Cognitive and Social Participation Improvements Following Inspiratory Muscle Training in Persons with Advanced Multiple Sclerosis: A Pilot Study

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DISCLOSURES

Alex Burnham receives a salary from the Boston Home, the sole data collection and participant recruitment site of the research project.

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The Boston Home (TBH) Profile

- Established in 1881, "Hope over Hardship"
- 96 bed in-patient non-profit facility for adults with progressive MS and other neurological disorders
- Offers long-term and outpatient care
- Designated a *Center for Excellence in Long Term Care* by the National MS Society
- Contributed to Nursing Home Care standards for individuals with advanced MS
- Offers outpatient and independent living programs

Learner Outcomes for this Session

1. Recognize how respiratory exercise can positively impact functional measures of cognition and social participation in people with advanced multiple sclerosis
2. Identify cognitive and social participation enhancements beyond primary respiratory functional outcomes following inspiratory muscle threshold training exercises in people with advanced MS
3. Explore current SLP clinical practice to expand access to respiratory muscle strength training for clients with severe accumulated disability from advanced multiple sclerosis

Multiple Sclerosis (MS)

- Idiopathic demyelinating autoimmune disorder
- Average age of onset 20-40
- Relapsing-remitting in earliest stages; transitions to progressive form in ~30-40% cases
- 2:1 female:male ratio
- Prevalence ~ 309.2/100,000, affecting >700,000 Americans
- Increasingly diagnosed and treated with disease-modifying therapies at earlier stages of disease

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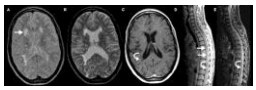
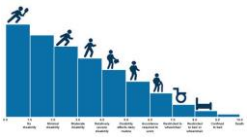


What is a person with advanced MS (PwAMS)?



- Functional turning point for people with primary (PPMS) or secondary progressive MS (PPMS)
- Can be described in terms of daily activity or disability scores, often scored on ambulation capacity
- Defined for this study as EDSS ≥ 6.5

Image source: https://img.medscapestatic.com/article/770/601/770601-fig3.jpg

Respiratory Disorders in PwAMS

- Respiratory strength declines in early stages of MS progression even without discernible impact on pulmonary function
- With accumulation of respiratory muscle weakness d/t disease progression, PwAMS experience:
  - Increased fatigue
  - Decreased exercise capacity
  - Susceptibility to pulmonary disease/infection
  - Impaired vocal loudness
  - Decreased social communication – increased isolation
  - Cognitive processing speed reduction

Previous Research on Respiratory Interventions for PwAMS

- Klefbeck & Hamrah (2003) = (+) improvements in maximum inspiratory & expiratory pressure (MIP & MEP) in PwAMS (EDSS 6-5-9.0) following 10-week IMT training program, no (-) fatigue impact
- Fry et al (2007) = (+) improvements in (MIP) following 10-week IMT program in people with mild-moderate MS-associated disability, no (-) fatigue impact
- Ray et al (2013) = (+) improvements in MIP, MEP, & fatigue in people less affected by MS (EDSS 1.0-6.5) following 5-week progressive resistance respiratory muscle training

Main Research Questions for This Study

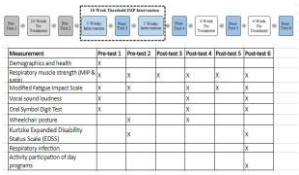
PI = Min-Hui Huang, PhD, PT, NCS (University of Michigan, Flint)

Co-investigators = Lisa Doyle, DPT, NCS (Franklin Pierce University); Donna Fry, PhD, PT, CHC (University of Michigan, Flint)

In order to expand beyond previous studies, among PwAMS:

- Does respiratory exercise improve breathing function?
- Does performing respiratory exercise increase fatigue?
- Does respiratory exercise reduce risk for respiratory infections?
- Does respiratory exercise improve vocal loudness?
- Does respiratory exercise impact socialization and activity?
- Does respiratory exercise have an effect on cognitive processing speed?

