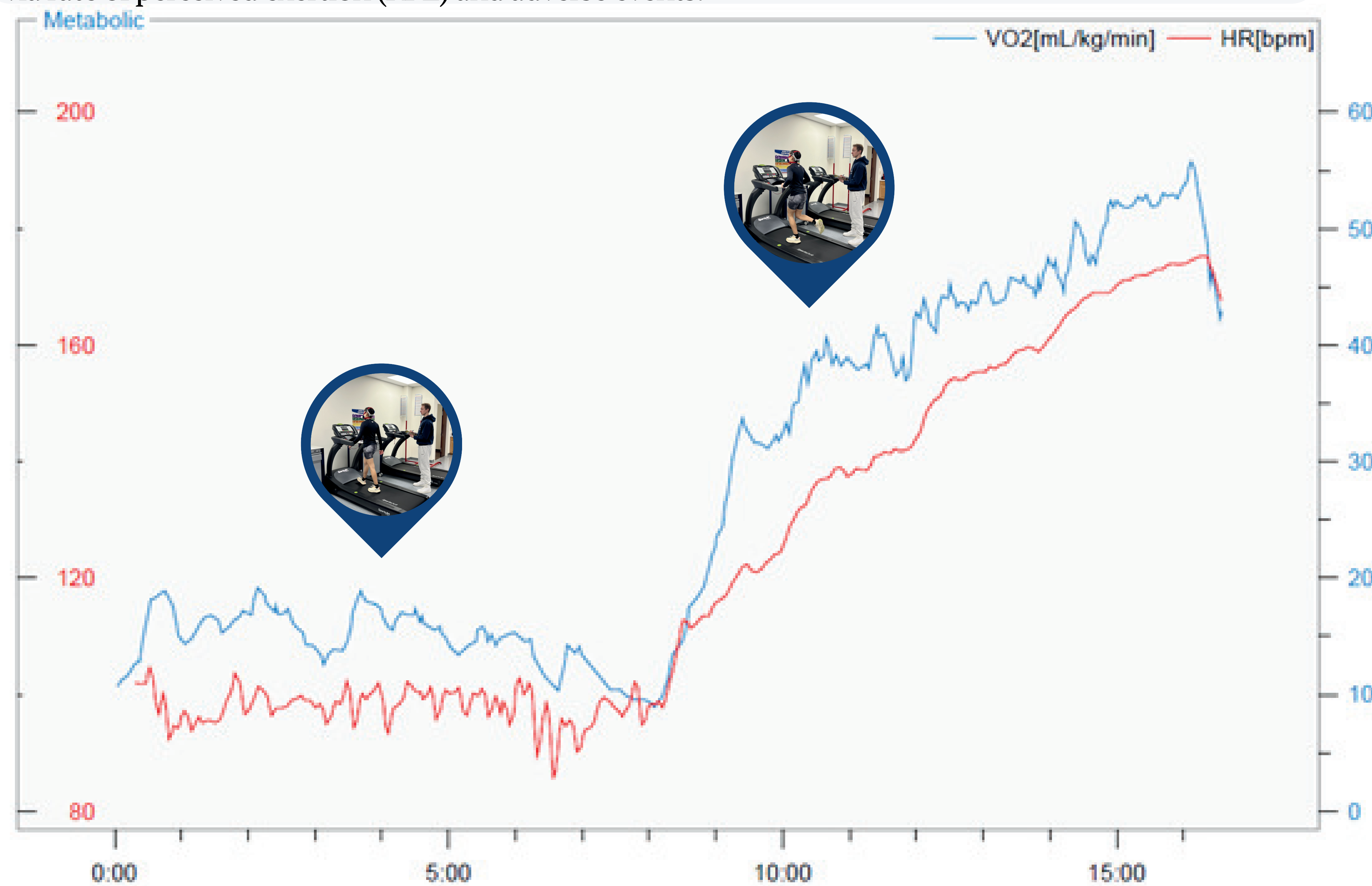


Figure 1: Walking warm-up + transition + CPET

RESULTS & DISCUSSION

Both conditions were completed without adverse events or protocol deviations. The SW elicited a higher HR and VO₂ at the end of the warm-up than WW. During the 2-minute transition phase, average cardiopulmonary values also remained higher following SW compared to WW (HR= 105.23 vs 96.24 bpm; VO₂= 17.77 vs 11.49 mL.kg⁻¹.min⁻¹).

All peak CPET outcomes were slightly higher for SW than for WW. See Table 1 for detailed results.

The participant completed CPET under the same RPE, termination criteria, and protocol stage (see figures 1 and 2). These preliminary findings support the feasibility and tolerability of suspension training as an alternative to a walking warm-up. It also may serve as an adequate primer for physically active participants before maximal CPET.

This data supports progression to a larger equivalence study.

