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The Neurological Exercise Training (NExT) Program: A Pilot Study of a Community Exercise for Survivors of Stroke

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Abstract

Background: Many survivors of stroke face chronic disability and increased risk for recurrent stroke. Regular physical activity can reduce these risk factors and improve cardiovascular fitness. Most survivors of stroke face barriers to exercise, including lack of access to programs; as a result, most are sedentary.

Objective: Pilot the Neurological Exercise Training (NExT) program for survivors of stroke for attendance, safety, and effectiveness.

Methods: The NExT program was designed to promote self-directed exercise in a safe, accessible environment. Six participants attended as desired during open gym hours over two exercise periods per week totalling 19 weeks. After, participants were encouraged to continue exercise away from the gym for 20 weeks. Practicability of the program was assessed through safety, attendance, exercise intensity, and perception of the program. Pilot effectiveness measures were performed at five time points and effect sizes were generated.

Results: Attendance averaged 76% (12%) of possible sessions with an average duration of 62 (SD 11.3) minutes. Effectiveness measures had positive effect sizes after 19 weeks of the NExT program, but these benefits were lost after 20-weeks (Cohen's d , mobility=0.67 to -0.22, balance=0.57 to -1.22, strength=0.41 to -0.30, endurance=0.09 to -0.19 and fatigue=1.02 to -0.57).

Conclusion: Results demonstrate that a community-based gym that is accessible for survivors of stroke will be well attended and perceived as beneficial. Pilot data suggests positive changes in

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multiple health domains regardless of the type of exercise self-selected by participants. Offering the gym on a continual basis may maintain gains.

Keywords

Stroke; Exercise; Community Program

Introduction

Stroke is a major source of disability for many of the estimated 6.8 million survivors of stroke in the United States. As a result, there is a need for services to manage chronic impairments and risk factors for recurrent stroke.^{1–3}

Rehabilitation focuses on the acute stage following a stroke, with limited effort focused on improving the chronic disability that remains after discharge from conventional therapy. Following the active rehabilitation period, individuals are left to continue recovery on their own, rarely returning to rehabilitation services.⁴ The combination of enduring physical impairments and loss of services contributes to a sedentary lifestyle and decreased physical activity (PA).³

Regular PA and structured exercise can help manage risk factors to decrease the chance of a subsequent stroke and improve cardiovascular fitness and walking ability.^{5–8} Despite these known benefits, survivors of stroke are significantly less active than the general population, with only 18% meeting general population guidelines.^{9,10}

Survivors of stroke encounter unique barriers to regular PA. External barriers include lack of community-based programs, transportation issues and financial concerns.^{11,12} Internal barriers include a lack of exercise knowledge, low exercise self-efficacy, and fear of embarrassment due to their disabilities.^{11,13} In order to increase PA, survivors of stroke need access to programs that reduce barriers and increase self-efficacy.

Previous research on community exercise programs for survivors of stroke has demonstrated improvements in overall health and secondary prevention by following structured programs with set protocols.^{14–17} These interventions may not translate into habitual regular PA, which often becomes an individual's personal responsibility after research completion. Therefore, the concept of self-directed PA and exercise for survivors of stroke warrants further investigation.¹⁸

The NExT (Neurological Exercise Training) program was a self-directed community program designed to empower survivors of stroke by reducing barriers and promoting self-directed exercise in a safe, accessible environment. The purpose of this study was to pilot the NExT program for attendance, safety, and effectiveness.

Methods

The NExT program facilities, located on a college campus, provided a safe, accessible and no cost facility for survivors of stroke to exercise. A convenience sample of participants was recruited from a database of survivors of stroke with interest in research studies at the

University of South Carolina or through community word of mouth. Those who were greater than one-year post-stroke who could ambulate for at least 10 meters and had transportation to the facility were eligible for the study. Potential participants had to be able to follow commands in English and communicate exertion and adverse effects. Failure to obtain medical clearance, having an infectious condition or requiring continuous one-to-one supervision for safety excluded participants. The NExT program consisted of a pre-program session, active exercise periods at the NExT facility (one 10-week period and one 9-week period separated by a 9-week break), and a 20-week period of unsupervised activity away from the facility. The 9-week break was required because of staffing and participant scheduling conflicts.

Pre-Program Session

The pre-program session included an educational component, a facility orientation, and collection of initial effectiveness measures. Participants received education using American Heart Association (AHA) guidelines on the importance of PA and exercise after stroke.^{19,20} The education was individualized and reinforced through discussion, handouts, and continued emphasis. The orientation introduced gym equipment and reviewed procedures, emphasizing to participants that they were free to come and go on their own schedule during open facility hours. Initial effectiveness measures and participant goals influenced the initial exercise plan. Upon completion of the pre-program session, participants gained full access to the NExT program.

