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Determining Swimming Power Output using a Commercially Available Tethered Pulley Device

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Abstract

Previous literature exists that supports resistive training in the water to improve competitive swim performance. Most of these examples include research involving relationships between swim power and performance. However, no established protocols to estimate measurements of power utilizing resistive training devices exist. **PURPOSE:** First to estimate peak swim power using a pulley-based training device and second, to examine the relationship between peak swim power estimated via a pulley-based training device and peak power achieved during an arm ergometer test. **METHODS:** Swimmers took part in two separate tests of power. SWIM POWER TOWER TEST: Participants performed a series of 10-meter freestyle sprints maximal effort while tethered to the resistive pulley device. The resistance was increased on each subsequent swim bout until failure. ARM ERGOMETER TEST: Participants performed a maximal arm crank test at a resistance of 5% of their body mass for 30 seconds. A Pearson correlation coefficient was used to examine the relationship between peak powers from both tests. **RESULTS:** The Pearson correlation of peak swim power and peak arm ergometer power was found to be significant, $R^2 = 0.64$; $p < 0.05$. **CONCLUSION:** Swim power was estimated using a commercial pulley-based training device. A positive relationship was found between peak swim power in the water and peak power performed during an arm ergometer test in the laboratory.

Introduction

- It is common for swim coaches to utilize pulley devices that provide resistance to in-water swimming as a strategy to competitively train. These devices allow for simple manual adjustments via weight stacks and buckets for purposes of applying resistance to the swimming motion. Previous research has demonstrated a relationship between the amount of force measured during tethered swimming and swim performance (Costill et al., 1982). However, there are no formal protocols for using the pulley-weight systems to assess peak power achieved during swimming. Such practices would allow coaches to specify resistive training to the individual swimmer. Thus, the present study sought to develop a practical approach to assess peak power.

Purpose

- The purpose of this study is two-fold. First, to estimate peak swim power using a pulley-based training device and second, to examine the relationship between peak swim power estimated via a pulley-based training device and peak power achieved during an arm ergometer test performed in a laboratory setting.

Methods

- Thirty-two participants (15 males and 17 females; age: 19.5 ± 1.1 years, height: 173.2 ± 8.5 cm, mass: 73.8 ± 10.7 kg) participated in the study.
- Participants partook in two testing sessions on separate days.

Swim Power Tower Test:

- Participants performed a series of 10-meter freestyle sprints (maximal effort) while tethered to the resistive pulley device (Fig. 1a). The resistance was increased on each subsequent swim bout until failure (i.e. when stroke count on consecutive bouts increased by 5 strokes or the time taken to complete the bout increased by 3+ seconds). Participants received approximately 90 seconds of rest between swim bouts.
- Measures of time (s), resistive force (N), and number of swim strokes were recorded during each of the swim bouts throughout the testing session.

Monark Arm Ergometer Test:

- Participants' height, weight, and age were recorded.
- Each participant performed a maximal arm ergometer test (Fig. 1b) for 30-seconds against a resistance (5% of their body mass). To begin this test, the participant was asked to crank as fast as possible with no resistance. Once peak RPMs were achieved, the 5% resistance was placed against the flywheel and the participant continued to crank against the resistance for 30-seconds.
- Peak power and mean power were recorded from the arm ergometer test.
- A Pearson correlation coefficient was used to examine the relationship between the peak power achieved during the swim power test and the arm ergometer test.
- An alpha level of $p < 0.05$ was set to indicate statistical significance for all statistical analyses.

Figure 1a. A Power Tower.

Figure 1b. A Monark Arm Ergometer.

