

# MONITORING INTERNAL LOAD PARAMETERS DURING COMPETITIVE SYNCHRONIZED SWIMMING DUET ROUTINES IN ELITE ATHLETES

## Introduction & Aim

Successful performance at an elite absolute level in Synchronized Swimming (SS) often result in high-volume (averaging about 40 h·wk<sup>-1</sup>) (Mountjoy 2009, Rodríguez-Zamora *et al.* 2012), high-intensity training programs (Mountjoy 2009).

The regulation of exercise intensity during SS training is critical to the success of each conditioning program since exercise intensity set too low does not induce the desired physiological adaptations while an exercise intensity set too high may result in overtraining fatigue or injuries from overuse in this kind of athletes (Mountjoy 2009).

To monitor and control the training process, it is important to have a valid measure of the swimmers' internal load (IL) (Foster 2001). This is particularly relevant in this kind of aesthetic sports, where the planned external load is often different for each team member because of the variety of elements configuring each routine, the order in which they are executed and the fact of spending almost the 50% of the routine time underwater (Homma 1994).

**The aim of the present study was to compare the heart rate (HR) and perceived exertion (RPE) responses as internal load indicators while performing duet routines during training and competition.**

## Material & Methods

**Subjects** were **10 SS Olympic medalists** (age: 17.4 ± 3.0 years, height: 164.0 ± 6.1 cm, body mass: 52.0 ± 6.4 kg, training: 36.3 ± 6.2 h·week<sup>-1</sup>, experience: 9.2 ± 2.6 years).

**Monitoring** was carried out while performing the same technical (TD) or free duet (FD) routines during a training session (T), and during an official competition (C) separated by an interval of 48 to 72 h (Figures 1 & 2).

**Heart Rate (HR)** was measured using waterproof beat-by-beat HR monitors (CardioSwim, Freelap, Switzerland). HR<sub>pre</sub> was recorded before the routine; HR<sub>peak</sub>, HR<sub>min</sub>, HR<sub>mean</sub>, HR<sub>range</sub> during the exercise; and HR<sub>post1</sub>, HR<sub>post3</sub>, HR<sub>post5</sub> were recorded post-exercise (Figure 3).

**Rate of perceived exertion (RPE)** was assessed using the Borg's category-ratio CR-10 scale (0-10+) after each performance.

## Results

HR responses (bpm) during T and C were almost identical: HR<sub>pre</sub> was 131 ± 14 (T) and 134 ± 8 (C), HR<sub>peak</sub> was 185 ± 6 (T) and 185 ± 7 (C), with interspersed bradycardic events down to 87 ± 4 (T) and 86 ± 5 (C).

Routines were perceived as “hard” to “very, very hard” in both conditions. Mean RPE scores were equally high in C (7.9 ± 1.2) and T (7.5 ± 1.2).