Intervention

The NExT program was open approximately 3 hours a day on 2–3 mornings per week throughout the intervention periods. Four Doctor of Physical Therapy students, under the guidance of two licensed physical therapists, staffed the program. All were CPR certified and knowledgeable of stroke-specific exercise guidelines.

The AHA exercise guidelines after stroke were the target emphasis with modifications based on individual performance level and limitations.^{19,20} The focus was the aerobic component of the guidelines with goals of 20–60 minutes, 3–5 days/week in light to somewhat hard effort levels (11–14 on Borg Rate of Perceived Exertion (RPE) scale).¹⁹ Secondary focus included AHA strength training guidelines of 2–3 days/week of 8–10 exercises targeting major muscle groups.¹⁹

Participants had freedom to choose the frequency and duration of each session, and no appointments were required. This autonomy was a unique attribute of the NExT program and mirrored community programs available to the non-disabled community. Initially, supervision was one staff member to one participant and then gradually reduced as individuals gained competency with activities. The exercises performed were recorded in a participant log at each session.

In the last two weeks of the active program period, participants received a personalized written plan of familiar exercises to continue in the post-program period. At the end of the active program period, effectiveness measures (post-program) were completed.

20 Week Post-Program Period

Participants were called by NExT program staff every 4-weeks to monitor activity and address concerns. After 20 weeks, participants returned for the final assessment of effectiveness measures (20-weeks post-program).

Pilot Program Safety, Attendance and Perception of Change

Safety and exercise intensity were evaluated through monitoring of pain and fatigue (numeric pain rating scale (0–10) and Wong-Baker faces scale),²¹ heart rate (HR), blood pressure, RPE, and occurrence of adverse events including falls, persistent muscle soreness, or unmanageable fatigue or pain.^{22,23} Additional measures included attendance, self-report of activity in the 20-week post-program period and participant perception of mobility change measured through a Global Rating of Change (GRC) scale.

Pilot Effectiveness Measures

Pilot effectiveness measures were completed at five points: pre-program, post-session-1, pre-session-2, post-program and 20-weeks post-program. The Timed Up and Go (TUG) assessed mobility.²⁴ Balance was evaluated using the Berg Balance Scale (BBS).²⁵ The Five Times Sit to Stand (5xSS) test was used as a surrogate measure for lower extremity strength.²⁶ The 6 Minute Walk Test (6MWT)²⁴ measured endurance and walking capacity.²⁷ The fatigue severity scale (FSS) measured the impact of participant fatigue on activities.²⁸ Each of these measures has validity and reliability in survivors of stroke.^{24–28} Individual changes were calculated and compared to minimal detectable change (MDC) for each measure when available. Overall means, standard deviations (SD), and effect sizes (Cohen's d) were calculated for effectiveness measures: (1) pre-program to post-program, (2) post-session-1 to pre-session-2 and (3) post-program to 20-weeks post-program. Because this was a pilot program, no power calculations occurred.

Results

Participants

Five participants (4 male, 1 female), with an average age of 66 (SD 8.28), completed the program. One additional participant died of unrelated causes and was omitted from analyses. All participants were ambulatory with three using an assistive device. All were in the chronic stage of stroke with an average of 6.4 (SD 3.5) years since their stroke. (Table 1)

Pilot Program Safety, Attendance and Perception of Change

Pain was minimal throughout the program, and did not, on average, vary with activity. Pre-session pain averaged 0.57 (SD 1.02) and post-session pain averaged 0.51 (SD 1.12). Pre-session fatigue averaged 0.52 (SD 0.93) while post-session fatigue averaged 4.39 (SD 2.82). No participants reported post-session fatigue as activity limiting and fatigue levels returned to baseline before the next session. HR and RPE averages demonstrate that participants worked at levels between “somewhat hard” and “hard” on average (Figure 1). No adverse events occurred during the exercise sessions, however, two participants reported controlled falls without injury outside of the program.

Participants attended an average of 76% (SD 12%) of all possible sessions with an average duration of 62 (SD 11.3) minutes. The most common aerobic activities were over ground walking, stair navigation, treadmill walking, and recumbent trainer use. Common strength exercises included body weight squats, lunges, pushups, and planks. Balance activities and flexibility training were performed when part of participants' goals. For example, participant 1 focused on endurance in walking so he selected mostly treadmill activity, while others had a mix of aerobic, strength and balance activities. A general example of an exercise log is available as ancillary material at (insert).

