Cardiopulmonary responses to robotic end-effector-based walking and stair climbing

Authors: Oliver Stoller, Matthias Schindelholz, Lukas Bichsel, Kenneth J. Hunt
Published on: JJBE-2404

Abstract
Background: A recently developed robotic end-effector device (G-EO system, Reha Technology AG) can simulate walking and stair climbing. This approach has the potential to promote cardiovascular exercise training during rehabilitation. The aim of this study was to characterize cardiopulmonary responses of end-effector-based exercise in able-bodied subjects and to evaluate the feasibility of intensity-guided exercise testing.

Methods: Five healthy subjects aged 33.7 ± 8.8 years (mean ± SD) performed a constant load test and an intensity-guided incremental exercise test. The outcome measures were steady-state and peak cardiopulmonary performance parameters including oxygen uptake (VO2) and heart rate (HR).

Results: Passive end-effector-based stair climbing (VO2 = 13.6 ± 4.5 mL/min/kg, HR = 95 ± 23 beats/min) showed considerably lower cardiopulmonary responses compared to reference data (VO2 = 33.5 ± 4.8 mL/min/kg, HR = 159 ± 15 beats/min). Peak performance parameters during intensity-guided incremental exercise testing were: VO2 = 35.8 ± 5.1 mL/min/kg and HR = 161 ± 27 beats/min, corresponding to a relative VO2 = 76.0 ± 18.7% of predicted aerobic capacity and a relative HR = 87.3 ± 14.5% of age-predicted HR maximum.

Conclusion: End-effector-based exercise is a promising method for the implementation of cardiovascular exercise. Although end-effector-based stair climbing evoked lower cardiopulmonary responses than conventional stair climbing, active contribution during exercise elicited substantial cardiopulmonary responses within recommended ranges for aerobic training.