Power output during uphill cycling can be estimated based on 1) the heart rate – power output relationship or 2) the mathematical relationship between cycling speed, power output and estimates of resistive forces. The purpose of this study was to explore the utility of directly quantifying the power output – cycling speed relationship for a hill-climb of interest. Validation Trials – Nine male road cyclists who were members of the AIS-SA.com continental cycling team cycled up a 2.4km, 8.9% climb (Black MTN) twice per day for 1-4 days. Dynamically calibrated SRM power meters (4 sg version) were used quantify power and speed during hill climbs (1Hz) and a time trial format was used for all climbs. A complete data set was collected for 56 climbs. The relationship between average power-to-mass and average speed for efforts <18 kph (n=42) was established using linear regression analysis. This regression equation was used to estimate the average power output ($W \cdot kg^{-1}$) associated with faster climbs – 18.0-19.5 kph (n=14). Alpe d’Huez Trials – Using a similar approach, SRM power–speed data were collected from cyclists and triathletes (n=7) who were either training or competing on Alpe d’Huez (13.8km, 8.1%). A power-speed regression was calculated for the first two hill-climb split times recorded during the 2004 Tour de France (bottom 7.45km, 9.0%; top 3.5km, 8.3%). The initial and final segments of the time trial were not evaluated because cycling speeds >30 kph would introduce assumptions associated with aerodynamic drag. During Black MTN trials average speed ranged from (13.2-17.9 kph) and corresponding power ranged from (4.1-5.9 $W \cdot kg^{-1}$). Average power-to-mass could be predicted by average climbing speed; Power($W \cdot kg^{-1}$) = .3411*Speed(kph) – .229; $R^2=.93$; P<.001; N=42. This equation predicted average $W \cdot kg^{-1}$ for climbing speeds 18.0-19.5 kph within .15 $W \cdot kg^{-1}$ in 14 validation cases (predicted vs estimated was < .1 $W \cdot kg^{-1}$ in 11/14 cases) confirming good predictability beyond the data set when climbing speeds were <25 kph. For the Alpe d’Huez trials average speed was between 11-18 kph and average power was between 2.8-5.2 $W \cdot kg^{-1}$. The two equations for predicting hill climbing power were – Bottom; Power($W \cdot kg^{-1}$) = .3303*Speed(kph) – .9184; $R^2=.93$; P<.001; N=13 and Top; Power($W \cdot kg^{-1}$) = .3101*Speed(kph) – .8136; $R^2=.96$; P<.001; N=11. Overall, it took Armstrong 31:36 to climb 11 km at 8.8% which equates to an average cycling velocity of 20.8 kph. This velocity would require 5.85 $W \cdot kg^{-1}$ total mass or 6.5 $W \cdot kg^{-1}$ body mass. Assuming Armstrong’s 2004 time trial up Alpe d’Huez was well paced and that his total mass was 79 kg, then his time of 39 min and 41 sec for the 15.5 km TT would have required an average power output of 460 W. Cycling power meters can be used to establish the power-to-mass speed relationship for climbs with an acceptable degree of accuracy.

Keywords: Power, Cycling, Performance Diagnosis