Effects of Non-Aerobic Maximal Effort Exercise on Fatigue in Deconditioned Men and Women with Multiple Sclerosis

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Background

Multiple Sclerosis (MS) is a neurodegenerative disease of unknown etiology affecting women more frequently than men. Mental and physical fatigue complaints are often the most disabling symptoms for an MS patient. Both are multifactorial, potentially exacerbated by aerobic exercise, may prevent sustained physical functioning, and significantly interfere with activities of daily living[1].

A multi-center study was designed to investigate the effects of non-aerobic maximal effort exercise (MEE) for deconditioned persons with MS, with the expectation of minimizing fatigue. The IsoPUMP® (Neuromuscular Engineering; Nashville, TN), is a specialized exercise and strength-sensing machine, designed to allow individuals to safely perform and record their non-aerobic MEE sessions.

The Modified Fatigue Impact Scale (MFIS) and Multiple Sclerosis Functional Composite (MSFC) are common, accepted methods used to measure fatigue and function. The MFIS is a 21-item questionnaire which assesses the subjects' perception of physical, cognitive, and psychosocial aspects of fatigue over a four-week period[2]. Each of the 21 items are scored on a scale from 0 (never) to 4 (almost always), and the total MFIS score is calculated by summing the circled number for each item. Total scores can range from 0 to 84; higher scores indicating a greater impact of fatigue on the person. The MFIS has three distinct subscales: (1) physical, (2) cognitive, and (3) psychosocial. These subscales can be scored independently by summing the questions that pertain to each subscale[2]. The MFIS physical subscale score can range from 0 – 36 and the MFIS cognitive subscale score can range from 0 – 40.

The MSFC combines clinical measures used to assess lower limb function (Timed 25-Foot Walk [25-FW]), upper limb function (9-Hole Peg Test [9-HPT]), and cognition (Paced Auditory Serial Addition Test [PASAT-3"])[3]. The 25-FW is a quantitative measure of lower extremity function. The 9-HPT is a quantitative measure of arm and hand function where a subject inserts and then removes 9 pegs from a board, using one hand at a time. The time is recorded for each hand with the dominant hand trial first and the non-dominant hand trial second. The final score is recorded as the mean time for both hands. The PASAT-3" is a measure of cognitive function, specifically assessing auditory information processing speed, short-term memory, flexibility, and calculation ability. Cognitive dysfunction affects half of all MS patients; slowing ability to reason, concentrate, and recall[5]. In this test subjects listen to a series of 61 spoken numbers separated by 3 seconds and must add each number to the prior number. Their final PASAT-3" score is the number of correct additions in the series, with 60 reflecting a perfect score. The MSFC is then evaluated by creating Z-scores for each component, which compare each outcome with the average outcome of the study population. The three Z-scores are then averaged to create an overall composite score (the MSFC score) which represents change over time for that population of MS subjects[3].

Hypothesis

Both male and female subjects will show a reduction in fatigue as measured by the MFIS physical and cognitive subscales.

Methods

Of 78 MS subjects taking part in this multicenter study, a total of 43 subjects (24 females, 17 males, 2 unknown) had complete MFIS data for analysis in this study. These subjects had performed progressive repetitions of MEE biweekly for 10 weeks (with week 10 being the end of intervention) with two additional follow-up visits at weeks 16 and 22; a total of 25 sessions scheduled for each subject. MEE consisted of leg presses and total body lunges, each with isometric and eccentric phases (4 secs, 3-5 reps each). These subjects completed MSFC components, the MFIS, and various other questionnaires at the initial visit (baseline-week 0), week 6, week 10, week 16, and week 22. Quality-of-life measures were followed longitudinally along with IsoPUMP® strength measures.

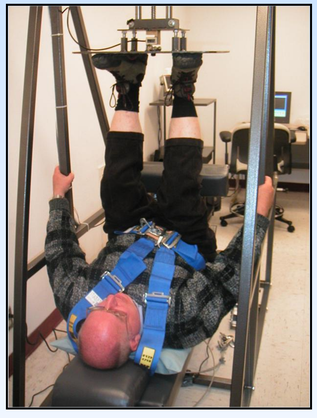


Figure 1. IsoPUMP® Leg Press exercise demonstration.