All participants reported positive changes in their mobility, with four of the participants rating a +3 and one participant rating a +5 on the GRC scale (−5 [a great deal worse] to 0[no change] to +5 [a great deal better]). During the 20-week post-program period, only one participant reported continuing with their exercise plan, in addition to regularly visiting a community gym. Another participant did not perform the exercise plan but remained active in a cycling club. The other three participants reported no formal exercise in the post-program period and a return to pre-program activity levels.

Pilot Effectiveness Measures

Individual changes from pre-program to post-program and from post-program to 20-weeks post program are presented in Table 1. Four participants (80%) improved in at least 4/5 outcome measures from pre-program to post-program and 100% of participants declined in at least 4/5 outcome measures from post-program to 20-weeks post-program.

While effect sizes varied across the measures, all pre-program to post-program (the period of active attendance) effect sizes were positive, while post-program to 20-weeks post-program (the period when participants were provided an exercise program away from the NExT program) effect sizes were negative (Figure 2). Effect sizes for the break (post-session-1 to pre-session-2) varied between −0.40 (decline) to +0.15 (maintenance).

Discussion

The NExT program was successful in terms of practicability with positive participation, safety and participant impact. From program initiation to completion, session attendance was high, despite having no attendance requirement. No adverse events occurred during the sessions and no participants reported significant fatigue or pain. All participants felt the program improved their mobility. After completion of the program, however, most participants did not report continued PA, and reported low adherence to the exercise plans.

Effectiveness measure results varied between individuals and between measures. Effect sizes point to an overall improvement in function for participants during the active program period (positive effect sizes), but a substantial decline during the inactive post-program period (negative effect sizes). While a small pilot sample size prevents conclusions on effectiveness, the results suggest gains are possible in mobility, balance, endurance and fatigue levels in general fitness routines with individualized goals.

Participants exhibited the largest improvement on the TUG (large effect size) and BBS (medium effect size) from pre-program to post program, suggesting gains in functional balance and mobility (Figure 2). All participants demonstrated some improvement on the TUG, with two of five participants exceeding the MDC of 2.9 seconds.²⁴ Many participants regularly selected ambulation activities and lower extremity strengthening exercises during program sessions, both of which could have contributed to improvements on the TUG. Specific balance training was not performed by all participants, though balance may have improved due to increased mobility and lower extremity strength.²⁹ The BBS may not have been the best balance assessment for this group of high functioning survivors of stroke. Three of the participants were unable to reach the MDC of 4.13 because of near maximum scores pre-program.²⁵ The remaining two participants exceeded the MDC.²⁵ All five participants scored greater than 50/56 at post-program assessment placing them in a low risk fall category.³⁰

The NExT program FSS results demonstrated a reduction in fatigue for all participants with a large effect size suggesting a generalized exercise program may decrease fatigue in survivors of stroke.³¹ This is a substantial finding because up to 40% of individuals with chronic stroke described fatigue as their most disabling symptom, which frequently leads to further deconditioning due to avoidance of moderate to vigorous activity.^{19,31}

Other effectiveness measures (endurance (6MWT) and Strength (5XSS)) improved over the course of the program, though fewer participants exceeded the MDC from baseline to post-program and effect sizes remained small. For example, participants ambulated an average of 16.59 m further on the 6MWT at the 20-week post-program assessment than at the initial preprogram assessment, though only two participants exceeded the MDC of 29 m.³² One participant specifically focused on increasing endurance during exercise sessions, and was able to gradually and independently increase treadmill ambulation distance from an initial 0.5 miles to 2 miles during the intervention. This participant improved 55.8 m from pre-program to post-program on the 6MWT, demonstrating that self-directed exercise, in combination with a supportive environment such as the NExT program, may lead to individualized, meaningful gains in function.

The 20-week post-program exercise plans were largely ineffective. Compared to post-program performance, after the 20-week post-program period participants demonstrated worse performance on over half of all effectiveness measures. The most prominent declines were observed on the BBS and the FSS. A large, negative effect was observed on the BBS with all five participants experiencing decline, including the two participants that had achieved a max score during post-program assessment. This may be explained by a return to the pre-NExT program level of activity as reported by the majority of the participants. Consistent with these results, a study by Jurkiewicz et al. found significantly higher adherence to a home exercise program in survivors of chronic stroke during concurrent participation in an organized program as opposed to a standalone home exercise program.³³ Another study concluded survivors of stroke struggle with continued motivation to exercise.³⁴ On-going support through education, accountability and encouragement can contribute to maintenance of regular exercise.^{23,34}

There were no improvements made during the 9-week break; improvements ceased when the gym was not in session. Inclusion of a break in future studies could evaluate duration required to build self-efficacy.