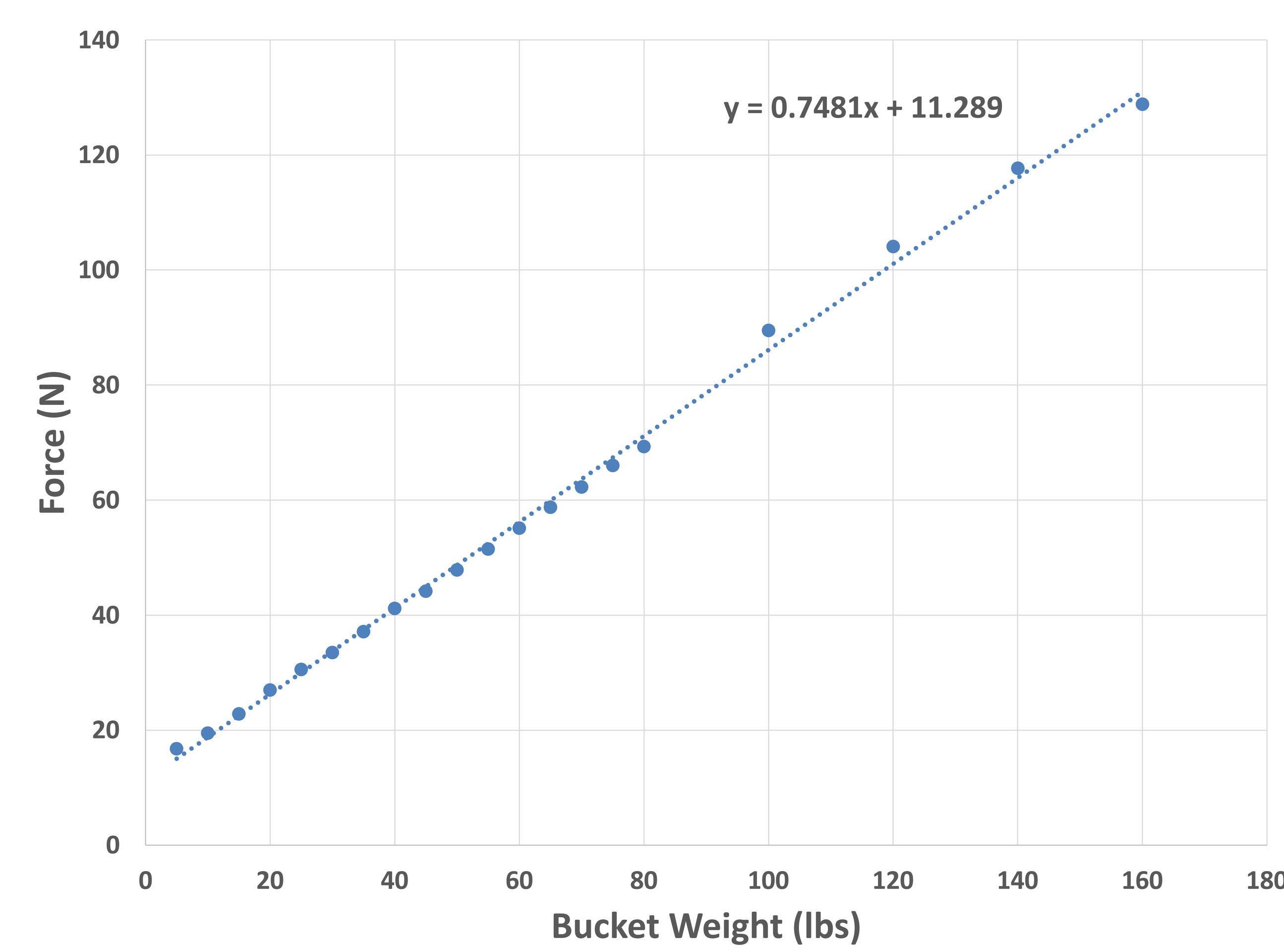

Figure 2. Power Tower calibration curve.

- The power towers were calibrated via a force transducer.
- This calibration allowed us to know if equal weights yielded the same force across each power tower.

Results

- The Pearson correlation was found to be significant, $R^2 = 0.64$; $p < 0.05$.
- Figure 3 depicts swim power calculated across swim bouts for both mean power and power per stroke.
- The swimmer represented in Figure 3 reached peak power at an approximate 85-pound load.

