

The Effects of Post-Warm-Up Recovery Time on Swim Performance

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ABSTRACT

Competitive swimmers are faced with a range of post-warm-up recovery times (PWRTs) during competitions. Previous exercise science literature suggests that the optimal PWRT is between 8-20 minutes. However, research specific to competitive swimmers has focused on comparisons to longer PWRTs. Further, there is limited research comparing multiple PWRTs, especially PWRTs less than 20 minutes. **PURPOSE** To investigate the impact of PWRTs ranging from 5-20 minutes prior to swim performance. **METHODS** Baseline heart rate and core temperature were estimated at the start of each session. Swimmers then completed a standardized swim warm-up. Measures of heart rate (HR), skin temperature (ST), and RPE were estimated upon completion. Participants were then randomly assigned one of four groups to rest for either 5 minutes (5PWRT), 10 minutes (10PWRT), 15 minutes (15PWRT), or 20 minutes (20PWRT). Each participant completed all conditions on different days. Heart rate, temperature, and RPE were recorded at the end of the PWRT. Lastly, participants completed a maximal swim of 100 yards. Total time and splits at each 50 yards were recorded, in addition to HR, ST, and RPE immediately after the completion of the swim. **RESULTS** Pairwise comparisons displayed a significant difference ($p < 0.05$) between baseline HR and PWRT HR in all conditions (5PWRT; 85 ± 10.1 vs 104 ± 15.5 bpm, 10PWRT; 79 ± 8.8 vs 103 ± 17.9 bpm, 15PWRT; 84 ± 10.6 vs 99 ± 14.4 bpm, 20PWRT; 82 ± 8.7 vs 98 ± 13.5 bpm). ST was significantly lower when compared to 15PWRT and 20PWRT ($95.5 \pm 1.8^\circ$ vs $97.5 \pm 0.8^\circ$ and $97.6 \pm 0.7^\circ$ respectively; $p < 0.05$). Pairwise comparisons for heart and swim performance displayed no difference between PWRTs. **CONCLUSION** While there were no differences between performance and physiological variables across the PWRT conditions, heart rate remained significantly elevated in all PWRT conditions compared to baseline.

INTRODUCTION

- At swim meets, swim teams typically warm-up as a group prior to competing. There is a range of time swimmers must wait following their warm-up prior to a race. Facilities may not have a separate pool to warm-up in. In general, warm-up prior to competition has been reported to increase muscle temperature and aid in force output (Kilduff, 2011). Muscle temperature has also been reported to decrease 15-20 minutes following the cessation of exercise (West, 2013).

- Existing literature has compared short recovery times to longer recovery times in competitive swimmers. For example, 10 and 45 minutes (Zochowski, 2007), 20 and 45 minutes (West, 2013), and 10 and 20 minutes (Neiva, 2007). Thus, these studies only compared two post-warm-up times and none of the project examined times less than 10 minutes. Furthermore, these studies are often completed in a small sample of elite levels swimmers.

- Additionally, The USA swimming rule 102.5 states that swim-offs (races performed as a tie-breaker) must take place within 45 minutes of the last swimmer completing their event in that swim session. Thus, it is possible then there could be swim offs that take place in less than 20 minutes from the completion of a race (USA Swimming Rule Book, 2022).

- This study sought to further examine the influence of post-warm-up recovery times on young competitive swimmers.

PURPOSE

- To investigate the impact of post-warm-up recovery times ranging from 5-20 minutes prior to swim performance.

METHODS

- Seventeen participants (6 males and 11 females; age: 15.0 ± 2.4 years, height: 167.9 ± 10.0 cm, mass: 62.6 ± 11.8 kg) participated.

- PRETEST: Subjects sat at rest for 15 minutes to collect baseline data of heart rate and temporal skin temperature (TST).

METHODS (cont.)

- WARMUP: heart rate, temperature, and RPE were recorded immediately after a standardized 1,200-yard warm-up was completed.
 - Warm-up: 300 easy, 4x100 kick drill by 25, 4x50 red, 8x25 variable, 100 easy

- POST-WARM-UP RECOVERY: participants were randomly assigned to one of four groups: 5 minutes of post-warm-up recovery (5PWRT), 10 minutes of post-warm-up recovery (10PWRT), 15 minutes of post-warm-up recovery (15PWRT), or 20 minutes of post-warm-up recovery (20PWRT). During this time, participants sat down and were asked to refrain from excessive movement and talking. Heart rate, temperature, and RPE were recorded one minute prior to the end of the recovery condition. All swimmers complete all conditions over an eight-week period.

