

Changes in Step Down Kinematics Following 16 Weeks of Supervised Progressive Resistance Training for People with Multiple Sclerosis

Bradley J Bowser, PhD¹, Cathleen Brown, PhD, ATC², Lesley White, PhD², & Kathy Simpson, PhD²

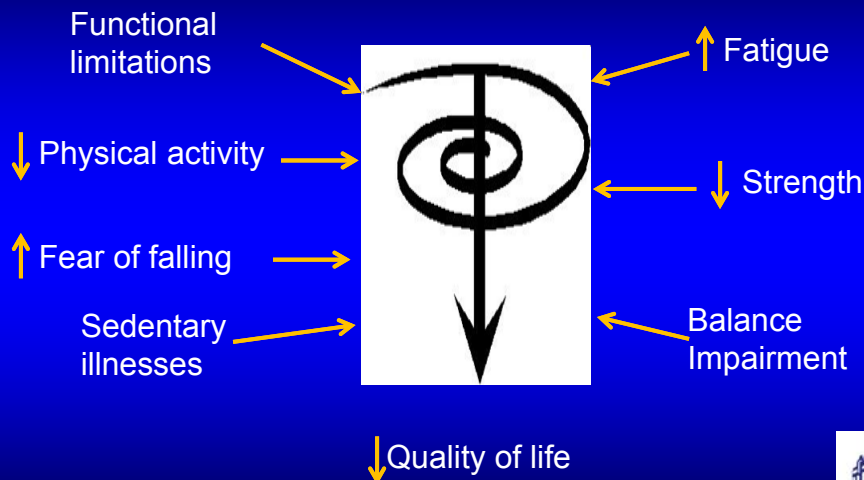


fitkonline.com



¹South Dakota State University, ²University of Georgia

Disability and MS



(Bowser et al, 2014; Filipi et al, 2011; Latash, 2008; Mottl, 2008)



Stair Descent

Common & functionally demanding activity of daily living

Suggested to require greater leg strength & dynamic balance than level walking

(Silverman et al., 2014)



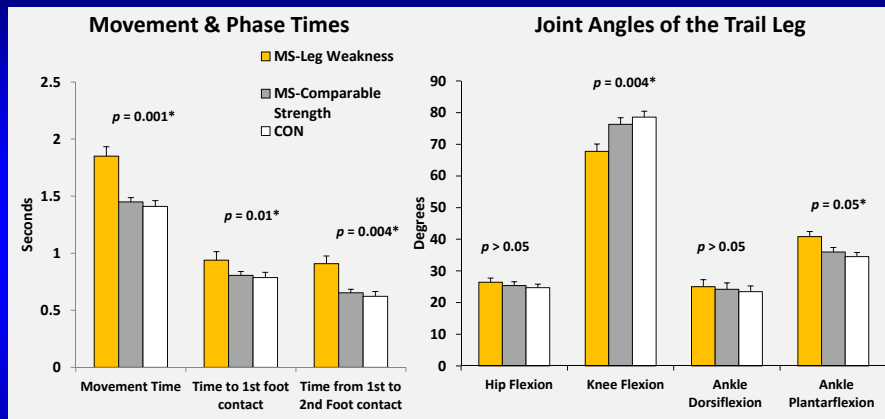
Research examining stair descent of persons with MS is limited.

Persons with MS take longer to perform timed stair descent

(Bowser et al., 2014)



Step Down Movement

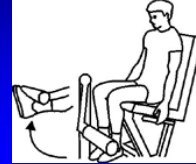


(Bowser et al., 2014)

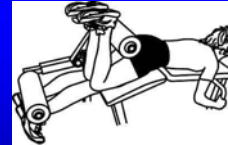


Exercise & MS

↑ physical activity related to:
 ↓ neurological impairments &
 disability (Mottl, 2008, Dalgas & Stenager, 2012)



Progressive resistance training (PRT):
 improves muscle strength, movement
 times, & postural stability (Bowser et al, 2011;
 Huisinga et al, 2012)



PRT improved stair ascent and descent time
 (White et al, 2004; Hayes et al, 2011)

Underlying changes in movement mechanics?



Purpose

To determine the kinematic changes of a
 step down task for persons with RRMS
 who participate in 16 weeks of supervised
 progressive resistance training.



Hypothesis

People with MS who participate in 16 weeks of PRT will display...