Results (continued)

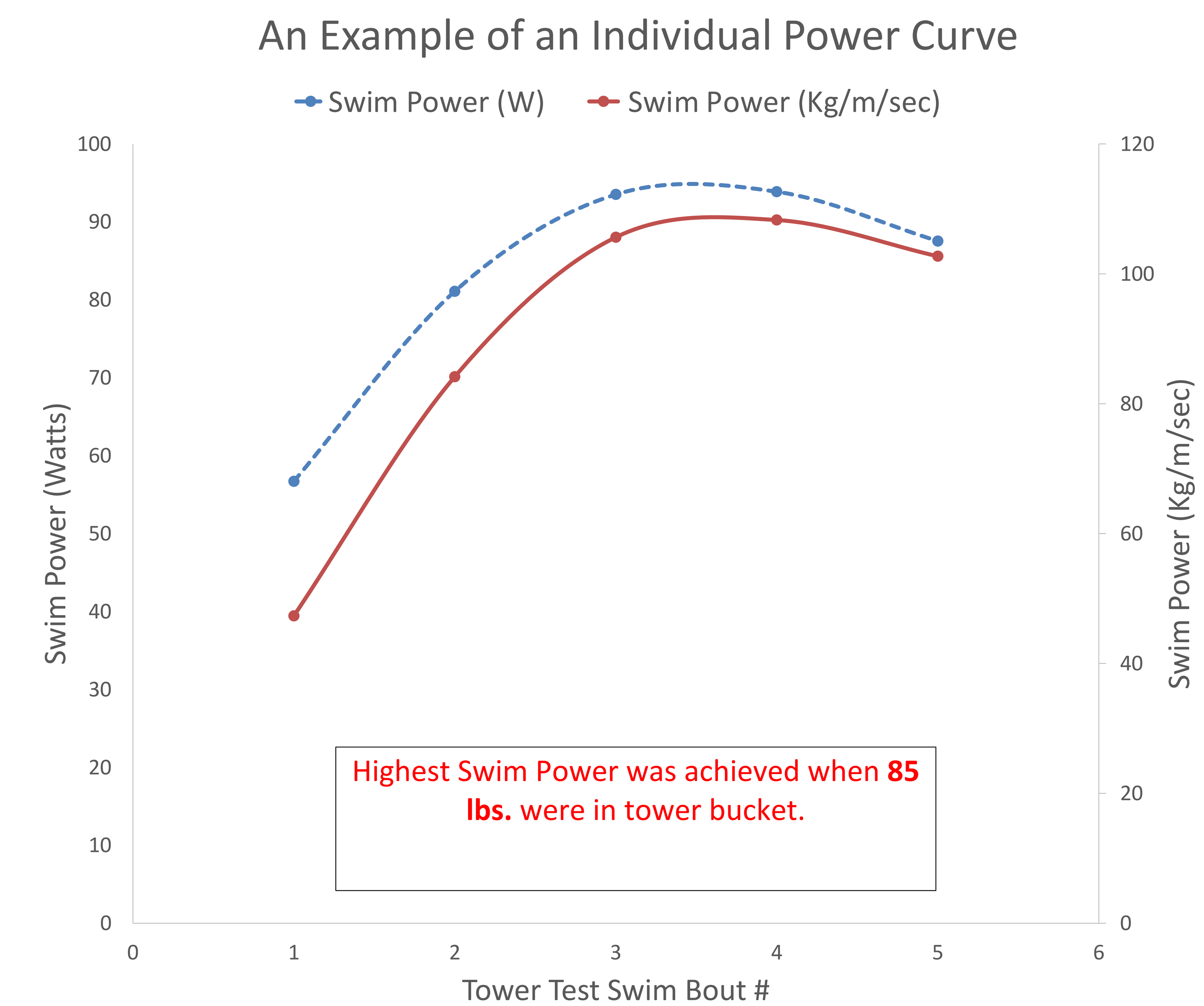

Figure 3. A Power Curve.

Discussion

- The attempts to estimate swim power without using sophisticated lab equipment appear to be promising.
- A relationship between power observed during swimming and power during an upper body arm ergometer was found to be significant.
- The findings from this project have the ability to aid swim coaches by providing simple methods to assess swim power. Once peak power is found, a coach can decide what percentage of that load they want that swimmer to train at to achieve specific goals.

Conclusions

- We were able to estimate swim power using a commercial pulley-based training device.
- We found a positive relationship between peak swim power in the water and peak power performed during an arm ergometer test in the laboratory.

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