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Validity and Reliability of the Powertap P1 Pedals Power Meter

Keywords: cycling, mobile power meter, testing, cycle ergometer, power output.

ABSTRACT

Introduction:

Several valid and reliable laboratory specialized ergometers and power meters have been developed so far to monitor exercise performance while cycling. It should be noted that it is not possible to use them for field testing. In addition, even if the cyclist can customize the position of the ergometer´s handlebars, saddle and pedals (not always possible), there would be considerable variations with their own bicycles in some decisive metrics such as the crank width (Q–factor), crank length, and other differences related to the specific geometry of the bicycle itself. Currently, there are some mobile power meters whose validity and reliability have been confirmed, but the recent development of the Powertap P1 pedals (PP1, CycleOps, Madisson, USA) has introduced another mobile power measuring tool to the market with a reduced price. It allows cyclists to use their own bicycle in tests or training sessions carried out on laboratory ergometers, indoor trainers, rollers or in the field, by just replacing the pedals. The purpose of this study is to examine their validity, reliability and accuracy of a new powermeter placed in the pedals of the bike under laboratory cycling conditions.

Method:

33 cyclists performed 12 randomized and counterbalanced graded exercise tests (100–500 W), at 70, 85 and 100 rev·min^{-1} cadences, in seated and standing positions. The rear wheel of a bicycle (fitted with the SRM 172.5 mm crank power meter), was removed and attached to a direct drive pedalling unit Cycleops Hammer (Lillo-Bevia & Pallares, 2017). A scientific SRM system and a pair of PP1 pedals continuously recorded cadence and power output data. Standard statistical methods were used for the calculation of means, standard deviations (SD), coefficient of variation (CV) and standard error of the mean (SEM). Spearman's rank–order correlation coefficients were calculated comparing the power outputs values of the SRM and the PP1 power meters during every graded exercise test. Additionally, Bland–Altman plots were used to assess and display the agreement and systematic difference among the SRM and PP1 power outputs values (Bland & Altman, 1999).

Conclusions:

The main results show that this new portable power meter is a valid and reliable device to measure power output in cyclists and triathletes for the assessment, training and competition using their own bicycle. Despite the fact that, according to the data collected in the present study, there are small but significant differences between the mean power output values obtained by the PP1 pedals and the SRM scientific model, there are highly significant, “near perfect”, relationships (rho ≥ 0.987; p < 0.001) from 100 W to 350 W with seated position at low, medium and high cadences. The previous concordance is reduced for standing free–chosen pedalling (rho = 0.927; p < 0.001) (figure 1). Besides, this study has

found very small bias and SD of bias in the agreement between the SRM and PP1 power output data, as well as between SRM and PP1 cadence (from -2.4 ± 4.8 W to -9.0 ± 5.3 W), both for the standing and seating pedalling positions. Nevertheless, it is important to be conscious that this portable power meter slightly underestimated the power output data in a directly proportional manner to the pedalling cadence (from -2.4 W at 70 rev·min^{-1} to -7.3 W at 100 rev·min^{-1}), independently of the cycling workload or pedalling position.

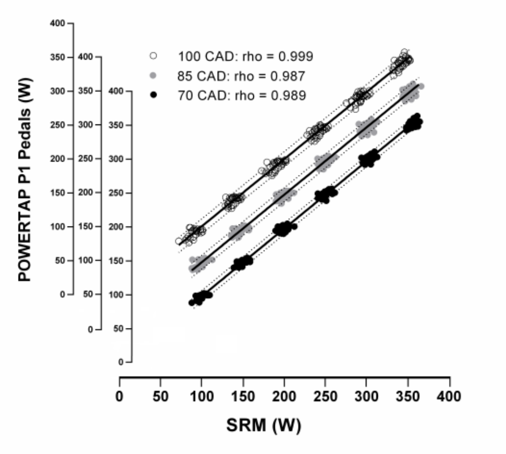

Figure 1. Spearman´s Correlation Coefficient of the Powertap PP1 pedals under three different cadences, during the submaximal graded exercises tests, compared to the scientific SRM power meter at 70, 85 and 100 rev·min-1.

These results are consistent but progressive. When used in laboratory and compared to the SRM crankset, similar mean and SD biases, as well as the 95% limits of agreement data, were reported for other mobile power meters, such as Garmin Vector Pedals (Bouillod, Pinot, Soto-Romero, Bertucci, & Grappe, 2016; Nimmerichter, Schnitzer, Prinz, Simon, & Wirth, 2017) (0.6 ± 6.2 W, 11.6 to 12.7 W; -11.6 to 12.7 W, -3.7 to 9.5 W), Powertap Hub (Bertucci, Duc, Villerius, Pernin, & Grappe, 2005) (2.9 ± 3.3 W; -3.7 to 9.5 W), and Look Keo Power Pedal (Sparks, Dove, Bridge, Midgley, & McNaughton, 2015) (4.6 ± 0.4 W; -15.9 to 13.9 W). Bouillod, et al. (2016) found higher mean and SD biases when the SRM crankset was compared with the Stages (-13.7 ± 12.4 W, -37.9 W to 10.6 W). This new portable power meter provides an alternative to more expensive laboratory ergometers, allowing cyclists to use their own bicycle for testing, training or competition purposes.

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