BOOK OF ABSTRACTS Open Access

Reliability of cycling performance during field-based uphill time-trials

P Lima[1], G Matta[1], A H Bossi[2], L Pertence[1], M Bara[1], J Hopker[2]

Introduction

Background: Performance-assessment tests are often used to verify the efficacy of cycling training programs or experimental interventions in scientific studies. Previous research has shown high reliability of mean power output (POmean) during field time-trials of different courses, such as 36- and 40-km flat, 1.4-km uphill and 4- and 20-min flat. However, the reliability of uphill time-trial performance during long-duration efforts is yet to be determined. As fluctuations in gradient and wind can affect power distribution, it is important to analyse reliability of pacing strategy when investigating reliability of performance during field time-trials.

Purpose: To assess the reliability of POmean and pacing strategy during field-based uphill time-trials.

Methods

Eighteen trained cyclists volunteered (age 31.8 ± 7.6 years, body mass 71.6 ± 8.3 kg and height 1.74 ± 0.08 m). Participants performed an incremental test firstly, and 4 field-based 20-min time-trials then (7 days apart). Different courses were utilised (6.5 and 5.6% mean gradients for courses 1 and 2, respectively), but each participant performed all of their time-trials on the same (course 1, n = 8; course 2, n = 10). Data were log-transformed and analysed using Excel spreadsheets to describe POmean reliability by intraclass correlation coefficients (ICC), typical errors (TE) and coefficients of variation (CV)—along with 90% confidence limits (CL90%). Within-participant differences in POmean were verified using one-way repeated measures ANOVA. To analyse pacing strategy, POmean from each 2-min interval was percentage normalised to the whole time-trial POmean, with statistical interactions assessed via two-way repeated measures ANOVA. Three-way mixed ANOVAs were performed to analyse whether pacing strategy would interact with performance level (cyclists split into 2 groups based upon POmean) and course. Statistical significance was set at $P \leq 0.05$.

Results

Peak power output from the incremental test was 350 ± 36 W. ICC, TE and CV of POmean between trials 2-1, 3-2 and 4-3 are presented in Table 1. Power output was not different ($F = 0.150$, $P = 0.855$, $\eta p2 = 0.009$) between time-trials (287 ± 30, 287 ± 29, 286 ± 32 and 286 ± 34 W for time-trials 1, 2, 3, and 4, respectively). Pacing strategy and TE of POmean at each 2-min interval along with CL90% are presented in Figure 1. We found higher variability in pacing strategy at the start and end of time-trials (TE = 7.57%, 6.29% and 6.08%; 7.01%, 6.34% and 6.24% for 0-2 and 18-20 min intervals, comparisons 2-1, 3-2 and 4-3, respectively) and a significant main effect of time ($F = 96.134$, $P < 0.001$, $\eta p2 = 0.850$). Pairwise comparisons revealed differences between intervals 0-2 and 2-4 only ($P < 0.001$). Pacing strategy adopted by cyclists did not differ between time-trials ($F = 1.970$, $P = 0.060$, $\eta p2 = 0.104$) and performance groups ($F = 1.052$, $P = 0.399$, $\eta p2 = 0.062$), but differed between courses ($F = 4.861$, $P = 0.006$, $\eta p2 = 0.233$).

Discussion

As shown in flat courses (Nimmerichter et al., 2010, International Journal of Sports Medicine, 31, 160-166), we demonstrated high reliability of performance during 20-min uphill time-trials, both overall and after splitting cyclists into groups. They adopted positive pacing strategies in all time-trials, with higher variability at the start and end of time-trials, similar to results reported from laboratory tests (Thomas et al., 2012, European Journal of Applied Physiology, 112, 223-229). Cyclists' performance level does not seem to influence pacing strategy, but course selection does, suggesting future studies should address POmean comparisons among different courses.

Conclusions

POmean during 20-min uphill time-trials is reliable and cyclists do not seem to adjust pacing strategy after consecutive performances, making this protocol robust for performance evaluations in the field.

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Table 1. Within-subject intraclass correlation coefficients (ICC), absolute typical errors (TE) and typical errors as coefficients of variation (CV) between tests. Data are presented as mean [CL90%].

