

Introduction

- The energetic cost of walking (C_w) is defined as the amount of oxygen consumed per kilogram of body weight per unit distance walked.
- C_w is higher in persons with multiple sclerosis (MS) than healthy controls and influences fatigue and daily activity.
- Spasticity of ankle plantarflexors might influence C_w , and alterations in gait parameters may explain this association between spasticity and C_w .

Purpose

The current study examined the associations among C_w , spasticity of the ankle plantarflexors, and spatiotemporal gait parameters in persons with MS who had moderate disability.

Methods

PARTICIPANTS: 44 persons with MS who had Expanded Disability Status Scale scores between 4.0 and 6.0 (i.e., a benchmark of moderate mobility disability indicative of the 2nd stage of MS)

MEASUREMENTS:

Energetic Cost: O_2 consumed per kilogram of body weight per unit distance traveled during last three minutes of the 6-Minute Walk (steady-state VO_2)

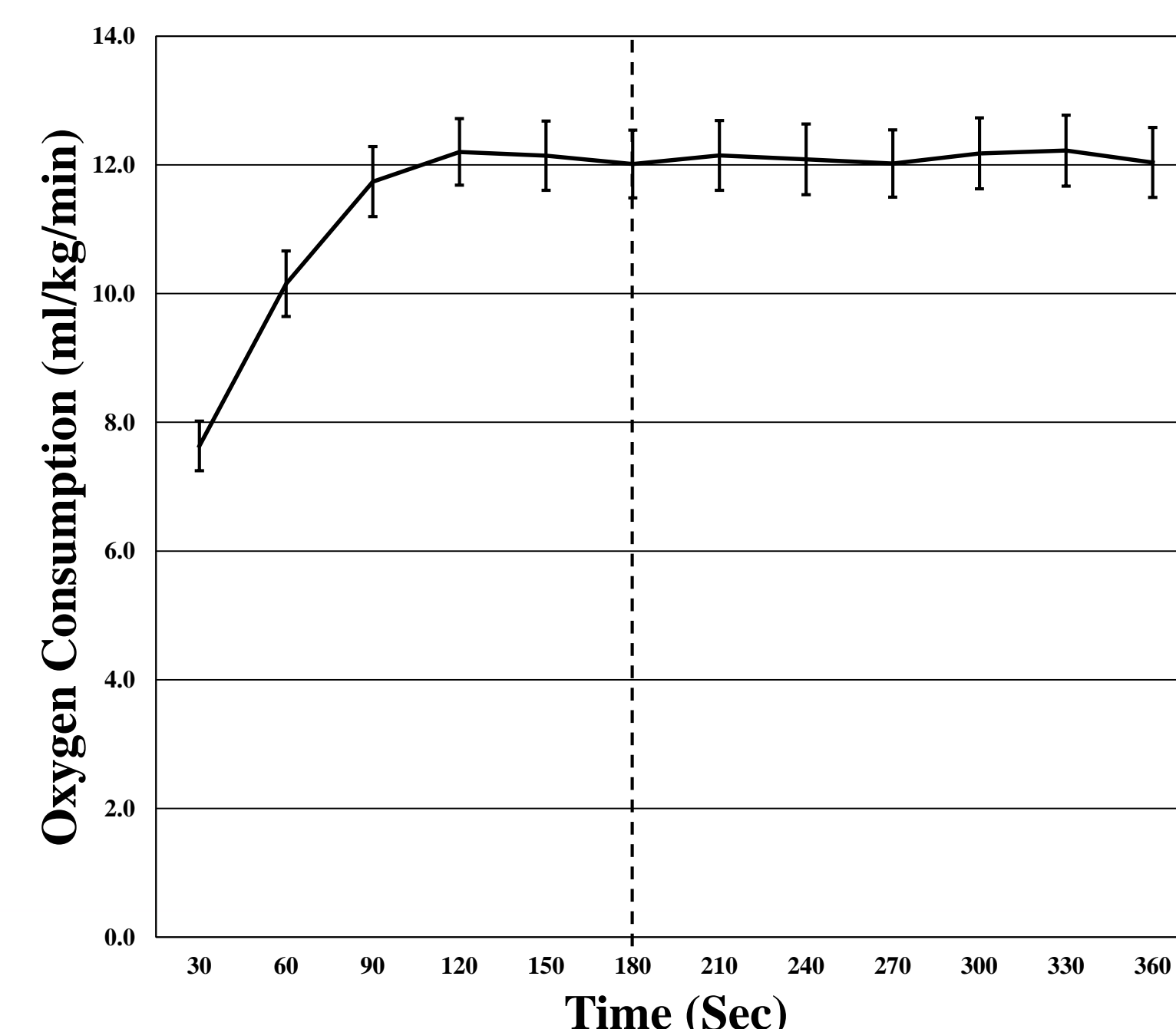


Figure 1. Oxygen consumption over a six-minute walk test in the sample of persons with MS (n=44).

Methods Continued

Spasticity: Measure of hypertonia of ankle plantarflexors on a five-point scale, ranging from 0 (no increase in muscle tone) through 4 (fixed contracture) using the Modified Ashworth Scale

Gait Parameters: Measure of cadence (steps/min) and step length (cm) from 4 walking trials on a 16-foot GAITRite electronic walkway at comfortable pace

Results

Table 1. Descriptive statistics of spasticity, cadence, step length, and C_w

Measurement	Mean (SD)
MAS	1.59 (1.04)
Cadence (steps/min)	95.25 (20.26)
Step length (cm)	53.80 (14.75)
C_w ($ml \cdot kg^{-1} \cdot m^{-1}$)	0.17 (0.07)

Note: Mean (SD); MAS, Modified Ashworth Scale

Table 2. Summary of correlations among spasticity, cadence, step length, and C_w

	1	2	3	4
1. MAS	--	--	--	--
2. Cadence (steps/min)	-0.45*	--	--	--
3. Step length (cm)	-0.40*	-0.40*	--	--
4. C_w ($ml \cdot kg^{-1} \cdot m^{-1}$)	0.52*	-0.59*	-0.56*	--

Note: MAS, Modified Ashworth Scale; * $p < 0.05$, two-tailed test

Table 3. Summary of regression analysis for spasticity, cadence, and step length predicting C_w

	C_w		
	B	SE B	β
Step 1			
MAS	0.039	0.010	0.522*
Note: $R^2 = .272$ for model ($p < .01$)			
Step 2			
MAS	0.024	0.010	0.320*
Cadence	-0.002	0.000	-0.451*
Note: $R^2 = .435$ for model ($p < .01$)			
Step 3			
MAS	0.018	0.010	0.248
Cadence	-0.001	0.001	-0.339*
Step length	-0.002	0.001	-0.302*

Note: $R^2 = .501$ for model ($p < .05$)

Note: MAS, Modified Ashworth Scale; * $p < 0.05$; B Unstandardized Beta, SE B Standard Error of Beta, β Standardized Beta

Discussion

- Spasticity of the ankle plantarflexors was significantly associated with C_w measured during over-ground walking in persons with moderate MS.
- Persons with moderate MS who have higher levels of spasticity demonstrate slower cadence and shorter stride length.
- The identification of cadence and step length as intervening variables of the association between spasticity and C_w indicates that altered spatiotemporal gait parameters might result in the energetic penalty of walking brought upon by spasticity in those with MS who have moderate mobility disability.

Future Directions

- Research might consider the application of a therapeutic, rehabilitation intervention for managing spasticity to possibly reduce C_w among persons with MS who have moderate mobility disability.
- Such interventions may result in secondary benefits including management of fatigue and improvement in quality of life in persons with MS.

