Changing Lives: Intensive exercise for adults living with chronic severe brain injury

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ENHANCING LIFE FOR SURVIVORS OF BRAIN INJURY

Abstract

Objective(s): Investigate changes in endurance, gait speed, advance mobility, participation and self-efficacy in individuals with chronic acquired brain injury (ABI) immediately after/6 weeks-post intensive exercise program participation.

Design: Prospective, non-randomized, unblinded interventional trial.

Setting: Fitness center in a supported independent living environment.

Participants: 14 Adults with chronic ABI who could stand with minimal or no assist, could walk with or without device and/or bracing, were interested in exercise, and were available 1½ hours, 3 days/week, for 6 weeks.

Interventions: Strengthening (e.g. lifting free weights), stretching, endurance and balance exercises as recommended by the American College of Sports Medicine and implemented by AccesSportAmerica.

Main Outcome Measure(s): Six Minute Walk Test (6MWT); Gait speed; High Level Mobility Assessment Tool (HiMAT); Participation Objective, Participation Subjective (POPS); Self-Efficacy Scale

Results: Changes in the three impairment and activity limitation measures (6MWT, Gait Speed and HiMAT) were statistically and clinically significant, on average and per individual. Specific results are reported (baseline, 6 weeks, 12 weeks) with interquartile range: 6MWT (feet) 431 (87,1294), 1016 (298, 1876)* and 712 (281,1566)*; Gait Speed (m/sec) 0.59 (0.25, 1.50), 1.11 (0.53, 1.96)* and 1.10 (0.46, 1.77)*; HiMAT 3.5 (1, 27), 9 (3.75, 33)* and 8 (p<0.05) (2.75, 29)*. POPS and self-efficacy results will also be reported. *= p<0.05.

Conclusions: Individuals living with chronic ABI can improve endurance, gait speed and the ability to do advanced gait. Functional activity status changed from home ambulator to community ambulator for some participants.

Background

Any acquired brain injury (ABI), can result in long-term impairments that affect physical, cognitive, and social function. Exercise has been shown to improve physical function outcomes such as mobility, strength, endurance and capacity to perform activities of daily living as well as cognitive function, mood and social interactions in persons with brain injury.[1]

Purpose

- To investigate the effects of an intensive exercise program on endurance, activity level, and gait speed while cultivating the social and emotional well-being of people with chronic moderate to severe ABI.
- We hypothesized that intensive exercise would be associated with improvements in impairment and activity limitation measures (endurance, activity level, and gait speed) immediately post-intervention and six weeks later.

References

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Table 1. Participant Characteristics at baseline (n=14)

Participant Characteristic at Baseline	Value
Age (y) (mean ± SD)	44.8 ±8.7
Years Since Injury (y) (mean ± SD)	20.5 ±11.2
Men (n) (%)	12 (83%)
Women (n) (%)	2 (17%)
TBI (n) (%)	9 (64%)
CVA (n) (%)	3 (21%)
Brain tumor (n) (%)	1 (.07%)
Anoxic encephalopathy (n) (%)	1 (.07%)

Figure 1: Participant Flow

Assessed for eligibility and recruited to study (n=16)

WEEK 0 - Baseline assessment (gait speed, advanced mobility, endurance, participation, and self-efficacy); exercise intervention initiated (n=16)

WEEK 2 - Two participants dropped out of the study (due to lack of interest) (n=14)

WEEK 6 - Exercise intervention completed; assessment - gait speed, advanced mobility, endurance, participation, and self-efficacy measures (n=14)

WEEK 12 – Assessments completed for follow up testing (gait speed, advanced mobility, endurance, participation, and self-efficacy) (n=14)

WEEKS 24 – 52 – Interviews with participants, family members, trainers, and staff to understand participants' exercise experience (n=22).

The intervention (Table 2) was modeled on programs recommended by the American College of Sports Medicine (ACSM)[2] and the National Center on Health, Physical Activity and Disability (NCHPAD)[3].

Findings

Table 2. Exercise protocol for the group

Frequency: 3 times per week; Intensity: Aiming for 80-140 bpm; Time: 60-90 minutes

Type:

Endurance Exercises:
- Treadmill walking with and without body weight support
- Stationary bike
- Overground walking
- Stairs and step ups
- Obstacle courses

Strength exercises: 10-15 repetitions in 2-3 sets

Arms and chest (uppers):
- Free weights
- TRX hanging system
- Modified ground bases training using body weight- push-ups, buddy lat pulls

Legs (lowers):
- Modified ground based training using body weight- squats, hamstring slides on discs, bridging
- Leg presses against weight of trainers
- Prone leg curls against trainer hand resistance

Abdominals/ core/ stomach:
- Planks, assisted as needed
- Burpees (modified push-up followed by standing up from the ground, assisted as needed) and other total body exercises
- Crunches on slant board

Stretching exercises:
- on mat targeting shortened muscles

Balance exercises: at bar
- standing with a narrowed base of support
- challenging standing balance utilizing equipment such as a dyna disc and Bosu ball.
- Lateral stepping, side to side swaying, standing on one leg- usually with assist.

