

ACADEMY OF SPINAL CORD INJURY PROFESSIONALS



Metabolic Testing For Exercise Intensity During Overground Robotic Exoskeleton Gait Training In Two Persons With Complete Tetraplegia



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CONTEXT

Participation in moderate-to-vigorous intensity physical activity (MVPA) is recommended to reduce the risk of developing chronic diseases associated with inactivity for individuals following spinal cord injury (SCI). Assessing exercise intensity using traditional methods (e.g., heart rate, rate of perceived exertion) may be inaccurate for individuals with high thoracic or cervical SCI (tetraplegia) due to neuromuscular and autonomic dysfunction resulting from incomplete sympathetic drive of the heart and vasculature. Utilizing direct gas analysis may be a more accurate method of assessing exercise intensity for individuals with tetraplegia. Overground robotic exoskeleton gait training (OEGT) can be physiologically demanding. Yet, its utility in facilitating MVPA in patients with chronic and acute complete tetraplegia has not been explored.

We present the results of two participants who completed one OEGT session with intensity assessed using a portable metabolic system and expressed in metabolic equivalents (METs).

FINDINGS

METs were calculated using a rolling 30-second average with 1 MET defined as 2.7 mL/kg/min and MVPA defined as MET \geq 3.0. Demographics, characteristics, and OEGT session outcomes are detailed in **Table 1**. Both participants tolerated activity well without observed adverse responses to activity.



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Table 1. Characteristics and OEGT Exercise Session Outcomes

Parameter	Participant A	Participant B
Characteristics		
Age (years)	28	21
Height (cm)	180.34	172.70
Weight (kg)	54.43	51.71
Body Mass Index (kg/m ²)	16.7	17.3
AIS Category	A	A
Level of Injury	C5	C4
Time Since Injury (months)	144	3
OEGT Session Outcomes		
Device Assist (Left/Right)	69/77	50/55
Up Time (minutes)	37.65	42.33
Walk Time (minutes)	28.90	40.50
Total Steps (#)	1,047	1,023
Average HR (bpm) and age predicted max (%)	112 (60)	76 (38)
Peak HR (bpm) and age predicted max (%)	133 (70)	106 (53)
Absolute VO ₂ (mL/min)	339.3 \pm 58.3	361.0 \pm 51.0
Absolute VO ₂ during MVPA (mL/min)	498.5 \pm 6.1	446.6 \pm 37.6
Relative VO ₂ (mL/min/kg)	6.2 \pm 1.1	7.0 \pm 1.0
Relative VO ₂ during MVPA (mL/min/kg)	9.2 \pm 0.1	8.6 \pm 0.7
Average METs	2.3 \pm 0.4	2.6 \pm 0.4
Average METs during MVPA	3.4 \pm 0.0	3.2 \pm 0.3
Duration of MVPA (minutes)	1	5
% of OEGT session in MVPA (%)	3	12

Note: Continuous data presented as mean \pm standard deviation, MVPA= moderate to vigorous physical activity; OEGT = overground robotic exoskeleton gait training; AIS = American Spinal Injury Association Impairment Scale; HR = heart rate; VO₂ = oxygen uptake; METs = metabolic equivalents.

CLINICAL RELEVANCE

OEGT may be an effective training modality to attain moderate intensity exercise patients with acute tetraplegia. However, chronicity of spinal cord injury may play a role in exercise intensity achieved.

Identifying exercise interventions for individuals with SCI to increase physical activity level may reduce the risk of developing chronic conditions associated with sedentary behavior.

Figure 1. Utilization of a portable metabolic system to assess exercise intensity during OEGT in a patient with chronic tetraplegia



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