	PO_{mean} (W)				
	All participants (n = 18)	**Top 9 performers**	**Bottom 9 performers**	**Course 1 (n = 8)**	**Course 2 (n = 10)**
ICC (2 to 1)	0.95 [0.89–0.98]	0.94 [0.80–0.98]	0.97 [0.91–0.99]	0.95 [0.82–0.99]	0.98 [0.93–0.99]
ICC (3 to 2)	0.97 [0.92–0.98]	0.96 [0.88–0.99]	0.98 [0.94–0.99]	0.96 [0.86–0.99]	0.98 [0.93–0.99]
ICC (4 to 3)	0.95 [0.90–0.98]	0.96 [0.86–0.99]	0.96 [0.87–0.99]	0.96 [0.85–0.99]	0.97 [0.90–0.99]
Mean	**0.96 [0.92–0.98]**	**0.95 [0.89–0.98]**	**0.97 [0.93–0.99]**	**0.96 [0.89–0.99]**	**0.97 [0.94–0.99]**
TE (2 to 1)	7.19 [5.64–10.06]	8.74 [6.28–14.95]	5.44 [3.91–9.31]	7.49 [5.29–13.47]	6.07 [4.43–9.99]
TE (3 to 2)	6.15 [4.82–8.60]	6.44 [4.62–11.01]	5.28 [3.80–9.04]	6.57 [4.64–11.81]	6.06 [4.42–9.97]
TE (4 to 3)	7.72 [6.06–10.81]	7.04 [5.06–12.05]	8.72 [6.27–14.93]	7.06 [4.98–12.69]	8.33 [6.08–13.71]
Mean	**7.05 [6.02–8.77]**	**7.47 [6.02–10.55]**	**6.67 [5.37–9.42]**	**7.05 [5.57–10.12]**	**6.91 [5.54–9.31]**
CV (2 to 1)	2.6 [2.0–3.6]	3.1 [2.2–5.3]	2.1 [1.5–3.6]	2.7 [1.9–4.9]	2.1 [1.5–3.5]
CV (3 to 2)	2.2 [1.7–3.1]	2.2 [1.5–3.7]	2.0 [1.4–3.5]	2.4 [1.7–4.3]	2.2 [1.6–3.6]
CV (4 to 3)	2.8 [2.2–3.9]	2.3 [1.7–4.0]	3.3 [2.4–5.8]	2.6 [1.8–4.6]	3.0 [2.2–5.0]
Mean	**2.5 [2.2–3.2]**	**2.6 [2.1–3.6]**	**2.6 [2.0–3.6]**	**2.5 [2.0–3.7]**	**2.5 [2.0–3.3]**

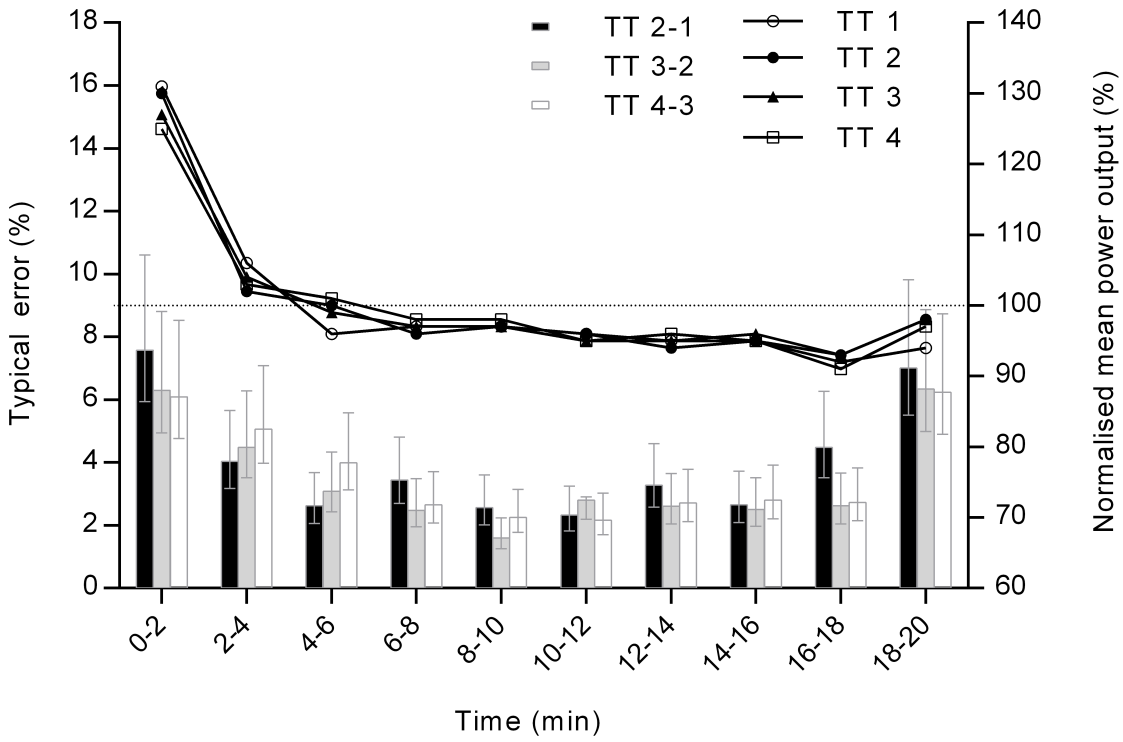

Figure 1: Typical error (CL90%) of the pacing strategy for trials 2–1, 3–2 and 4–3 for each 2-min interval (bars). Error is calculated from normalised mean power output (lines)

Key words: reproducibility; repeatability; work distribution; outdoor time-trial; uphill performance

✉ **Contact email:** abossi.ef@gmail.com (A. Bossi))

[1] *Faculdade de Educação Física e Desportos, Universidade Federal de Juiz de Fora, Juiz de Fora, Minas Gerais, Brazil*
[2] *School of Sport and Exercise Sciences, University of Kent, Chatham Maritime, Chatham, Kent, England*