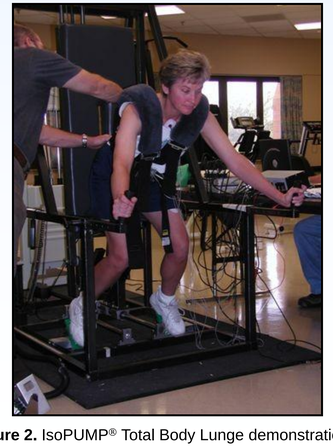
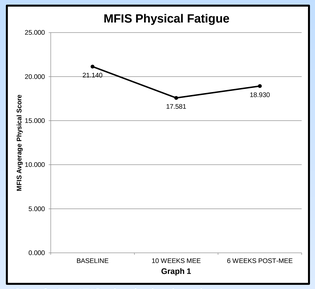


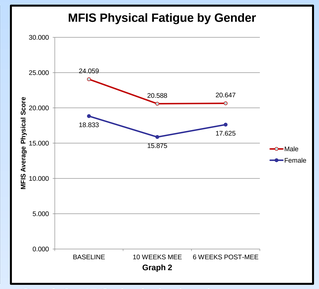
Figure 2. IsoPUMP® Total Body Lunge demonstration.

Results

MFIS physical subscale scores can range from 0 to 36, with higher numbers signifying greater fatigue. Compared to a physical fatigue baseline of 21.1, the total MFIS physical subscale average scores showed significant improvement by decreasing at week 10 to 17.6 (p=0.003), and at week 16 to 18.9 (p=0.031); *see Graph 1.* We also evaluated whether the improvement in physical fatigue was affected by gender; *see Graph 2*. At baseline, the males MFIS physical subscale average score was 24.1; for week 10, scores decreased to 20.6 (showing a trend, p=0.066), and for week 16 scores maintained a decreased score below baseline at 20.6 which was statistically significant (p=0.034). The MFIS physical subscale for females showed average scores at baseline of 18.8; at week 10 scores decreased to 15.9 (showing a trend, p=0.062); and at week 16 scores remained below baseline with an average score of 17.6 (not statistically significant).

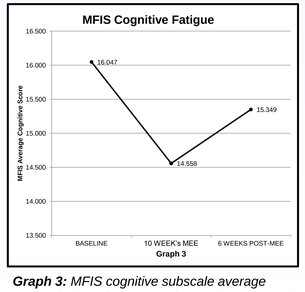


Graph 1: *MFIS physical subscale average scores for baseline, 10 weeks MEE, and 6 weeks post-MEE.*

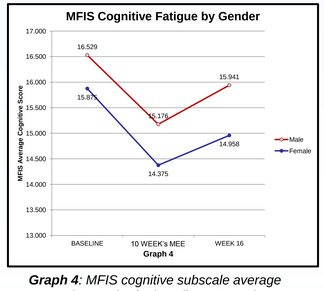


Graph 2: *MFIS physical subscale average scores by gender for baseline, 10 weeks MEE, and 6 weeks post-MEE.*

MFIS cognitive subscale scores can range from 0 to 40; again with higher numbers signifying greater fatigue. The total MFIS cognitive subscale scores averaged 16.0 at baseline, 14.6 at week 10, and 15.3 at week 16. Although these scores show a decrease in cognitive fatigue, these changes only show a suggestive trend at week 10 (p=0.119); *see Graph 3.* When looking at gender's effect on cognitive fatigue, MFIS cognitive subscale scores for males averaged 16.5 at baseline, 14.4 at week 10, and 15.9 at week 16. For females, MFIS cognitive subscale scores averaged 15.9 at baseline, 14.4 at week 10, and 15.0 at week 16 (*see Graph 4*). Even though these scores show improvements (more so the female gender), these changes were not statistically significant for either gender.



Graph 3: *MFIS cognitive subscale average scores for baseline, 10 weeks MEE, and 6 weeks post-MEE.*



Graph 4: *MFIS cognitive subscale average scores by gender for baseline, 10 weeks MEE, and 6 weeks post-MEE.*

Conclusion

Integrating a progressive, non-fatiguing MEE protocol achieved a statistically significant reduction of overall physical fatigue as measured on the MFIS physical subscale in both male and female deconditioned MS subjects. Males reported greater physical fatigue at baseline, week 10, and week 16 versus females as reported on the MFIS physical subscale.

Changes in cognitive fatigue did not reach statistical significance for the total population or for responders based on gender as reported on the MFIS cognitive subscale. Cognitive fatigue subscale measures however suggested a statistical trend towards improvement at the end of the MEE intervention.

Discussion

Preliminary analysis of the data reveals that non-aerobic MEE can significantly ameliorate physical fatigue for MS patients, while cognitive fatigue improvements were only suggestive. Previously reported data showed significant improvement in PASAT-3" (cognitive) scores during MEE protocol, lasting 12-weeks post-MEE[5]. These results indicate that through progressive non-aerobic MEE, it may be possible to attenuate the deleterious effects of MS fatigue in individuals with this chronic degenerative disorder.

A study with an increased number of subjects might improve the significance of the data. Additionally, it should be noted that the self-reported measure used in this study, the MFIS, is inherently subjective[4].

Acknowledgements

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