The present pilot study was limited due to the small sample size. The format impairs reproducing dosing, a limitation that was anticipated and appropriate because the program's self-selected nature is reflective of a community gym behaviors. Participants willing to commit to an exercise study may have different beliefs than other survivors of stroke. Additionally, transportation availability may influence those participating; future studies should include transportation. Effectiveness measures were obtained by two different raters; all raters were trained and supervised by the same research staff. While there were no adverse events, the sample may be below the number needed to harm (NNH).³⁵ A larger sample size in further iterations of the study would allow for a sufficiently powered comparison for statistical validity. The sample size required to power a larger study depends on the desired outcome measures of interest. Pilot effect sizes from this study may assist in appropriate estimations.

Conclusions

The NExT program had high attendance and retention, and positive pilot effectiveness measures, demonstrating the potential benefits of community-based exercise programs for survivors of stroke. The sample of participants with varied movement capabilities and exercise interests is consistent with survivors of mild stroke living in the community. Most participants demonstrated improved mobility, balance, and fatigue during the active program period. However, these gains degraded after program cessation. Our pilot results suggest that a community-based program that is accessible and offered on an ongoing basis is important for maintenance of exercise and physical function. Further research is needed to determine how best to provide and sustain community exercise opportunities to meet the needs and interests of a diverse population of survivors of stroke.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Go AS, Mozaffarian D, Roger VL, et al. Heart Disease and Stroke Statistics— 2013 Update. A Report From the American Heart Association. 2013;127(1):e6–e245.
2. Hardie K, Hankey GJ, Jamrozik K, Broadhurst RJ, Anderson C. Ten-year risk of first recurrent stroke and disability after first-ever stroke in the Perth Community Stroke Study. *Stroke*. 2004;35(3):731–735. [PubMed: 14764929]
3. Ovbiagele B, Goldstein LB, Higashida RT, et al. Forecasting the future of stroke in the united states. *Stroke*. 2013;44(8):2361–2375. [PubMed: 23697546]

4. Aziz NA, Leonardi-Bee J, Phillips MF, Gladman J, Legg LA, Walker M. Therapy-based rehabilitation services for patients living at home more than one year after stroke. The Cochrane Library. 2008.
5. Kono Y, Kawajiri H, Kamisaka K, et al. Predictive impact of daily physical activity on new vascular events in patients with mild ischemic stroke. *International Journal of Stroke*. 2015;10(2):219–223. [PubMed: 25381835]
6. Pang MY, Charlesworth SA, Lau RW, Chung RC. Using aerobic exercise to improve health outcomes and quality of life in stroke: evidence-based exercise prescription recommendations. *Cerebrovascular Diseases*. 2013;35(1):7–22. [PubMed: 23428993]
7. Veerbeek JM, Koolstra M, Ket JC, van Wegen EE, Kwakkel G. Effects of Augmented Exercise Therapy on Outcome of Gait and Gait-Related Activities in the First 6 Months After Stroke. *Stroke*. 2011;42(11):3311–3315. [PubMed: 21998062]
8. Harris JE, Eng JJ. Strength training improves upper-limb function in individuals with stroke. *Stroke*. 2010;41(1):136–140. [PubMed: 19940277]
9. Butler EN, Evenson KR. Prevalence of physical activity and sedentary behavior among stroke survivors in the United States. *Top Stroke Rehabil*. 2014;21(3):246–255. [PubMed: 24985392]
10. Michael KM, Allen JK, Macko RF. Reduced ambulatory activity after stroke: the role of balance, gait, and cardiovascular fitness. *Arch Phys Med Rehabil*. 2005;86(8):1552–1556. [PubMed: 16084807]
11. Nicholson S, Sniehotta FF, Wijck F, et al. A systematic review of perceived barriers and motivators to physical activity after stroke. *International Journal of Stroke*. 2013;8(5):357–364. [PubMed: 22974010]
12. Rimmer JH, Wang E, Smith D. Barriers associated with exercise and community access for individuals with stroke. *Journal of rehabilitation research and development*. 2008;45(2):315. [PubMed: 18566948]
13. Damush TM, Plue L, Bakas T, Schmid A, Williams LS. Barriers and facilitators to exercise among stroke survivors. *Rehabilitation Nursing*. 2007;32(6):253–262. [PubMed: 18065147]
14. Eng JJ, Chu KS, Kim CM, Dawson AS, Carswell A, Hepburn KE. A community-based group exercise program for persons with chronic stroke. *Medicine and science in sports and exercise*. 2003;35(8):1271. [PubMed: 12900678]
15. Pang MY, Eng JJ, Dawson AS, McKay HA, Harris JE. A community based fitness and mobility exercise program for older adults with chronic stroke: A randomized, controlled trial. *Journal of the American Geriatrics Society*. 2005;53(10):1667–1674. [PubMed: 16181164]
16. Weinrich M, Stuart M, Benvenuti F. Community-based exercise for chronic disease management: an Italian design for the United States? *Neurorehabilitation and neural repair*. 2014;28(8):729–732. [PubMed: 24743228]
17. Salbach NM, Howe J-A, Brunton K, Salisbury K, Bodiam L. Partnering to increase access to community exercise programs for people with stroke, acquired brain injury, and multiple sclerosis. *Journal of Physical Activity and Health*. 2014;11(4):838–845. [PubMed: 23676952]
18. Olney SJ, Nymark J, Brouwer B, et al. A randomized controlled trial of supervised versus unsupervised exercise programs for ambulatory stroke survivors. *Stroke*. 2006;37(2):476–481. [PubMed: 16410482]
19. Billinger SA, Arena R, Bernhardt J, et al. Physical activity and exercise recommendations for stroke survivors. *Stroke*. 2014;45(8):2532–2553. [PubMed: 24846875]
20. Kernan WN, Ovbiagele B, Black HR, et al. Guidelines for the prevention of stroke in patients with stroke and transient ischemic attack. *Stroke*. 2014;45(7):2160–2236. [PubMed: 24788967]
21. Cook KF, Dunn W, Griffith JW, et al. Pain assessment using the NIH Toolbox. *Neurology*. 2013;80(11 Supplement 3):S49–S53. [PubMed: 23479545]
22. Busse M, Quinn L, Debono K, et al. A randomized feasibility study of a 12-week community-based exercise program for people with Huntington's disease. *Journal of Neurologic Physical Therapy*. 2013;37(4):149–158. [PubMed: 24232362]
23. Preston E, Dean CM, Ada L, et al. Promoting physical activity after stroke via self-management: a feasibility study. *Topics in Stroke Rehabilitation*. 2017;24(5):353–360. [PubMed: 28335690]