Table 3. Outcome measures for participants at baseline, post-intervention and 6 weeks later (n=14)

Measure	Low ambulatory status[d] (n=8)	High ambulatory status[e] (n=6)	All (n=14)
6MWT (feet)[a]			
Baseline	185 (45, 381)	1313 (872, 1805)	431 (87, 1294)
After	319 (193, 734)*‡	1878 (1706, 2363)*‡	1016 (298, 1876)*‡
6 weeks	293 (255, 563)* ‡	1594(1341, 2016) *‡	712 (281, 1566)*‡
HiMAT[b]			
Baseline	1 (1, 3)	29 (21, 38)	3.5 (1, 27)
After	4 (2, 4)*	33 (24, 40) ‡	9 (3.75, 33)*‡
6 weeks	3 (1, 4)	31 (24, 42)*	8 (2.75, 29)*‡
10MWT (m/sec)[c]			
Baseline	0.36 (0.12, 0.50)	1.58 (1.36, 2.19)	0.59 (0.25, 1.5)
After	0.62 (0.25, 0.96)*‡	1.97 (1.3, 2.22)‡	1.11 (0.53, 1.96)*‡
6 weeks	0.48 (0.26, 0.88)*‡	1.78 (1.47, 2.20)‡	1.10 (0.46, 1.77)*‡

†Results presented show median (IQR); * p<0.05; ‡ Greater than minimal detectable MDC for the measure. (6MWT ≥112.76 feet; HiMAT ≥4; 10MWT > 0.05 m/sec); [a] 6MWT(feet)=Six Minute Walk Test; [b] HiMAT=High-level Mobility Assessment Test; [c] 10MWT=Ten Meter Walk Test; Gait Speed calculation; [d] ≤ 0.8 m/sec and includes Home Walkers (≤0.4 m/sec) and Limited Community Ambulators (0.4 m/sec to 0.8 m/sec)[3]; [e] >0.8 m/sec and includes Community Ambulators (> 0.8 m/sec to 1.2 m/sec) and Cross Streets & Normal Walking Speed (>1.2 m/sec)[3]

Table 4. Intervention impact on ambulatory status post-intervention and 6 weeks later.

	Low Ambulatory Status[a]	High Ambulatory Status[b]
Baseline	8	6
After intervention	5	9
6 weeks later	5	9

[a] ≤ 0.8 m/sec and includes Home Walkers (≤0.4 m/sec) and Limited Community Ambulators (0.4 m/sec to 0.8 m/sec)[3]; [b] >0.8 m/sec and includes Community Ambulators (> 0.8 m/sec to 1.2 m/sec) and Cross Streets & Normal Walking Speed (>1.2 m/sec)[3]

Limitations

- Small sample size with a mixed population of persons with acquired brain injury; no control group

Discussion & Conclusions

- People living with chronic moderate to severe ABI can: improve endurance, move from low to high ambulatory status, and demonstrate the ability to achieve advanced gait with just six weeks of intensive exercise.
- Despite the physical function gains reported, barriers to participation in physical activity and community life remain. They include lack of motivation and program cost.[4]
- Overcoming personal and environmental/physical barriers may require complementary interventions.
- Based on the 10MWT, three participants moved from low to high ambulatory status post- intervention and remained there six weeks later. Rimmer et al[5] suggested classifying complex participants with disabilities by function to help identify key health outcomes. Given that gait speed is a general indicator of overall health and indicates activity and exercise tolerance, [6, 7] we categorized participants into two groups: low ambulatory status and high ambulatory status.
- Twenty-eight (out of 39) residents now work out alongside each other. Persons with brain injury in the community now come to the wellness center for physical training.

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Supportive Living Inc, a non-profit charity, strives to raise the quality of life for survivors of brain injury. To achieve this mission, Supportive Living develops appropriate and affordable supportive housing; provides life-long physical, cognitive, and social fitness through wellness programs; and fosters research aimed at improving the lives of those affected by brain injury. **For more information** about this study: ann.charrette@mcphs.edu and llorenz@brandeis.edu **For more information** about Supportive Living Inc: peter.noonan@verizon.net

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