Current Study Design/Enrollment



Measurement	Pre-test 1	Pre-test 2	Post-test 3	Post-test 4	Post-test 5	Post-test 6
Demographics and health	X					
Respiratory muscle strength (MIP & MEP)	X	X	X	X	X	X
Modified Fatigue Impact Scale	X	X		X	X	X
Vocal sound loudness	X			X		X
Oral Symbol Digit Test	X			X		X
Wheelchair posture		X		X		
Kurtzke Expanded Disability Status Scale (EDSS)		X				X
Respiratory infection						X
Activity participation of day programs						X

- 37 PwAMS (EDSS > 8.0) recruited in unique residential community for adults with complex neurodegenerative disorders
- 32 completed all measures of cognitive processing speed outcomes
- All participants completed 10-week respiratory exercise program using handheld threshold inspiratory muscle trainer (IMT) with progressive increase in resistance
- Outcomes measures were obtained pre- & post-exercise period, midway during intervention and retention phases, and at end of retention eight weeks post-exercise phase
- 10-week baseline pre-exercise period
- Repeated measures within-subject design

Intervention/Data Collection

- MIP and MEP: assess respiratory muscle strength
- Symbol Digit Modalities Test (SDMT) (oral version only): assess cognitive processing speed
- # days /wk on which participants within the residential community attended group activities documented by trained facility staff: assess social participation.
- IMT device usage = 3 sets of 15 breaths daily during 10-week intervention phase (participant or staff held device & documented)
- Only 1 participant reported discomfort d/t pre-existing CN V neuralgia

Outcomes: Responders & Non-Responders

- Participants who improved MIP after the 10-week IMT program = "responders" (n = 24)
- Participants without improvements in MIP ="non-responders" (n = 8)
- BMI significantly lower in responders than non-responders (p=0.046)
- *No other characteristics at baseline* differed between groups

MIP Change Score from Baseline	Immediately post 10-wk training (p<0.001)	8-wk retention post training (p<0.001)
Responders	10.3±7.3 cmH2O	7.4±8.8 cmH2O
Non-responders	-8.9±7.6 cmH2O	-6.5±7.8 cmH2O

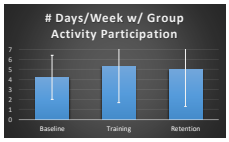
Outcomes: Cognitive Processing Speed

- SDMT scores at pre-training baseline did not differ significantly between IMT non-responders (14.5±9.8 correct items) and responders (19.8±10.9 correct items)
- Improvements in cognitive processing speed between groups reflected large effect size (see below)

SDMT change scores by category	Retention – pre-training (p=0.005; $\eta 2p$ = 0.22)	Retention – post-training (p=0.009 , $\eta 2p$ =0.24)
Responders	5.1±8.1	4.5±6.3
Non-responders	-4.8±7.72	-3.3±6.0

Outcomes: Activity Participation

- Structured group activity participation data across 28-week duration of study (including 10-week no-exercise baseline period prior to IMT intervention) were available for 29/32 participants
- # days with group activity attendance per week per participant = 4.2±2.2 during pre-training baseline, 5.3±3.6 during IMT training, and 5.0±3.7 during retention phase
- # days with group activity attendance/week differed significantly across time periods (p=0.013)
- Post-hoc analysis revealed that participants attended group activities across more days/week during IMT training period compared to the baseline period (p=0.014)



Discussion of Findings

- PwAMS responded positively to IMT training program in parameters of respiration, cognition, and social interaction with very few side effects or negative consequences
- Besides enhancements in MIP, majority of participants also demonstrated enhanced cognitive processing speed following IMT training despite severe disease burden accumulation
- Participation in this exercise protocol trended towards increased social engagement (although statistical significance not found) independent from outcomes, promoting peer communication and desirable QOL for individuals coping with chronic progressive illness

Future Directions in Respiratory Muscle Intervention for PwAMS

- Comparison of outcomes from IMT with EMST in PwAMS
- More controlled comparison of respiratory, cognitive, and social outcomes from people at home/in community vs in LTC environment
- Exploration of other domains of cognition (e.g., memory, attention) potentially affected by respiratory muscle training in PwAMS
- More feedback from PwAMS on what constitutes meaningful social participation to guide data collection/future study design

Questions & Thanks

- Thank you for your time and attention!
- Extremely special thanks to TBH residents and staff for their participation and data collection for this project
- Please contact me at aburnham@thebostonhome.org with any questions or additional feedback
- Please contact the PI, Dr. Min Hui Huang, at mhhuang@umich.edu with any questions about research protocol or future study directions
- You are invited to visit the residents and staff at Boston Home whenever you are in the neighborhood!

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