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Abstract

Comparison of mean maximal powers measured in indoor and outdoor tests and recorded during training and competition

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Abstract: The aim of this study was to compare the mean maximal powers (MMP) in road cycling measured during four conditions (training, racing, indoor and outdoor tests). Seven male amateur cyclists completed four test sessions (2 indoors and 2 outdoors) over a 14-day period, consisting of mean maximal power tests for durations of 5, 15, 30, 300 and 1200 s. Indoor testing was done on a home trainer while outdoor testing was on an uphill road. MMPs were also determined from power data recorded for 3-6 months during training sessions and competitions. No significant difference in MMPs was found between road and racing tests, nor between indoor and outdoor tests except for the 5 s duration (-10% for indoor test). The duration MMPs of 5 and 20 min recorded during races, indoor and outdoor tests were significantly higher than during training (+12-14% and +9-11%, respectively). According to these results, cyclists (amateurs) can determine their record power profile for durations of 15 to 1200 s during home trainer tests or uphill road tests or from the race data e, but not at from training data.

Keywords: record power profile, road, home-trainer, training, race

1. Introduction

The record power profile (RPP) has been widely studied over the past decade in road cyclists (Leo et al., 2022). Previous studies have shown that mean maximal power (MMP) for durations of 1-14 min were higher in professional cyclists when measured during an outdoor (road) test compared to an indoor test (home-trainer) (Lipski et al., 2022) or when they were recorded during competitions only during training sessions (Leo et al., 2020). However, Quod et al. (2010) found no significant difference in MMPs measured in an indoor test and during races. Surprisingly, to our knowledge, the MMPs recorded during these four measurement conditions (race, training, indoor and outdoor tests) have never been compared in the same group of cyclists. Reviewing results from the literature, we hypothesized that MMPs recorded during outdoor testing were higher compared to indoor testing and training sessions, but similar to racing.

2. Materials and Methods

Subjects — Seven male amateur cyclists (age: 22.9 ± 4.7 years, height: 1.76 ± 0.05 m; body mass: 63.0 ± 9.6 kg) volunteered to participate in this study after being informed of any potential risk. The study was approved by the local ethical committee and was performed accordingly to the ethical standards established by the Helsinki Declaration of 1975.

Protocol and measures —Each subject performed two test sessions separated by at least 7 days during the first part of the season (February to March). To determine MRPs during an indoor test, each subject pedaled on their road bike that was mounted on a direct-drive trainer (Tacx Flux 2, Tacx Neo 2T, Elite Suito, or Wahoo Kickr Core). During the first day of testing, each subject performed 4 "all-out" exercises lasting 5, 15, 30 and 300 s and a 20 min time trial on the second day. All tests were preceded by a standardized 15-minute warm-up. To determine the MMPs during an outdoor test, the same protocol was carried out on a hill (length: 3.6 km, average slope: 3.8%). The 20 min TT started on a flat road and ended on the same hill. Subjects were not allowed to perform any intense or long-duration workouts the day before each test. MMPs were also determined from power data recorded of 4 months of training session (January to April), which including endurance and high-intensity interval training session, and 11 one day road competition (February to April). Power output was recorded every second throughout test sessions, training and races with each subject's personal power meter (Sram Quark crankset, Rotor 2-inpower crankset, Favero Assioma Duo pedals, or Garmin Vector pedals). Each power meter was calibrated before each test session according to the manufacturer's recommendations.

Statistical Analysis— Data are presented as mean ± SD in the text and mean ± standard error in the figures. The Shapiro-Wilk test confirmed that all data was normally distributed. Therefore, a one-way ANOVA (measurement condition: indoor, outdoor, training, competition) with repeated measures was performed on the MMP data. When a significant effect was detected, pairwise comparison was carried out using the Tukey's post-hoc test. The significance level was set at $p \leq 0.05$.

3. Results

ANOVA analysis revealed that measure conditions have a significant effect on MMP value for5 s ($p = 0.03$), 30 s ($p = 0.02$), 5 min ($p < 0.001$) and 20 min ($p < 0.001$) but no for 15 s ($p = 0.08$). The MMPs measured during the outdoor test were significantly higher compared to training for 30 s (+ 8%, $p = 0.01$), 5 min (+ 13%, $p < 0.001$) and 20 min (+ 10%, $p < 0.001$). The MMPs measured during race were significantly higher compared to training for 5 min (+ 14%, $p < 0.001$) and 20 min (+ 11%, $p < 0.001$). The MMPs measured during indoor test were also significantly higher compared to training for 5 min (+ 12%, $p < 0.001$) and 20 min (+ 9%, $p < 0.001$). Although MMP of 5, 15 and 30 were lower during the indoor test compared to outdoor test, the difference was only significant for the shortest effort (- 10%, $p = 0.02$). The MMP of 5 s measured during the indoor test was also significantly lower compared to training (- 9%, $p = 0.02$) and race (- 10%, $p = 0.03$). No significant differences in MMP were found between the outdoor test and race whatever the effort duration.

