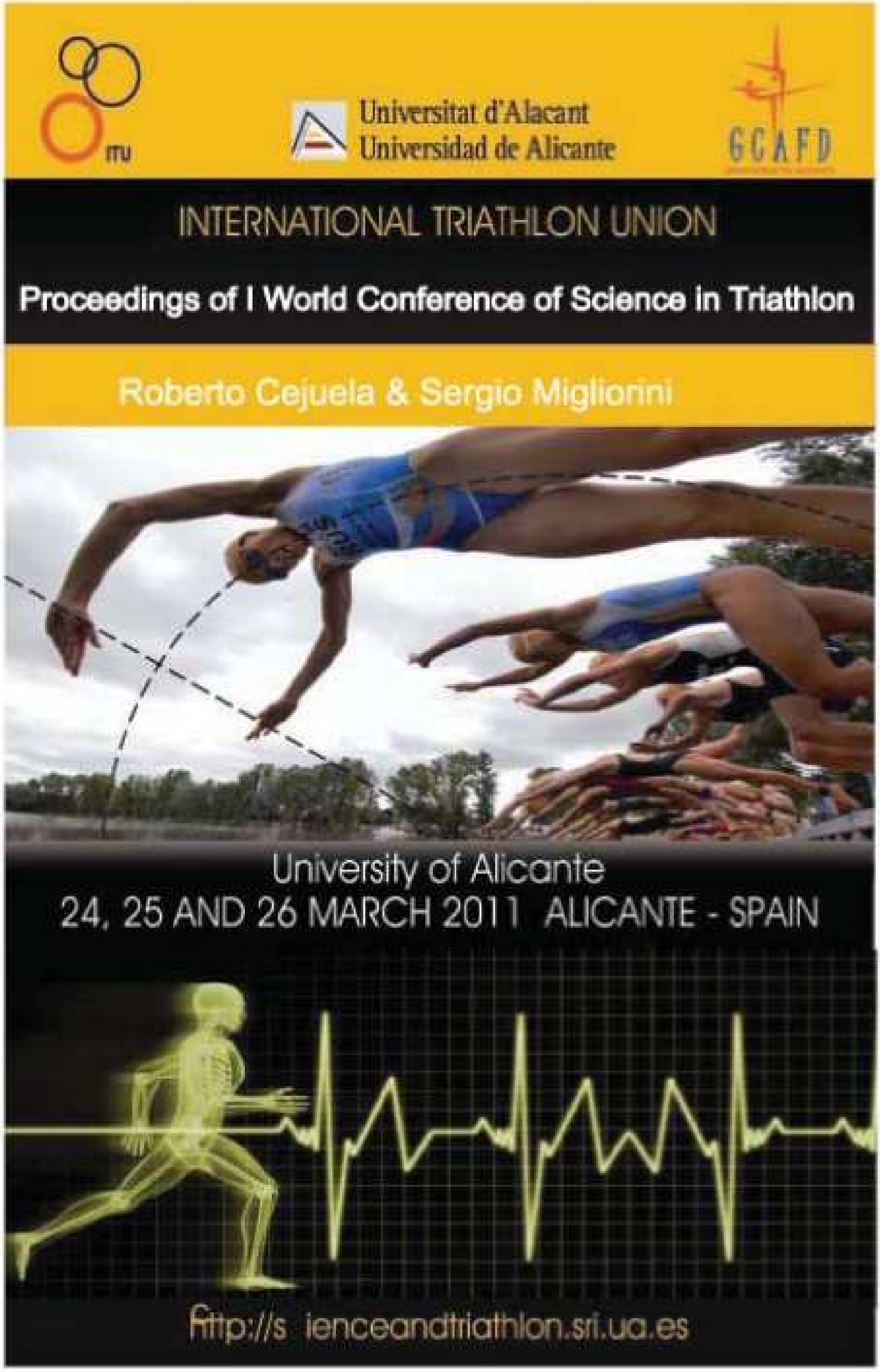

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Reliability of simulated sprint-distance triathlon

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Summary

To assess reliability of simulated sprint-distance triathlon seven non-elite, male triathletes completed three trials (750 m swim, 20 km bike, 5 km run), using a 25 m pool, an electromagnetically braked cycle ergometer and motorised treadmill. Total times (h, min and s) were 1:17:37 ± 0:06:41, 1:18:22 ± 0:08:59 and 1:18:47 ± 0:09:56. Coefficient of variation (CV) for total performance time was 2.7% between trials 1&2 (CI = 1.7-6.0) and 2.3% between trials 2&3 (CI = 1.5-5.1). Performance CV's for swim, cycle and run phases were also <5% between trials 2&3. These results show that for non-elite, competitive male triathletes, performance time in simulated sprint-distance triathlon is highly reproducible, with a CV comparable to endurance performances of similar duration (<5%).

