

# Validation of the firefighter WFI treadmill protocol for predicting $\text{VO}_2$ max

B. A. Dolezal<sup>1</sup>, D. Barr<sup>2</sup>, D. M. Boland<sup>1</sup>, D. L. Smith<sup>2</sup> and C. B. Cooper<sup>1</sup>

<sup>1</sup>Department of Medicine and Physiology, Exercise Physiology Research Laboratory, David Geffen School of Medicine, University of California, Los Angeles, CA 90095, USA, <sup>2</sup>Department of Health and Exercise Sciences, First Responder Health and Safety Laboratory, Skidmore College, Saratoga Springs, NY 12866, USA.

Correspondence to: B. A. Dolezal, Department of Medicine and Physiology, Exercise Physiology Research Laboratory, David Geffen School of Medicine, 10833 Le Conte Avenue, CHS 37–131, University of California, Los Angeles, CA 90095, USA. Tel: +1 310 741 8954; fax: +1 310 206 8211; e-mail: bdolezal@ucla.edu

The Wellness-Fitness Initiative submaximal treadmill exercise test (WFI-TM) is recommended by the US National Fire Protection Agency to assess aerobic capacity ( $\text{VO}_2$  max) in firefighters. However, predicting  $\text{VO}_2$  max from submaximal tests can result in errors leading to erroneous conclusions about fitness.

**Aims** To investigate the level of agreement between  $\text{VO}_2$  max predicted from the WFI-TM against its direct measurement using exhaled gas analysis.

**Methods** The WFI-TM was performed to volitional fatigue. Differences between estimated  $\text{VO}_2$  max (mean  $\pm$  SD) and measured  $\text{VO}_2$  max (mean  $\pm$  SD) were compared using a paired t-test (p < 0.05). The mean bias and 95% prediction interval (PI) were calculated (mean bias  $\pm$  1.96 SD). The mean bias and 95% PI were compared to zero (mean bias  $\pm$  1.96 SD) using a paired t-test (p < 0.05). The mean bias and 95% PI were compared to zero (mean bias  $\pm$  1.96 SD) using a paired t-test (p < 0.05). The mean bias and 95% PI were compared to zero (mean bias  $\pm$  1.96 SD) using a paired t-test (p < 0.05).

$\text{VO}_2$  max was 0.9 ml/kg/min with a 95% prediction interval of  $\pm 13.1$ . Prediction errors for 22% of subjects were within  $\pm 5\%$ ; 36% had errors greater than or equal to  $\pm 15\%$  and 7% had greater than  $\pm 30\%$  errors. The correlation between predicted and measured  $\text{VO}_2$  max was  $r = 0.55$  (standard error of the estimate = 2.8 ml/kg/min).

**Conclusions** WFI-TM predicts  $\text{VO}_2$  max with 11% error. There is a tendency to overestimate aerobic capacity in less fit individuals and to underestimate it in more fit individuals leading to a clustering of values around 42 ml/kg/min, a criterion used by some fire departments to assess fitness for duty.

**Key words** Firefighters; fitness tests; physical fitness.