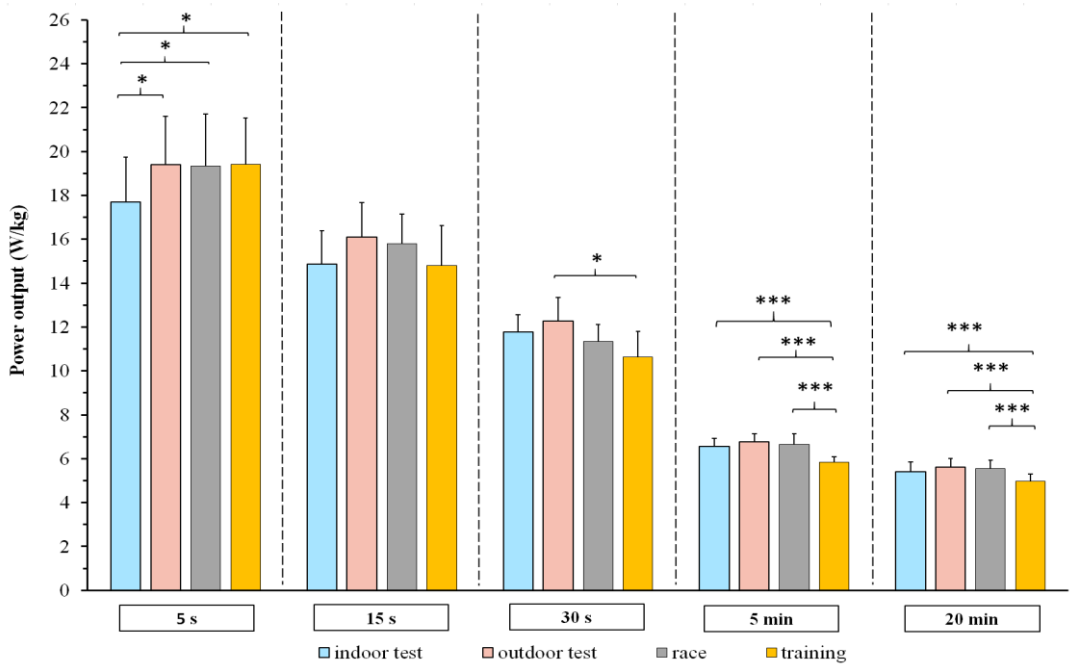

Figure 1. Mean maximal powers measured in indoor (trainer) and outdoor conditions (road) and recorded during road competition (race) and road training sessions (training) over time lasting 5 s, 15 s, 30 s, 5 min and 20 min. Significant difference: *: $p < 0.05$; ***: $p < 0.001$

4. Discussion

Only two of our three hypotheses were confirmed. According to Quod et al. (2010), we did not find a significant difference in the MMPs measured during the road test carried and in the race. As it has been shown by Leo et al. (2020) for durations of 2-12 min, the 5 and 20 min MMPs recorded during training sessions were significantly lower than during racing. However, unlike Lipski et al. (2022), we found no significant difference in MMPs measured during indoor and outdoor testing. This difference is partly explained by the level of the cyclists, which was not the same between the 2 studies (professionals vs amateurs). Additionally, we found a lower MMP value over 5 s in the indoor test. This is likely due to the lateral sways of bike were constrained while standing pedaling on the trainer during all short maximal efforts (5- 30 s), which was not the case during the tests carried out on the road.

5. Practical Applications.

Although we must take precautions in interpreting our results due to the small number of participants, it seems that cyclists (amateurs) can measure MMPs for durations of 15 to 1200 s on a home trainer or in an uphill road without altering the validity of their record power profile. As demonstrated in professional cyclists, MMPs recorded during recorded training sessions in amateur cyclists cannot be used to determine a valid RPP.

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Conflicts of Interest: The authors declare no conflict of interest.

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