

# A Treadmill Ramp Protocol Using Simultaneous Changes in Speed and Grade

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## ABSTRACT

PORZASZ, J., R. CASABURI, A. SOMFAY, L. J. WOODHOUSE, and B. J. WHIPP. A Treadmill Ramp Protocol Using Simultaneous Changes in Speed and Grade. *Med. Sci. Sports Exerc.*, Vol. 35, No. 9, pp. 1596–1603, 2003.

**Introduction:** A treadmill exercise test requiring a low initial metabolic rate that then increments the work rate linearly to reach the subject's limit of tolerance in approximately 10 min would have significant advantages for exercise testing and rehabilitation of subjects with impaired exercise tolerance.

**Methods:** We developed such a treadmill protocol that uses a linear increase in walking speed coupled with a curvilinear increase in treadmill grade to yield a linear increase in work rate. **Results:** Twenty-two healthy, sedentary subjects performed both this new treadmill protocol and a standard cycle ergometry ramp protocol eliciting similar work rate profiles. The low initial treadmill speed and grade resulted in a low initial metabolic rate, commensurate with unloaded pedaling on a cycle ergometer (average  $\dot{V}O_2 = 0.54 \pm 0.16$  vs  $46 \pm 0.12$  L·min<sup>-1</sup>). This combination of simultaneous increase in speed and grade yielded a linear work rate and its oxygen uptake response ( $R^2 = 0.96 \pm 0.03$ ) with a slope of  $11.4 \pm 2.4$  mL·min<sup>-1</sup>·W<sup>-1</sup> - slightly, but significantly, higher than on the cycle ( $9.6 \pm 2.0$  mL·min<sup>-1</sup>·W<sup>-1</sup>). This difference was attributed to unmeasured work associated, for example, with additional limb movements and frictional losses. As previously demonstrated, both the peak oxygen uptake and the estimated lactate threshold were higher on the treadmill than for cycle ergometry (averaging 23% and 27%, respectively, in these subjects). **Conclusion:** This treadmill protocol provides a linear profile of work rate as is currently standard for cycle ergometry and is appropriate for testing of subjects with low exercise tolerance.

**Key Words:** WALKING, CYCLING, EQUIVALENT WORK RATES, METABOLIC COST

0195-9131/03/3509-1596

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DOI: 10.1249/01.MSS.0000084593.56786.DA

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The Journal of the American College of Sports Medicine