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# Reliability and validity of PowerCal power distribution during cycling time trial

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## Abstract

**Background:** The PowerCal device (Cyclops, Madison, USA) is a heart rate (HR) strap that estimates power output (PO) using an algorithm computed from the HR response recorded during exercise. The device is a low-cost method (~ 99 US dollars) compared to the traditional power meters (~ 700-3000 US dollars) of getting a rough order of magnitude of the power level on a given ride. Furthermore, PowerCal is a low complex set up device and it does not use any calibration system to start getting use. Collectively, those features seem to be an advantage for cyclists to control and monitor training and racing. To the best of our knowledge, we do not found studies about the PowerCal power estimation. PowerCal is a new device and its error of measurement still needs to be investigated in different modes of exercise.

**Purpose:** The aim of this study was to determine the reliability and validity of the PowerCal power distribution during cycling time trials.

**Methods:** Fifteen well-trained male cyclists ( $35.2 \pm 9.8$  years;  $74.1 \pm 4.4$  kg,  $178.3 \pm 4.9$  cm; maximal oxygen uptake,  $62.0 \pm 5.6$  mL.kg<sup>-1</sup>.min<sup>-1</sup>) reported to the laboratory on three separate occasions. First, cyclists completed a maximal incremental exercise test to determine their physiological parameters. Then, cyclists completed two self-paced 20-km time trial (TT) each separated by ~72 hours. All testing were conducted on an electronically braked cycle ergometer (Velotron Dynafit Pro, RacerMate Inc, WA, USA). During the TT cyclists used the PowerCal. Participants were able to view their progress over the course on a computer monitor and were provided with information on distance completed and gear selected; all other information was blinded to remove any potential pacing effect (i.e. PO, HR, cadence, speed). Furthermore, no verbal encouragement was provided that could possibly interfere with an individual's pacing effort.

**Results:** The coefficient of variation (CV) of the mean PO during the TT of the Velotron was lower (0.8%) than PowerCal (2.6%). Also, the Velotron CV over a distance of 1 km during the TT was high (~5%) in the beginning and in the final meters of the trial. In contrast, the PowerCal CV was higher than Velotron over the middle part of the TT (Figure 1). The mean PO of the PowerCal was significant lower ( $234 \pm 23$  W) than Velotron ( $271 \pm 23$  W) ( $P < 0.01$ ). Also, the mean PO showed high bias (43 W) and limits of agreement ranging from -44 to 130 W between the Powercal and Velotron. Figure 2 shows that the distribution of PO was significant lower for the PowerCal compared to the Velotron over the TT ( $P < 0.05$ ).

**Discussion:** The PowerCal is a new device designed to estimate PO from HR, but its validity are dubious. From the practical point of view, even the device generate a reliable mean PO the use of the PowerCal during TT events will underestimate the "real" PO. It's expected that adaptations of training can effective decrease sub-maximal HR combining with enhancement in PO of the cyclists. However, the individual data from the Powercal shows that cyclists with lower HR are able to output lower power during the TT.

**Conclusion:** Thus, we do not recommend competitive cyclists or sport science researchers use the PowerCal if valid PO information is required during TT events.

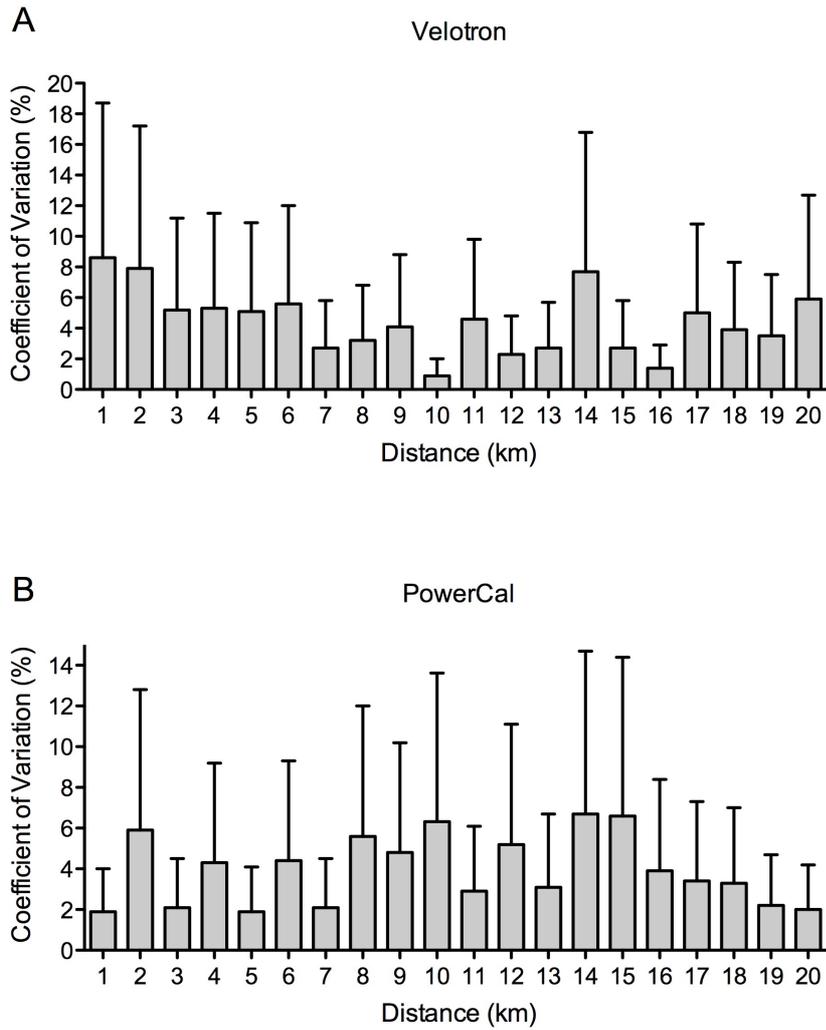


Figure 1: Coefficient of Variation (CV) of the Velotron (A) and PowerCal (B).

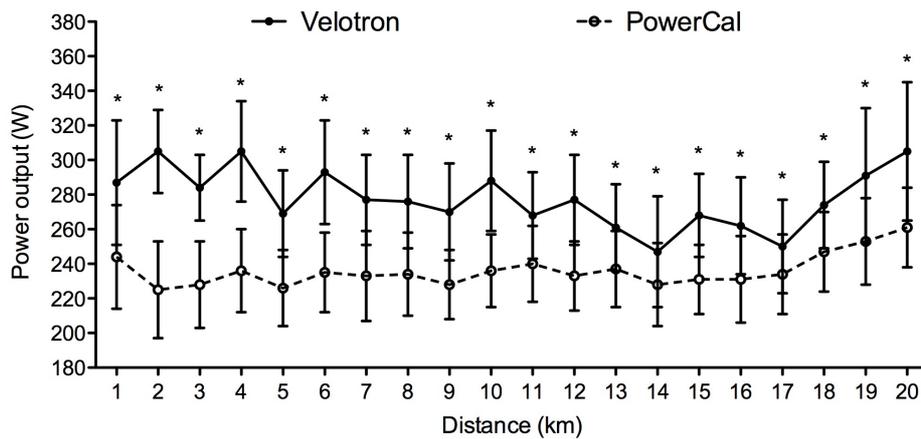


Figure 2: Power output distribution during the 20-km time trial

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