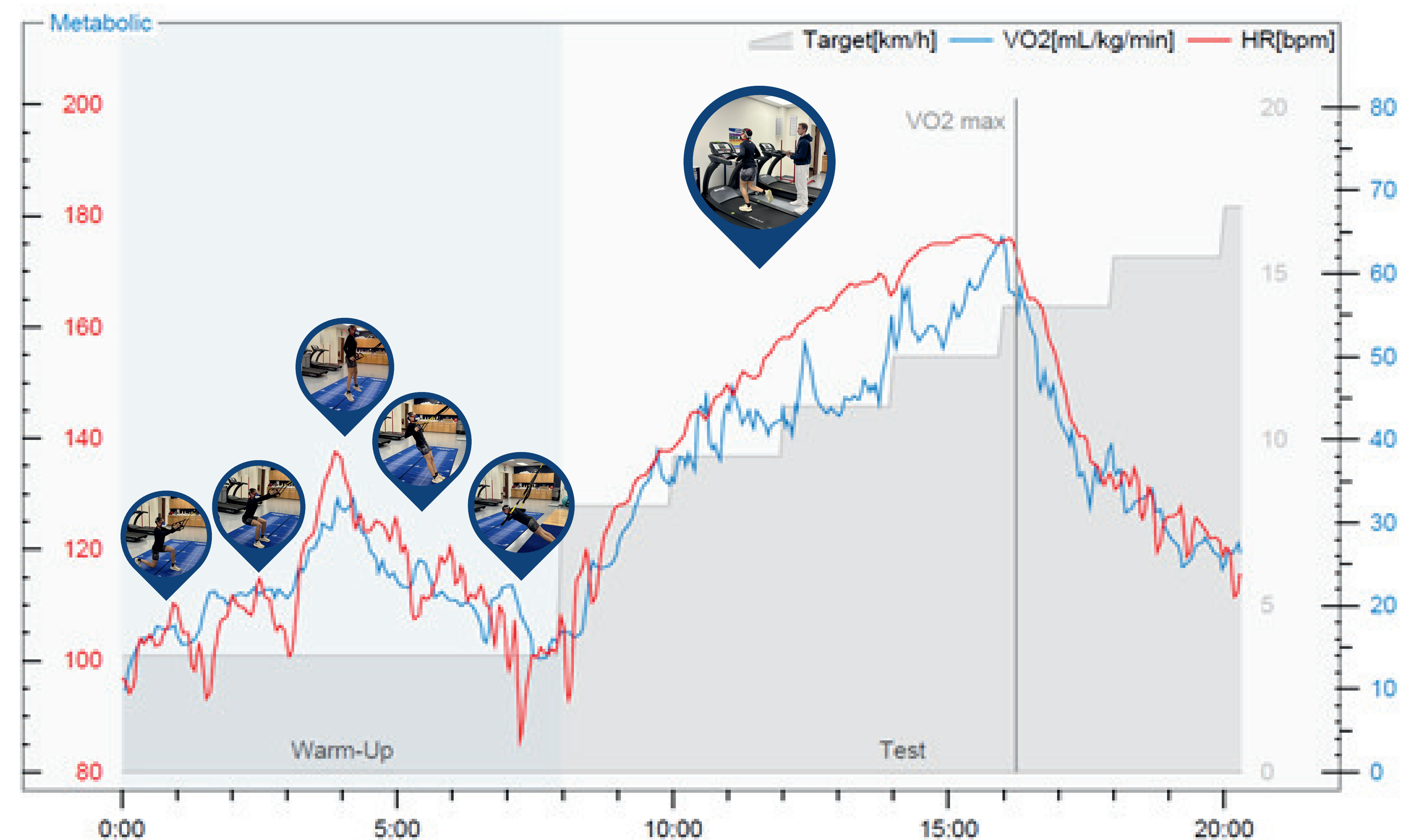


Figure 2: Suspension training warm-up + transition + CPET

Table 1: results from both protocols

Protocol Phase	Variables	WW (mean)	SW (mean)	Differences (SW-WW)
End warm-up (300-360 s)	HR (bpm)	98.73	114.86	16.13
	VO ₂ (ml/kg/min)	14.85	22.17	7.32
	Ve (L/min)	26.75	57.81	31.06
	RF (breaths/min)	24.89	32.7	7.81
	TV (L)	1.1	1.94	0.84
Transition to test (360 to 480 s)	HR (bpm)	96.24	105.23	8.99
	VO ₂ (ml/kg/min)	11.49	17.77	6.28
	Ve (L/min)	18.53	42.92	24.39
	RF (breaths/min)	22.6	29.29	6.69
	TV (L)	0.9	1.48	0.58
Maximal Cardio-pulmonary Exercise Test (CPET)	Variables	WW (mean)	SW (mean)	Differences (SW-WW)
	Peak VO ₂ (ml/kg/min)	53.87	62.5	8.63
	Peak HR (bpm)	174.6	176.3	1.7
	Peak RF (breaths/min)	54.34	59.16	4.82
	Peak Ve (L/min)	138.19	144.05	5.86
	Peak TV (L)	2.73	3	0.27
	Total time to exhaustion	8:02	7:44	0:18