

Oxygen Uptake, Form Power, and Form Power Ratio Responses during Walking at Variant Slopes and Cadences

Jooyoung Lee, Saemi Park, Somang Son, Jihwan Park, Jaeyeop Lee, Dae Taek Lee

Exercise Physiology Laboratory, Kookmin University, Seoul, Korea, Republic of.

ABSTRACT

Purpose: This study investigated the effects of walking slope and cadence on oxygen uptake (VO_2), Form Power (FP), and Form Power Ratio (FPR).

Methods: Nine healthy women (23.7 ± 1.3 years, 160.8 ± 3.5 cm, 58.1 ± 8.9 kg) participated in this study. They performed treadmill walking at 3.5 km/h under five gradients: level (0%), uphill and downhill ($\pm 10\%$, $\pm 20\%$). Preferred step frequency (PSF) was determined during 5 min of walking at each gradient. Then five variant cadences (80%, 90%, 100%, 110%, and 120% of PSF) were determined. They completed 25 (5 slopes x 5 cadences) randomized 5-min walking trials, each separated by 3 ± 2 min of rest. VO_2 was measured using a COSMED K5, while body mass-normalized FP and running power were obtained using a Stryd sensor. FPR (%) was calculated as FP divided by running power $\times 100$. Data from the 5-min period of each trial were averaged. A two-way repeated-measures ANOVA examined the effects of slope and cadence on VO_2 , FP, and FPR.

Results: VO_2 showed significant main effects of slope ($p < .001$) and cadence ($p = .044$), without a significant interaction ($p = .230$). FP exhibited significant main effects of slope ($p = .002$) and cadence ($p < .001$), and a significant interaction ($p = .001$). FPR showed a significant cadence effect ($p < .001$) and interaction ($p < .001$), but not in slope ($p = .126$). FP and FPR increased markedly at higher cadences during downhill walking at -10% and -20% slopes.

Conclusion: Walking slope and cadence differentially influenced VO_2 , FP, and FPR. While VO_2 was primarily affected by slope, FP and FPR showed pronounced increases at higher cadences during steep downhill walking, highlighting distinct physiological and Stryd-derived mechanical responses to walking conditions.

Keywords: walking biomechanics; incline and decline walking; locomotion; metabolic cost; step frequency