Keywords: reproducibility , multisport , transition , constant-distance test , triathlete

Resumen

Para evaluar la fiabilidad de un triatlón sprint simulado, siete triatletas entrenados de género masculino completaron tres intentos (750 m natación, 20 km ciclismo, 5 km carrera) utilizando una piscina de 25 m, un cicloergómetro de freno electromagnético y una cinta mecánica. Los tiempos totales (h, min y s) fueron 1:17:37 ± 0:06:41, 1:18:22 ± 0:08:59 and 1:18:47 ± 0:09:56. El coeficiente de variación (CV) para el tiempo total fue 2.7% entre los intentos 1 y 2 (CI = 1.7-6.0) y 2.3% entre los intentos 2 y 3 (CI = 1.5-5.1). El CV del rendimiento en los segmentos de natación, ciclismo y carrera fue también <5% entre los intentos 2 y 3. Estos resultados muestran que para triatletas hombres y entrenados, el rendimiento en un triatlón sprint es altamente reproducible, con un CV comparable al rendimiento en pruebas de duración similar (<5%).

Palabras clave: reproducibilidad, multideportivo, transición, test de distancia constante, triatleta

Introduction

For triathlon-based studies to examine performance effectively it is necessary to consider the complete event, rather than focus on only one or two of the associated sub-disciplines (i.e. cycle-run) (Peeling, 2009). Despite the observed residual impact of each sub-discipline on subsequent performance in the triathlon (Peeling et al., 2005) only a small number of studies have fully considered the specificity of experimental or simulated triathlon tests by including each of the sub-disciplines in a continuous effort (Hausswirth et al., 2010; Peeling et al., 2005; Miura, et al., 1999; Millard-Stafford et al., 1990). Nevertheless, there are no studies to date that have attempted to establish the reliability of any such performance test involving all three sub-disciplines of sprint-distance triathlon. As such, it remains unclear whether performance time, power output, and key physiological responses are reproducible during a lab-based performance test, when the modality is specific to sprint-distance triathlon. Therefore the aim of this study was to establish reliability of performance time for a simulated sprint-distance triathlon and also reliability of mean (cycling) power output, respiratory and lactate measurements during this performance.

Materials and methodology

Seven non-elite, competitive male triathletes (mean ± SD: age 32.6 ± 6.2 yrs, body mass 76.9 ± 6.0 kg) completed three simulated triathlon trials (with each trial including 750 m swim, 500 kJ bike, 5 km run), using a 25 m pool, an electromagnetically braked cycle ergometer ergometer (SRM; Jülich, Welldorf, Germany) and motorised treadmill (LifeFitness 93T, Schiller Park, IL). Triathlon trials were completed at least 72 hrs apart and at the same time of day, with all three trials completed within a 28 day period. In addition to performance time of individual sub-disciplines and transitions, power output (W) was measured during the cycle phase whilst $\dot{V}O_2$, $\dot{V}CO_2$, V_E, HR (Cosmed K4b2, Rome, Italy) and capillary blood lactate concentration (Lactate Pro, Kodak, Japan) were measured throughout both cycle and run phases. Within-subject variation, expressed as coefficient of variation (CV), between trials was calculated via log-transformation of measured variables using calculations presented previously (Hopkins, 2009). Confidence intervals were set at 95%.

Results

Physiological values obtained for the triathletes during incremental cycle ergometry and treadmill running are shown in Table 1. Total performance time (h, min and s) during trial 1 (1:17:37 ± 0:06:41) was 0:00:45 (0.8%) lower when compared to trial 2 (1:18:22 ± 0:08:59), with a subsequent increase of 0:00:25 (0.4%) during trial 3 (1:18:47 ± 0:09:56). Coefficient of variation (CV) for performance and physiological variables between trials 1&2 and trials 2&3 are shown in Table 2. Times for first and second transitions represented ~0.2% of the total performance time, with a combined CV of 5% ([95% CI] 3.2 - 11.4). Mean power output during the cycle phase represented 68.2 ± 7.2% of W_{peak}. Mean $\dot{V}O_2$ during cycle and run phases corresponded to 81.1 ± 8.4% and 88.8 ± 10.1% of $\dot{V}O_{2peak}$ (ml·min^{-1}kg^{-1}), respectively. Mean HR during cycle and run phases were 89.6 ± 3.3% and 91.9 ± 1.9% of HR_{peak}, respectively.

