BOOK OF ABSTRACTS Open Access

Validity of Track Aero System to assess aerodynamic drag in professional cyclists

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Abstract

Purpose: Aerodynamic drag is the main resistance (80---90 %) among the total resistive forces (RT, N) opposing motion on level ground in cycling. It is important to decrease it to improve the performance in time---trial (TT). In order to decrease the aerodynamic resistance, it is important to evaluate it accurately (Debraux et al., 2011). Even if the wind tunnel is considered as a reference due to its reliability and sensitivity in detecting small changes in aerodynamic drag, this technique is very expensive and presents some methodological limitations. Garcia---Lopez et al. (2014) demonstrated the validity of velodrome tests for evaluating aerodynamic drag. Following the evolution of technology in sport science, a Track Aero System (TAS, Alphamantis, Montreal, Canada) has been recently created to display the aerodynamic drag coefficient (ACd, m2) in real---time. The aim of this study was to compare the measurement of ACd between the TAS and the classical indirect method (Grappe et al., 1997; Garcia--Lopez et al., 2014).

Methods: 9 professional road cyclists exercised with their personal TT bike on a covered velodrome (Roubaix, France). Three sets of measurements were performed in different positions: 1) reference position, 2) position after a first change and 3) position after a second change (to try to again decrease ACd). For each position, the cyclists performed an incremental exercise at different speeds (V), performing a total of 37 laps. ACd was determined from the classical indirect method with the RT-V2 linea regression(Grappe et al., 1997) and from the TAS. RT was determined from the measurement of PO (W) and speed (m.s---1) with a SRM powermeter (SRM Dura Ace 9000, Schoberer Rad Messtechnich, Julich, Germany). The TAS combined wireless timing measurements, the cyclists' speed and power sensors. Moreover, it takes into account ride height, drive train efficiency and the track geometry.

Results: For each tested position, a significant difference was found between the ACd measured with the TAS and the indirect method ($p < 0.001$). Fig. 1 shows that ACd was underestimated with the indirect method. The mean value for the 3 tested positions was lower (---13.6 %, $p < 0.001$) with the indirect method (0.199 ± 0.013 m2) compared to the TAS (0.226 ± 0.010 m2).The ACd was not significantly affected by the position changes. However, a strong correlation ($r = 0.94$, $p < 0.001$) was found between the ACd changes in the two methods. The mean change was similar between the TAS and the indirect method (---1.6 ± 3.1 % vs. ---1.5± 2.8 % respectively).

Conclusions: This is the first study that analyse the validity and sensitivity of the TAS for assessing ACd during real---time cycling locomotion on velodrome. The results demonstrate a high sensitivity with the TAS and the indirect method to detect small changes in aerodynamic position. Other studies performed with portable power meters have also demonstrated a high sensitivity in detecting major/minor changes in aerodynamic positions (Grappe et al., 1997; Garcia---Lopez et al., 2014). Additionally, the results show that the indirect method underestimated ACd. The TAS computed the energy stored in the curve using track geometry. Indeed, in the velodrome curves, the centrifugal force increases V and decreases PO. This induces a decrease in ACd with the indirect method while the TAS took into account this physical phenomenon.The TAS is a very valuable and relevant system that allows the ACd measurements in real time with a high validity and sensitivity.

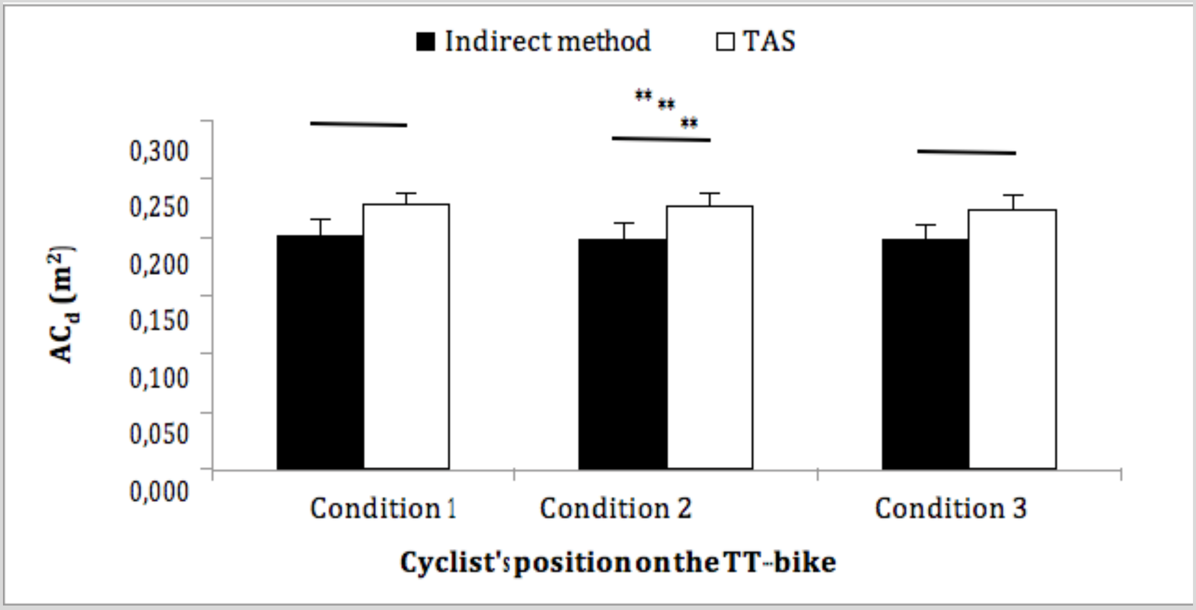

Figure 1: ACdobtained with the TAS and the indirect method in different positions. ** Significant difference ($p < 0.001$)

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