**Appendix A: Methodological Details**

*Power Meter Calibration Checks*

Mechanical checks of each power meter used in this study were performed by comparing 20 units to a dynamometer from 100 to 500W (inter-unit analysis) and one unit referenced 20 times (intra-unit analysis). Results from both the inter-unit (r = 0.9998) and the intra-unit (r = 0.9999) regressions of the power meter – dynamometer relationship illustrate the reliability and validity of the units. This is similar to the findings from others (Bertucci et al., 2005). Additionally, prior to every use, each power meter was calibrated against a zero load according to the manufacturer’s instructions.

*Metabolic Cart Calibration*

Before each test, gas fractions were calibrated against a primary standard within the physiologic range (15% O2, 5% CO2), while the pneumotach was calibrated using a 3-liter syringe at 5 distinct flow rates between 50 and 300 l·min-1(ATPS). In addition, a 2-minute mechanical check was performed before and after each test using the primary standard and a flow rate of 60 l·min-1 (ATPS). From pre- to post-mechanical checks, ventilation measures remained within 1% and gas fractions within 0.3% of original calibration values.

*Field Measured Aerodynamic and Rolling Resistance and Projected Frontal Area Profiling*

Within three weeks of the time trial, aerodynamic and rolling resistances were calculated by measuring the power versus velocity relationship while subjects rode a level section of road on the bicycle they used during the time trial, as described previously (Edwards & Byrnes, 2007; Lim et al. 2011). Briefly, since velocity affects the actual aerodynamic resistance faced by a cyclist, it is easier to describe the aerodynamic character of a cyclist independent of velocity. The constant k represents the aerodynamic character of a cyclist independent of velocity, and equals half the product of air density (ρ), projected frontal area (AP), and the drag coefficient (Cd).

(1) k = 0.5 ρ · AP · Cd

With a measure of air density, it is then straightforward to remove all environmental effects and reduce equation 1 to only those terms that reflect the aerodynamic characteristics of the rider. That is, the product of the projected frontal area and the drag coefficient, a term referred to as the drag area (Ad) (Pugh, 1974; Kyle, 1991; Grappe et al., 1997; Martin et al., 1998; Jeukendrup & Martin, 2001).

(2) Ad = AP · Cd

 The above variables were determined in the field. A cyclist’s tractive resistance, which can be determined from field measures of power and velocity (power output · velocity-1 = Force (N)), was plotted against the square of velocity (v2) across a broad range of power outputs (100, 200, 300, and 400 Watts) and a linear regression was performed (di Prampero et al., 1979). From this relationship, the cyclist’s aerodynamic resistance (slope) and rolling resistance (intercept) were calculated. The slope of the relationship is equal to the constant k. With a value for k, along with the air density and AP (described below), equation 1 can be solved for Cd. The measured AP and calculated Cd can then be used to determine Ad using equation 2.

Rolling resistance was determined as the intercept of the force versus velocity relationship described above. The following equation for rolling resistance was also used to calculate the dimensionless coefficient describing the quality of the tire and road interface (Cr), which is dependent upon the total mass of the bicycle and rider (mTOT), the acceleration of gravity (g), and rolling resistance (Rr) (Grappe et al., 1999).

(3) Rr = mTOT · g · Cr

*Projected Frontal Area*

Projected frontal area was determined based on the recommendations of Olds and Olive (1999). Digital photographs (Nikon Cool Pix 4300, Melville, NY) of the subjects were taken while subjects sat in a riding position on the bicycle they used during the time trial, which was mounted on a stationary trainer. The camera was set at the level of the handlebars 3 meters away from the edge of the front wheel. The shortest focal length available on the camera was used to fill the cyclist within the frame. The camera was set in its “best shot selection” mode allowing the most focused of ten automatically shot photos to be selected. Photos were taken of each cyclist in the body position used during the time trial and in different foot positions – random pedaling, with feet at the 3 and 9 o’clock position, and with feet at the 6 and 12 o’clock position. For each subject a reference board with 10 cm square tracings was also photographed. The reference board was set perpendicular to and directly over the center of the top tube of the bicycle. All photos were downloaded to an Apple G4 computer for analysis. Photographs were analyzed using NIH Image 1.62 software. This software, after calibration against a known distance or area, automatically calculates the area of a given tracing. Projected frontal area was calculated from tracings of the subject’s body and helmet only with the bicycle excluded. To enhance the objectivity of our AP determinations, three independent observers performed three tracings for each subject in each body and foot position. No difference was found within or between observers for measures of projected frontal area for any subject. In addition, no difference was found within or between observers for the three distinct foot positions. The mean from all observers and all foot positions was used for data analysis and reported measures of projected frontal area.

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