The influence of bicycle lean on maximal crank power during sprint cycling

Ross D. Wilkinson and Rodger Kram
Locomotion Laboratory, The University of Colorado, Boulder, CO, USA
Email: ross.wilkinson@colorado.edu

Summary

Here, we investigated two questions related to maximal 1-s crank power during non-seated, sprint cycling: 1) Does *ad libitum* lean affect maximal crank power compared to a traditional stationary ergometer? and 2) Does trying to minimize lean affect maximal crank power compared to *ad libitum* lean? To address these questions, we modified a cycle ergometer so that it could lean from side-to-side or be locked to prevent lean. This modified ergometer made it possible for riders to sprint under three different conditions: locked (no lean), *ad libitum* lean, and minimal lean. Subjects performed 9 maximal 5-s sprints from rest in a non-seated posture—3 locked, 3 *ad-lib* lean, and 3 minimal lean. Leaning the bicycle *ad libitum* did not enhance maximal 1-s crank power compared to the locked condition. Trying to minimize bicycle lean decreased maximal 1-s crank power by $\sim 5\%$ compared to leaning *ad libitum*.

Introduction

Competitive cyclists typically sprint out of the saddle and alternately lean their bikes from side-to-side, away from the downstroke pedal. Yet, there is no direct evidence to show whether leaning the bicycle or attempting to minimize it affects maximal crank power during sprint cycling. Here, we investigated two questions related to maximal 1-s crank power during non-seated, sprint cycling: 1) Does *ad libitum* lean affect maximal crank power compared to a traditional stationary ergometer? and 2) Does trying to minimize lean affect maximal crank power compared to *ad libitum* lean? To address these questions, we modified a cycle ergometer so that it could lean from side-to-side or be locked to prevent lean. This modified ergometer made it possible for riders to sprint under three different conditions: locked (no lean), *ad libitum* lean, and minimal lean. In the minimal lean condition, the ergometer could lean but we asked the subjects to try to minimize lean. Our first hypothesis (null) was that *ad libitum* lean would result in the same maximal 1-s crank power as the locked condition. Our second hypothesis was that trying to minimize lean would decrease maximal 1-s crank power compared to the *ad-lib* and locked conditions.

Methods

Nineteen healthy recreational cyclists volunteered (13M/6W, 28 ± 6 y, 1.75 ± 0.09 m, 69 ± 10 kg, mean$\pm$SD). Subjects pedaled a friction-loaded ergometer equipped with a crank-based mechanical power meter that was mounted atop a hinged platform. In the *ad-lib* lean and minimal lean conditions, springs attached to the rear legs of the ergometer provided a restoring torque proportional to lean angle. Aluminum struts prevented lean during the locked condition. Subjects performed 9 maximal 5-s sprints from rest in a non-seated posture—3 locked, 3 *ad-lib* lean, and 3 minimal lean. We measured crank angle and ergometer lean angle at 500 Hz using two IMUs.

Results

Range of ergometer lean: The range of lean in the *ad-lib* condition (9.6 ± 2.3 deg.) was more than twice the minimal lean condition (3.9 ± 1.0 deg.), $p < 0.001$, $ES = 1.3$, and the locked condition (0.8 ± 0.3 deg.), $p < 0.001$, $ES = 1.7$. *Maximal 1-s crank power:* Maximal 1-s crank power in the *ad-lib* condition (974 ± 33 W) was 47 W (5%) greater than in the minimal lean condition (927 ± 32 W), $p < 0.001$, $ES = 1.3$, but similar to the locked condition (982 ± 30 W), $p = 0.8$, $ES = 0.2$.

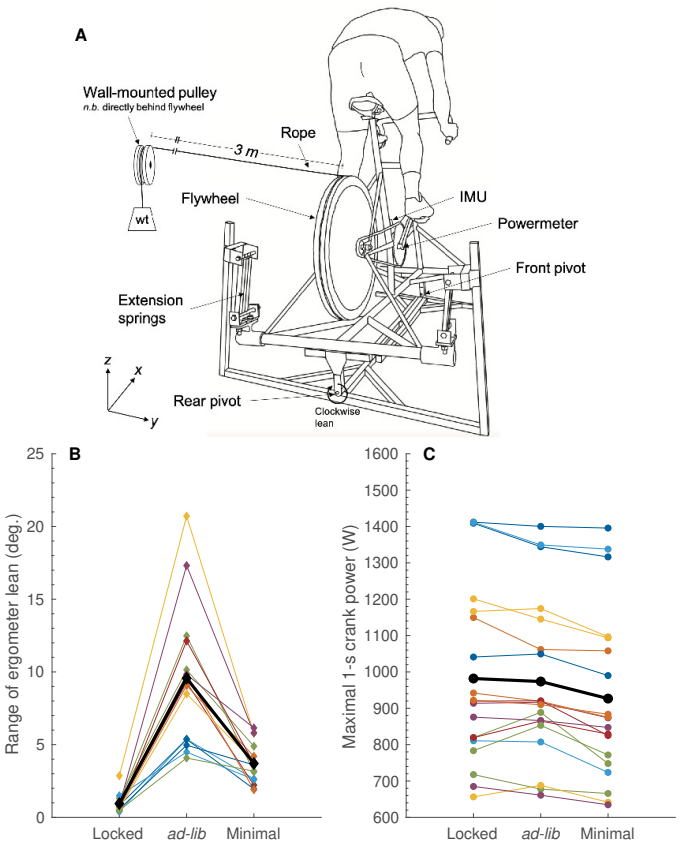

Figure 1: A. Diagram of modified cycle ergometer. B-C. Individual (color) and group mean (black) range of ergometer lean and maximal 1-s crank power, respectively.

Conclusion

Leaning the bicycle *ad libitum* does not enhance maximal 1-s crank power compared to a traditional stationary ergometer. Trying to minimize bicycle lean decreases maximal 1-s crank power by $\sim 5\%$ compared to leaning *ad libitum*.

Acknowledgments

This research was supported by an ISB Student International Travel Grant awarded to RDW.