P-02

A NEW DEVICE TO ESTIMATE VO_2 DURING CYCLING ON INCLINES BY ACCELEROMETRY AND BAROMETRY

Shigeki Ikegawa, Yuji Takahashi, Yoshi-ichiro Kmaijo, Yoshiyuki Okada, Ken Miyagawa, Mayuko Morikawa, Hirokazu Genno, Shizue Masuki, and Hiroshi Nose

Dpt. of Sports Med. Sci, Shinshu Univ Grad. Sch. of Med., Inst. for Biomed. Sci., Shinshu Univ., and Jukunen Taiikudaigaku Res. Ctr, Matsumoto 390-8621, Japan.

Purpose: Recently, cycling exercise has been highlighted for health promotion for across young to older generations; however, there have been few devices to estimate energy expenditure during cycling in the field including inclines. We have already developed the calorimeter (JD-Mate, Kissei Comtec, Matsumoto) to estimate energy expenditure (VO_2, ml/kg/min) during walking on inclines from the equation of VO_2 = aVM + bHu + cHd, where VM (G) is a vector norm of 3 dimensional accelerations measured with a tri-axial accelerometer, and Hu and Hd (m/min) are uphill and downhill speeds, respectively, measured with a barometer. Based on these results, in the present study, we newly determined the values of a, b, and c in order to estimate energy expenditure during cycling on inclines.

Methods: First, we had 5 male and 2 female adults (28-57 yr) perform cycling trials on the level ground at the speeds of 5, 10, 15, 25 km/h for 5 min during which period we measured VM with the above calorimeter and VO_2 with a portable respiratory gas analyzer (Metamax 3B, Cortex, Leipzig) and determined the value of a. Second, we had 8 male and 1 female adults (25-57 yr) performed 2 cycling trials at subjective slow and fast speeds on the incline; 1150m horizontal distance and 62m altitude distance, by the protocol of 5-min rest at the highest altitude, downhill cycling to the lowest altitude, 5-min rest at the lowest altitude, and uphill cycling to the highest altitude in that order, and then, we determined the values of b and c from VM and VO_2 measured during the trials. Finally, to validate the precision of the equation, we had 5 male and 2 female adults (28-57yr) perform cycling on the outdoor course composed of level, uphill, and downhill roads; 2,500m horizontal distance and 15m altitude distance, and the compared VO_2 estimated from the equation and VO_2 measured with the respiratory gas analyzer during the trial. .

Results: The values that we determined are a = 0.129 ± 0.027 (mean ± SE, ml/kg/G), b=1.534 ± 0.357 (ml/kg/min (m/min)), and c= 0.311 ± 0.097 (ml/kg/min (m/min)). The eVO_2 estimated by the equation; eVO_2 = 0.129 VM + 1.534 Hu + 0.311 Hd, was highly correlated with mVO_2 measured with the respiratory gas analyzer ($r = 0.923$, $P<0.0001$) with a regression equation of eVO_2 = 0.994 mVO_2 with a mean difference of 0.17 ± 4.36 (mean ± SD) over the range of 0.0 - 25.9 ml/kg/min

VO_2 by Bland-Altman analysis.
Conclusions: We have successfully determined the equation to estimate VO_2 precisely during cycling exercise on outdoor roads including inclines using the calorimeter.

Key words: cycling exercise, inclines, outdoor, calorimeter, VO_2 estimation