- SWIM PERFORMANCE: participants completed a maximal swim of 100 yards freestyle. Total time and splits at each 50 yards were recorded, in addition to heart rate, temperature, and RPE immediately after the completion of the swim.

Statistical Analyses

- A repeated measures ANOVA was used to compare post warm-up recovery time periods for each variable. Pairwise comparisons were performed using a Bonferroni correction factor if significance was detected.

- Paired sample T-test were used to compare baseline measures to pre-swim measures.

- An alpha level of $p < 0.05$ was set for all statistical analyses.

RESULTS

- Temporal skin temperature was significantly lower at 5PWRT compared to the 15PWRT and 20PWRT ($p < 0.05$).

- Results from the ANOVA showed no change regarding heart rate and swim performance across PWRTs.

- Paired-samples T-test displayed a significant difference between baseline HR and PWRT HR in all conditions ($p < 0.05$).

Table 1. Comparisons between post-warm-up recovery conditions.

	Pre-Swim HR (bpm)		Pre-Swim TST ($^\circ$ F)		100-Yd Swim Time (s)		Post-Swim RPE	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
5PWRT	104.25	15.47	95.98*	1.78	71.78	9.06	16.63	1.41
10PWRT	102.75	17.92	97.11	1.04	71.82	9.11	16.38	1.15
15PWRT	99.00	14.37	97.48	0.79	70.63	8.95	16.69	1.92
20PWRT	98.25	13.48	97.59	0.71	71.21	8.40	16.69	1.35

*Indicates significant difference compared to 15PWT and 20PWT.

Table 2. Comparisons between pre-warm-up (baseline) and pre-swim performance measures.

		Heart Rate (bpm)			TST ($^\circ$ F)			RPE	
		Mean	Std. Dev		Mean	Std. Dev		Mean	Std. Dev
5PWRT	Baseline	85.13	10.09	Baseline	98.53	0.58	Post-WU	13.19	1.72
	Pre-Swim	104.25	15.47	Pre-Swim	95.98	1.78	Post-Swim	16.63	1.41
10PWRT	Baseline	79.13	8.82	Baseline	98.47	0.59	Post-WU	13.19	2.04
	Pre-Swim	102.75	17.92	Pre-Swim	97.11	1.04	Post-Swim	16.38	1.15
15PWRT	Baseline	84.38	10.61	Baseline	98.69	0.57	Post-WU	13.75	1.73
	Pre-Swim	99.00	14.37	Pre-Swim	97.48	0.79	Post-Swim	16.69	1.92
20PWRT	Baseline	81.75	8.73	Baseline	98.47	0.58	Post-WU	12.94	1.12
	Pre-Swim	98.25	13.48	Pre-Swim	97.59	0.71	Post-Swim	16.69	1.35

DISCUSSION

- Results from this study differ from the findings of previous studies. The most similar study was performed by Neiva and colleagues (2016). Specifically, swimmers' performances of similar length (91.4-m in this study vs. 100-m) did not differ in performance whereas Neiva's findings reported an improved performance following 10PWRT compared to 20PWRT. It is possible this could be due to the fact that Neiva and colleagues had a small sample size (11 elite male swimmers compared to our mixture of 16 male and female swimmers of varying ability level). Thus, the variability with our sample was much larger.

- The other two existing articles (West et al. 2013 and Zochowski et al., 2007) had participants complete a 200-meter time trial, instead of a 100-yard time trial. These two studies reported significant differences across swim times. Perhaps the range of 5-20 minutes of PWRT did not impact the 100-yard freestyle (91.4-m) as much as a 200-m freestyle. Again, these studies had small sample sizes and included national level swimmers.

- There were no significant differences between 100-yard (91.4-m) swim performance across any of the PWRTs in my study. It is possible that in this group of swimmers remained physiologically prepared to perform within the timeframe of rest provided. The heart rate data suggested that the participants' heart rate remained elevated from 5-20 minutes following warm-up

- It is also important to recognize that the small sample size of the current project remains small. Future work should focus on the influence of post-warm-up recovery time in larger samples across various ability levels and swim events.

CONCLUSIONS

- Swimmers' performance in the 100-yard (91.4-m) freestyle did not vary when presented with post-recovery-warm-up times in the range of 5 to 20 minutes.

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