Table 1 Mean ± SD values performed during incremental cycling and running tests before the simulated sprint-distance triathlon trials.

Peak cycling values	
$\dot{V}O_{2peak}$ (l·min^{-1})	4.2 ± 0.4
$\dot{V}O_{2peak}$ (ml·min^{-1}kg^{-1})	54.1 ± 6.0
W_{peak} (W)	307.0 ± 19.5
W_{peak} (W·kg^{-1})	4.0 ± 0.4
W_{4mmol} (W)	241.0 ± 15.3
HR_{peak} (b·min^{-1})	175 ± 6
Peak running values	
$\dot{V}O_{2peak}$ (l·min^{-1})	4.3 ± 0.5
$\dot{V}O_{2peak}$ (ml·min^{-1}kg^{-1})	55.5 ± 3.9
V_{peak} (km·h^{-1})	15.9 ± 1.2
V_{4mmol} (km·h^{-1})	13.6 ± 1.0
HR_{peak} (b·min^{-1})	182 ± 6

Table 2 Coefficient of variation (CV [95%CI]) for variables measured during simulated sprint-distance triathlon.

Subject	Trial 1 and 2	Trial 2 and 3
Overall		
Mean time	2.7% (1.7 - 6.0)	2.3% (1.5 - 5.1)
Mean lactate	11.3% (7.1 - 26.6)	7.2% (4.6 - 16.5)
$\dot{V}O_2$ (ml·min^{-1}kg^{-1})	3.7% (2.4 - 8.4)	3.8% (2.4 - 9.6)
VE	5.5% (3.5 - 12.6)	4.6% (2.8 - 11.6)
Heart rate	1.0% (0.6 - 3.0)	1.9% (1.1 - 5.5)
Swim		
Mean time	1.6% (1.0 - 3.5)	1.1% (0.7 - 2.3)
Mean lactate	7.3% (4.7 - 16.8)	7.5% (4.8 - 17.3)
First transition		
Mean time	9.7% (6.2 - 22.6)	9.2% (5.8 – 21.4)
Cycle		
Mean time	5.6% (3.6 - 12.8)	3.9% (2.5 - 8.9)
Mean lactate	17.3% (10.8 - 42.0)	9.0% (5.7 - 20.9)
Mean power	5.7% (3.6 - 12.9)	3.9% (2.5 - 8.7)
Mean cadence	0.1% (0.0 - 0.1)	0.1% (0.1 - 0.2)
$\dot{V}O_2$ (ml·min^{-1}kg^{-1})	4.2% (2.7 - 9.4)	4.9% (3.1 - 12.6)
VE	8.6% (5.5 - 20.0)	7.4% (4.6 - 19.2)
Heart rate	2.6% (1.7 – 5.8)	1.9% (1.2 – 4.8)
Second transition		
Mean time	3.5% (2.3 – 8.0)	8.1% (5.2 – 18.8)
Run		
Mean time	1.3% (0.8 - 2.9)	1.2% (0.7 - 2.6)
Mean lactate	9.6% (6.1 - 22.4)	11.0% (7.0 - 26.0)
$\dot{V}O_2$ (ml·min^{-1}kg^{-1})	4.0% (2.5 - 9.0)	3.7% (2.3 - 9.4)
VE	3.1% (2.0 - 7.0)	4.4% (2.7 - 11.2)
Heart rate	1.3% (0.8 - 3.8)	1.8% (1.1 - 5.3)

Discussion and conclusions

To our knowledge this is the first study to have examined the reliability of simulated triathlon performance, and associated physiological responses, regardless of event distance. For non-elite, competitive male triathletes, performance time in simulated sprint-distance triathlon is highly reproducible, with a CV comparable to endurance performances of similar duration (<5%) (Currell & Jeukendrup, 2008). Whilst performance intensities (%$\dot{V}O_{2peak}$, %W_{peak}, %HR_{peak}) were comparable to higher calibre triathletes performing in similar sprint-distance performance tests

(Hausswirth et al., 2001), there appeared to be greater variability in performance and physiological measures during simulated triathlon in comparison to performance in each isolated sub-discipline, specifically the cycle phase (Sporer & McKenzie, 2007; Zavorsky, et al., 2007). Increased variability within sub-disciplines may reflect the residual fatigue mechanisms that are thought to exist during continuous triathlon performance (Peeling et al., 2005). Further research is necessary to establish the extent of these residual effects during complete triathlon performance, and to identify the specific physiological mechanisms involved in this fatigue process.

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