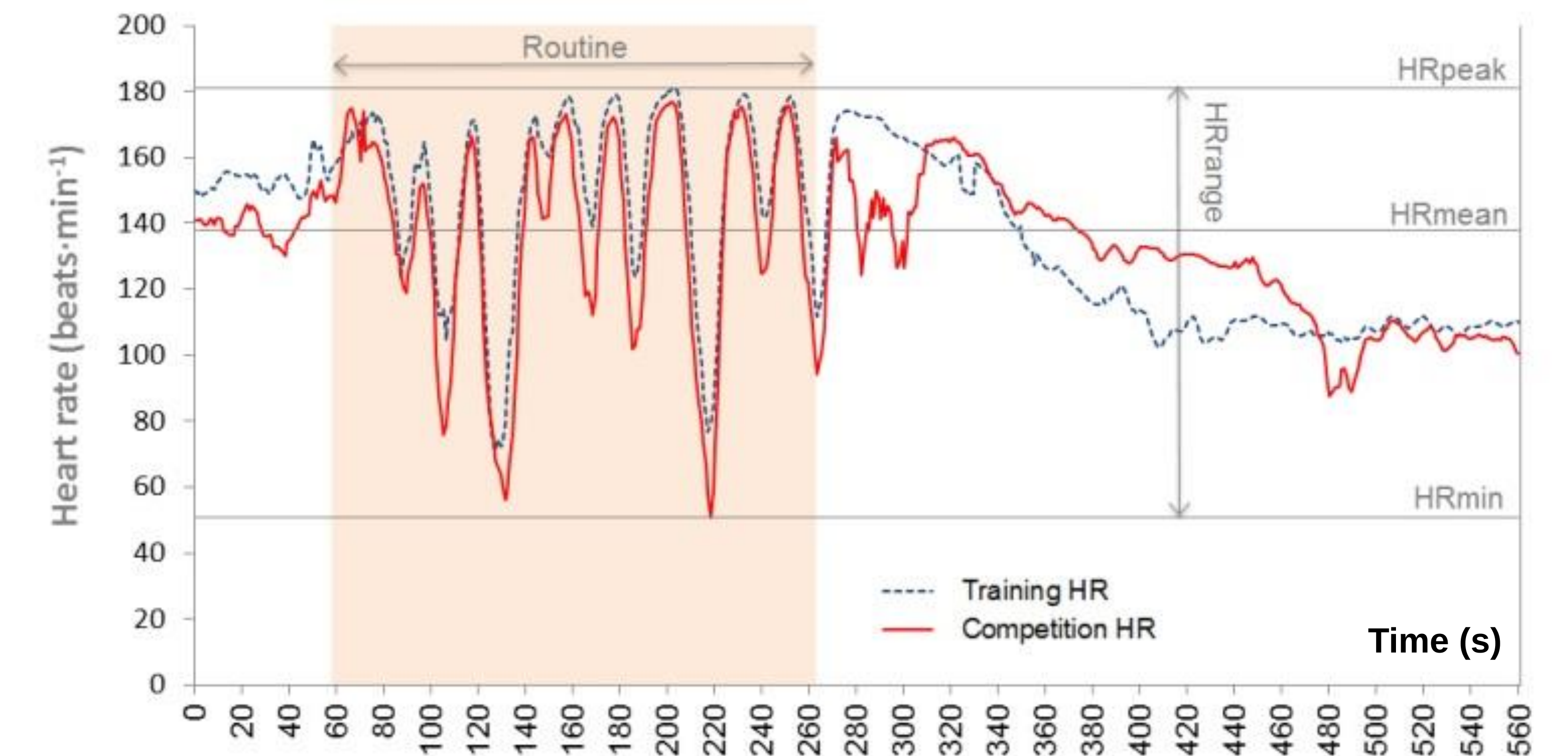
RPE inversely correlated with minimum ( $r=-0.55$ ,  $p=0.01$ ) and mean HR ( $R=-0.45$ ;  $p=0.03$ ), and positively correlated with HR<sub>range</sub> ( $r=0.52$ ;  $p=0.01$ ).



**Figure 1.** The National Spanish duet wearing the waterproof cardiotaconeter while executing the free program during the competition



**Figure 2.** The National Spanish duet wearing the waterproof cardiotaconeter while executing the free program during a training session



**Figure 3.** Heart rate profiles before, during (shadowed), and after a free duet routine performed during training (blue line) and competition (red line) in one of the swimmers.

## Conclusions

- **The internal load** imposed by SS duets routines can be monitored using objective (HR) and subjective (RPE) assessments, and is virtually identical during competition and training.
- **The effects of automaticity** could be a possible explanation, embodied through the replication of the same movement sequence during practice, and by the swimmers' long-term adaptations to specific routine exercises and apnea.
- **Practicing competitive routines** is suitable for developing and maintaining the cardiovascular fitness necessary for specific conditioning in elite synchronized swimmers, with the added value of favouring exercise automaticity, inter-individual coordination, and artistic expression simultaneously.

## References

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