High-level biathletes with a fast-start pacing pattern improve time-trial skiing, without changes in shooting performance, by using a more even pacing strategy

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Background

In World-cup biathlon sprint, the most common pacing pattern is a J-shaped pacing strategy with a relatively fast first lap (before prone shooting), a slower second lap (before standing shooting) and then a (slightly) faster third lap. Faster skiing speed on laps 2 and 3 differentiates medalists from other top 20 finishers (Bjørklun & Laaksonen 2022). Compared to lower performing athletes, the best biathletes tend to have lap times closer to their average pace, indicating that they employ a more even pacing pattern.

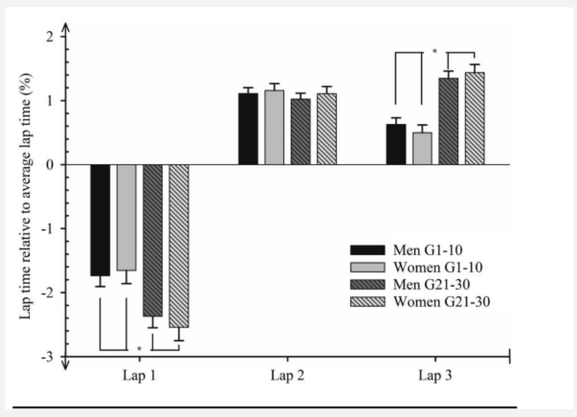

Figure 1: In biathlon World cup sprint the most common pacing pattern is a J-shaped pacing strategy, fast first lap, a slower second lap and then a faster third lap. From Luchsinger et al (2018) IJSPP.

These observations allow us to hypothesize that a more conservative pacing strategy would be beneficial for skiing performance in high level biathletes with a fast-start pacing pattern.

Purpose

This study tested the hypothesis that biathletes with a fast-start pacing pattern would improve time-trial skiing and shooting performance by using more even pacing during a simulated sprint biathlon competition.

More specifically we investigated how this change in pacing strategy influences

a) time-trial roller ski performance,
b) hit rate and precision of prone and standing shooting and
c) rate of perceived exertion and heart rate responses.

Methods

Twelve female (age 20 ± 1 yrs) and 26 male (age 22 ± 1 yrs) biathletes were recruited to the project. All biathletes were highly trained national and regional level athletes.

All participants performed two time-trials on the same two days separated by 72 hrs. The participants performed an individual sprint 7.5 km (3x2.5 km) for females or 10 km (3x3.3 km) for males in the freestyle technique on a roller ski track at an international racecourse at Birkebeiner ski area (Lillehammer, Norway).

Prone shooting (after lap 1) and standing shooting (after lap 2) were performed on standardized paper targets on a 50 m outdoor shooting range, with scoring rings from 1-10.

On Day 1, participants performed the biathlon sprint with a self-selected pacing strategy. Based on the ranking of their relative starting pace over the first ~800-m segment on Lap 1 in relation to their average ~800-m segment pace on Lap 1-3, the participants were assigned into two groups; an intervention group with the fastest starting pace (INT, n=20, 14 men) and a control group with a more conservative start pace (CON, n=18, 12 men).

On Day 2, the participants were informed of their assigned group before the warm-up. INT were instructed to target their Day 1 average ~800 m segment pace from Lap 1-3 at Lap 1, and they were informed how many seconds slower they should ski the first 800 m segment relative to Day 1. CON was instructed to maintain the same starting pace and overall pacing strategy as Day 1.

During the race, the participants wore an integrated Inertial Measurement Unit (IMU) and Global Navigation Satellite System (GNSS) unit on their back to capture position and speed continuously.

Rate of perceived exertion (RPE) using a 6-20 scale was reported verbally during the race (after ~800 m of each lap, before (~150 m) and after 1st shooting (~50 m), before and after 2nd shooting, ~200 m before the finish) and ~30 s after crossing the finish line.

Results

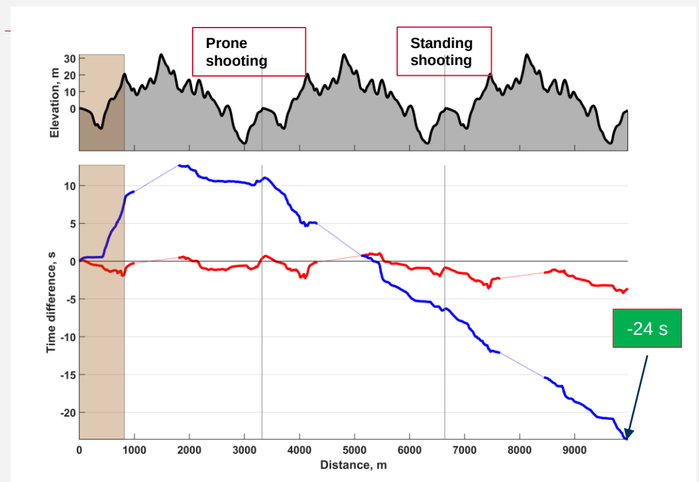

Figure 2: Relative skiing time differences (excluding shooting) from Day 1 to Day 2 for INT (Intervention) in blue and CON (Control) in red. The thin dotted lines illustrate the segments were only the males skied. Females performed 7.5 km and males 10 km. The brown area illustrates the segment where INT were told to adjust the start pace the first lap.

- INT slowed their starting pace for the first ~800-m by (mean ± 95% confidence interval) 5.0 ± 1.5% (*P*<0.01) from Day 1 to Day 2, with no significant differences for CON (-0.8 ± 2.7%).
- INT increased their overall time-trial performance more than CON from Day 1 to Day 2 (1.5 ± 0.7% vs. 0.0 ± 0.9%, *P*=0.02).
- No differences in shooting performance were found within or between groups.
- INT reduced their summated rate of perceived exertion more from Day 1 to Day 2 compared to CON (*P*<0.05).

Practical application

The present findings demonstrate that reduced starting speed during the first ~3 min of a biathlon sprint competition substantially improves skiing performance for fast-starting biathletes. The beneficial effects of adjusting the starting pace were equal to a penalty lap (~25 s). Since changing the pacing strategy did not influence shooting performance, but did reduce overall RPE, it appears that biathlon coaches and athletes would benefit from systematically evaluating individual pacing strategies and changing pacing patterns towards a more even lap-to-lap pacing for fast-starting biathletes. The improved skiing performance was accompanied by reduced summated RPE, implying less discomfort during the race.

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