

Physiological demands of riding an electric-assist bicycle

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ABSTRACT

The American College of Sports Medicine (ACSM) recommends adults participate in weekly aerobic activity: minimum of 30 minutes moderate intensity exercise 5 days per week or 20 minutes of vigorous activity 3 days per week. The electrically assisted bicycle may help individuals achieve the ACSM’s aerobic recommendations and introduce inactive individuals to physical activity. **PURPOSE:** To compare the physiological requirements of riding a bicycle with electric-assist versus no assist. **METHODS:** Participants (n=14, 23.2 ± 0.7 y, 174 ± 2 cm, 77.8 ± 4.0 kg, 20.8 ± 2.0 % body fat, 3.2 ± 0.3 L/min) completed two randomized cycling trials using 1) electric assist and 2) no assist. Cycling trials were over a 3.5 km course with varying terrain. **RESULTS:** Time to completion was faster in the electric-assist (12.5 ± 0.3 min) than the no assist (13.8 ± 0.3 min, p=0.01). Rating of Perceived Exertion (RPE) was lower in the electric-assist (12.0 ± 0.4,) than the no assist (14.8 ± 0.5, p<0.001). There was no difference in VO₂ between electric-assist (2.3 ± 0.1 L/min) and no assist (2.5 ± 0.1 L/min, p=0.45). There was no difference in power output when comparing electric-assist (115 ± 11 Watts) to no assist (128 ± 11 Watts, p=0.38). There was no difference in mean heart rate between electric-assist (147 ± 5 bpm) and no assist (149 ± 5 bpm, p=0.77), except during the final 0.875 km. **CONCLUSIONS:** The electric-assist bicycle was faster and perceived to be easier compared to the no assist. However, oxygen utilization, power output and heart rate were no different. Both the electric-assist and no assist exercise bouts met criteria for vigorous exercise according to ACSM guidelines.

INTRODUCTION

- Physical inactivity has been associated with coronary heart disease, type 2 diabetes, breast and colon cancers; and shortens life expectancy.
- The ACSM recommends that all adults participate in a minimum of 30 min of moderate intensity 5 days per week or 20 min of vigorous activity 3 days per week.
- Commuting by bicycle is one possible way to achieve moderate intensity exercise in order to meet the ACSM recommended guidelines for physical activity and receive the health benefits associated with physical activity
- The Electrically Assisted Bicycle may help inactive individuals overcome obstacles such as wind, hills or longer distances while also achieving the ACSM guidelines for aerobic fitness.

METHODS

- 15 participants (8 males and 7 females) completed two randomized cycling trials outside. Both trials took place on the same 3.5 km “cycling friendly” route along normal trails and roads with stop signs and hills in the UNO area.
- Participant utilized the IZIP E3Path eBike (Currie Technologies, Simi Valley, CA)
- Trials were separated into Electric Assist Bicycle (EA) and No Assist (NA) with a 30 minute rest between trials. The participants were instructed to cycle during the two trials at a self-selected pace consistent with their normal commuting cycling intensity.
- Oxygen uptake (VO₂) was measured using Medical Graphics VO2000 Portable Metabolic system.
- Heart rate and Power Output were measured using Garmin Vector Power Meter Pedals and Garmin 810 Heart Rate Monitor and GPS cycling computer.
- Rating of Perceived Exertion, Borg Scale (6-20), was taken at the end of the trials.



RESULTS

Participant Descriptive Data

Age (y)	Height (cm)	Weight (kg)	Body Fat (%)	VO ₂ peak (L · min ⁻¹)	Power at VO ₂ peak (W)
24 ± 3	174 ± 6	78.0 ± 15.6	20.6 ± 7.2	3.42 ± 0.7	239 ± 23

RESULTS

- The 3.5-km course was completed faster in the electric-assist (12.5 ± 0.3 min) than the no assist (13.8 ± 0.3 min, p=0.01).
- Rating of Perceived Exertion was lower in the electric-assist (12.0 ± 0.4,) than the no assist (14.8 ± 0.5, p<0.001).

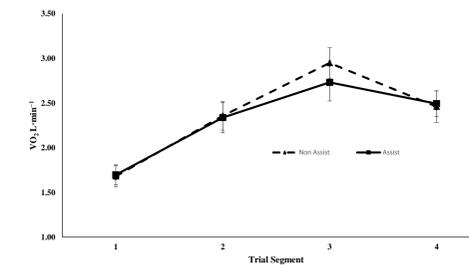


Figure 1. 3.5-km randomized trials showing mean VO₂ (L·min⁻¹) during each quarter (0.875-km) stage. Values are mean ± SE.

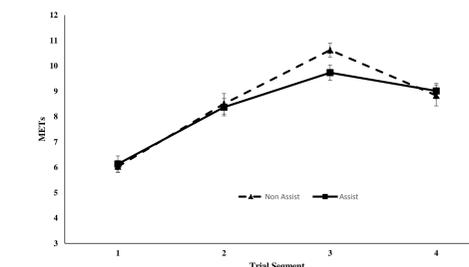


Figure 3. 3.5-km randomized trials showing mean METs during each quarter (0.875-km) stage. Values are mean ± SE.

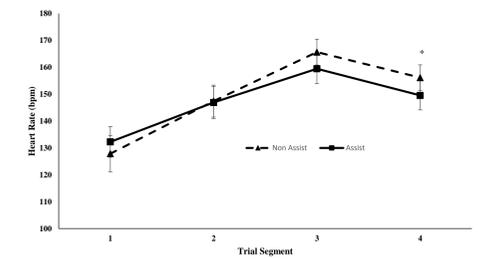


Figure 2. 3.5-km randomized trials showing mean heart rate during each quarter (0.875-km) stage. Values are mean ± SE. *p ≤ 0.05 between trials during the last quarter.

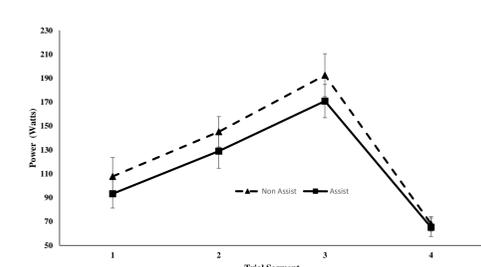


Figure 4. 3.5-km randomized trials showing mean power output during each quarter (0.875-km) stage. Values are mean ± SE.

CONCLUSIONS

- The electric-assist bicycle was faster and perceived to be easier compared to the no assist.
- Average METs, VO₂ (L/min), power output and heart rate were not significantly different.
- Both the electric-assist and no assist exercise bouts met criteria for moderate and vigorous exercise according to ACSM guidelines.
- From an applied aspect, riding the IZIP eBike with the electric assist mode provides similar physical activity intensity compared to the no assist mode, however the electric assist allowed riders to complete the course faster.
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