- ↑ 1-repetition max on a leg press (1RM)
- ↓ Step down movement times
- ↑ Knee flexion of the trail leg
- ↑ Ankle Dorsiflexion of the trail leg

No other kinematic changes



Participants

9 ambulatory individuals with Neurologist diagnosis of relapsing remitting MS (EDSS \leq 6.0)

- 8 females, 1 male
- age = 44 ± 12 yr
- height = 1.7 ± 0.1 m
- mass = 77 ± 23 kg
- EDSS = 2.7 ± 2.0



PRT Training Protocol

Supervised, 60-90 min sessions, 3x week for 16 consecutive weeks (M,W,F)

– Resistance exercises using machine weights

Week 1	Familiarization & 1RM
Weeks 2-16	Warm-up- 5 reps at 40% 1RM 3 Sets 10-15 reps at 70% 1RM Self-selected pace with 1 min rest Periodically Increased resistance 2-5%



Experimental Task-Step Down

- 5 Trials at self-selected speed
- Step height of 16 cm
- Feet placed shoulder width apart
- Verbal commands “Go ahead and step down”
- 2 practice trials
- 1-3 min rest



Instrumentation

Leg Extension Strength

(Cybex Eagle Leg Press; Cybex Int. Corp., Medway, MA)



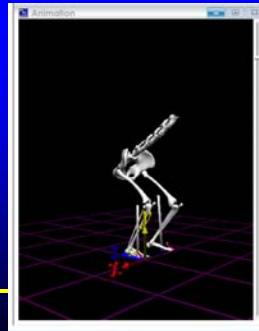
Motion Tracking (100Hz)

(Flock of Birds® motion tracking system; Ascension Technologies Corp., Burlington, VT)



Ground Reaction Forces (1000Hz)

(Bertec Corp., Columbus, OH)



Data Processing

(The Motion Monitor, Innovative Sports Training Inc., Chicago, IL)



Comparisons

Descriptive statistics:

Mean Difference and Standard Error

Clinically meaningful if:

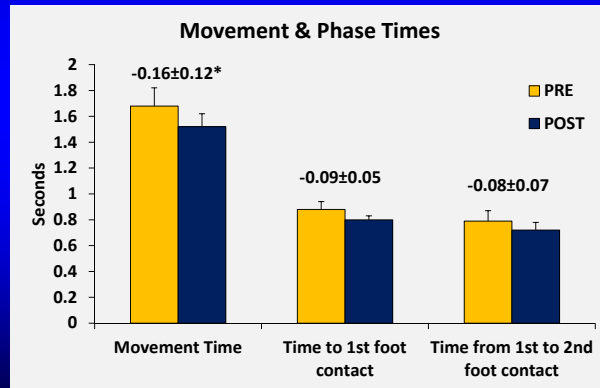
Differences $\geq 0.1s$ for time and $\geq 3^\circ$ for angular displacements



Results

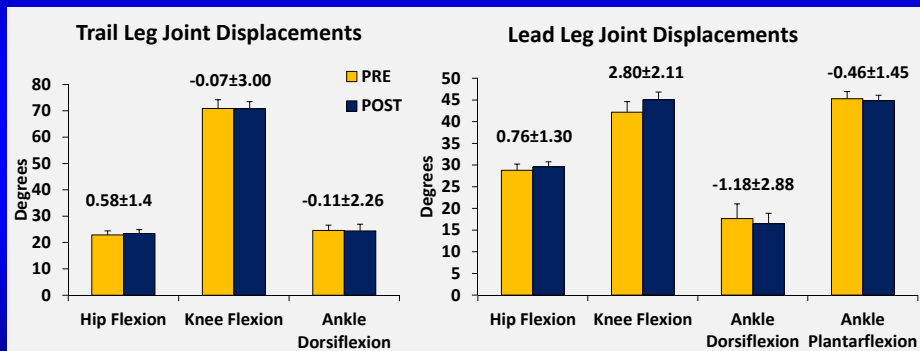
Following the 16 week PRT program:

- 1RM Leg Press increased by 18% (reported in previous abstract)
- Step down movement time decreased by 10%



Results

- No clinically meaningful changes were found for hip, knee or ankle joint displacements for either leg.



Results

PRE PRT



POST PRT



Discussion

Similar to previous literature, people with MS increased 1RM leg press following PRT (Dalgas, et al., 2009)

Increased leg strength may be responsible for a faster step down movement time

Previous Research:

↑ Leg extensor strength 12-20% displayed 20% faster stair descent (Hayes, et al., 2011)

↑ Leg press 37% also showed 27.5% faster STS (Dalgas, et al., 2009)

16% faster 25 m walk time (Mott, et al., 2012)

Improved postural control (Huisinga et al, 2012)



Future Directions

More research examining the mechanics behind the “functional” changes of activities of daily living following exercise training

Research that examines muscle activation & coordination during functional activities

The influence of limb symmetry during functional outcome measures



Conclusion



16 weeks of supervised exercise training can increase leg strength and elicit improvements to locomotor function for people with MS



Faster step down movement times may indicate improved balance and possibly increased confidence.

Understanding the mechanical differences will aid clinicians in developing optimal treatment plans



Acknowledgements

Mary Ella Lunday Soule
Scholarship Award
&
Whitaker Research Track
offered in memory of
Dr. John N. Whitaker



Thank you!

