Cycling Time Trial Performance with Varied Crank Arm Lengths Utilizing a Smart Bike and Augmented Reality Software in Active Young Adults

Boram Lim and Christopher M. Hearon

Human Performance Laboratory, Department of Health & Kinesiology

Texas A&M University – Kingsville, Kingsville, TX

INTRODUCTION

- The selection of crank arm length (CAL) is a crucial factor influencing various cycling metrics such as cadence, cycling power, muscle activations, and ultimately cycling performance.
- Despite abundant previous research demonstrating changes in cycling economy and biomechanical factors across a wide range of CALs (e.g., 100 ~ 265mm) and relatively short duration (e.g., 30 sec), there still exists a gap in understanding the specific effect of CAL on cycling time trial performance from a practical standpoint.
- These days, indoor cycling with augmented reality (AR) software is gaining more attention due to several benefits such as weather independence, the ability to visually mimic real race roads, and the capability to track numerous cycling metrics.
- The purpose of this study was to identify whether cycling metrics and cycling time trial performance using smart bike and augmented reality software are affected by different CALs.

METHODS

- This study was approved by the Texas A&M University-Kingsville Institutional Review Board (#2023-041).
- Fourteen subjects (8 male; 6 female) voluntarily participated in the study (age: 21.4 ± 1.5 yrs., height: 1.73 ± 0.11 m, body mass: 77.8 ± 17.3 kg, BMI: 25.8 ± 2.5 kg/m^2).
- In a balanced crossover design, each subject completed three cycling time trials with different CALs (175 mm, 170 mm, 165 mm) on three separate occasions along a designated virtual course (distance: 11.65 km, elevation: 34.1 m).
- The experimental sessions were conducted using a smart bike (KICKR BIKE, Wahoo, Atlanta, GA) and augmented reality software (Rouvy, Vimperk, CZ).

METHODS, cont.

- Prior to the first session, the bike fit was assessed and adjusted for comfort, and it remained constant across three trials except for the CALs.
- Repeated measures ANOVA was conducted to analyze the effect of CAL on various cycling metrics: cadence (rpm), pace (m/sec), power (W), time trial performance (min), energy expenditure (kJ), average heart rate (bpm), and perceived exertion (RPE, 6-20), with appropriate *post hoc* tests as needed. The significance level was set *a priori* at $p \leq 0.05$, and maintained throughout all *post hoc* tests.

RESULTS

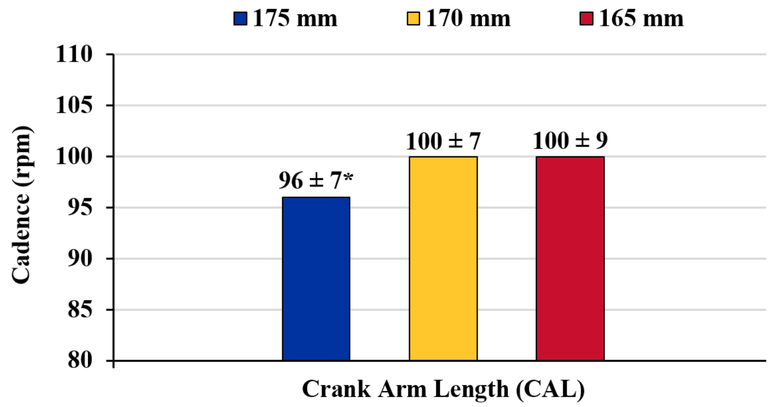

Figure 1: Crank Arm Length Effect on Cadence.
Cadence was significantly lower in the 175 mm CAL trial than in both the 165 and 160 mm CAL trials. Means ± SD, *$p < 0.01$

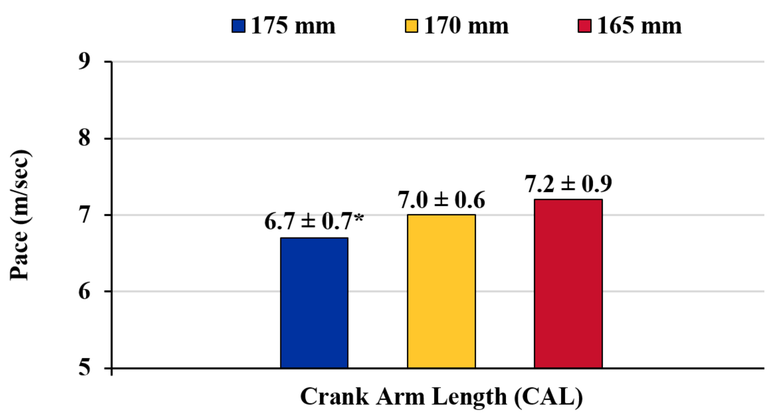

Figure 2: Crank Arm Length Effect on Pace.
Pace was significantly slower in the 175 mm CAL trial than in both the 165 and 160 mm CAL trials. Means ± SD, *$p < 0.001$

RESULTS, cont.

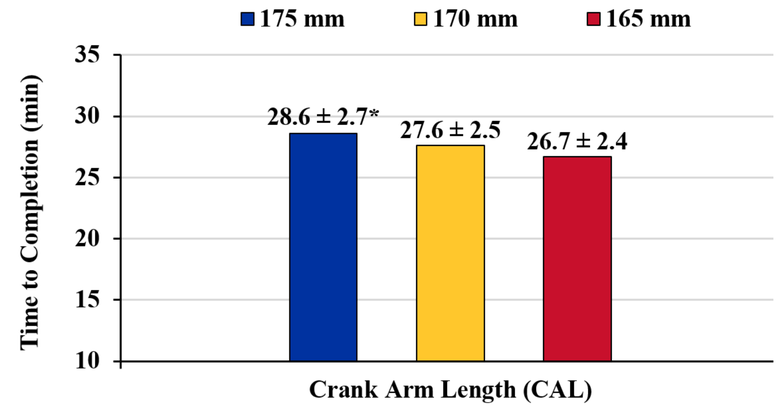

Figure 3: Crank Arm Length Effect on Time Trial Performance.
Time to completion was significantly longer in the 175 mm CAL trial than in both the 165 and 160 mm CAL trials. Means ± SD, *$p < 0.001$

- No statistical differences were shown across CALs in cycling power ($p = 0.54$), energy expenditure ($p = 0.44$), average heart rate ($p = 0.59$), and RPE ($p = 0.29$).

CONCLUSIONS

- CALs significantly influenced cycling time trial performance by affecting cadence and pace without impacting overall cycling power, energy expenditure, heart rate, and RPE.

PRACTICAL APPLICATIONS

- Based on the results of this current study, cyclists aiming for faster completion time at a given distance may benefit from selecting a shorter CAL (i.e., 165 mm or 170 mm), as opposed to the longer CAL (i.e., 175 mm).
- Future research may need to conduct longer distance utilizing the AR software to determine if there are any significant differences between CALs. Additionally, it would be beneficial to collect data overground to assess whether these results are applicable to real cycling race situations.

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