24. Flansbjer U-B, Holmbäck AM, Downham D, Patten C, Lexell J. Reliability of gait performance tests in men and women with hemiparesis after stroke. *Journal of rehabilitation medicine*. 2005;37(2):75–82. [PubMed: 15788341]
25. Flansbjer U-B, Blom J, Brogårdh C. The reproducibility of Berg Balance Scale and the Single-leg Stance in chronic stroke and the relationship between the two tests. *PM&R*. 2012;4(3):165–170. [PubMed: 22306324]
26. Mong Y, Teo TW, Ng SS. 5-repetition sit-to-stand test in subjects with chronic stroke: reliability and validity. *Archives of physical medicine and rehabilitation*. 2010;91(3):407–413. [PubMed: 20298832]
27. Salbach NM, O'Brien KK, Brooks D, et al. Consideration for the selection of time-limited walk tests post-stroke: A systematic review of test protocols and measurement properties. *Journal of Neurologic Physical Therapy*. 2016;41(1).
28. Nadarajah M, Mazlan M, Abdul-Latif L, Goh H. Test-retest reliability, internal consistency and concurrent validity of Fatigue Severity Scale in measuring post-stroke fatigue. *European journal of physical and rehabilitation medicine*. 2016.
29. Weiss A, Suzuki T, Bean J, Fielding RA. High intensity strength training improves strength and functional performance after stroke. *American journal of physical medicine & rehabilitation*. 2000;79(4):369–376. [PubMed: 10892623]
30. Blum L, Korner-Bitensky N. Usefulness of the Berg Balance Scale in Stroke Rehabilitation: A Systematic Review. *Physical Therapy*. 2008;88(5):559–566. [PubMed: 18292215]
31. Saunders DH, Sanderson M, Hayes S, et al. Physical fitness training for stroke patients. *The Cochrane Library*. 2016.
32. Liu J, Drutz C, Kumar R, et al. Use of the six-minute walk test poststroke: is there a practice effect? *Arch Phys Med Rehabil*. 2008;89(9):1686–1692. [PubMed: 18760152]
33. Jurkiewicz MT, Marzolini S, Oh P. Adherence to a home-based exercise program for individuals after stroke. *Topics in stroke rehabilitation*. 2011;18(3):277–284. [PubMed: 21642065]
34. Poltawski L, Boddy K, Forster A, Goodwin VA, Pavey AC, Dean S. Motivators for uptake and maintenance of exercise: perceptions of long-term stroke survivors and implications for design of exercise programmes. *Disability and rehabilitation*. 2015;37(9):795–801. [PubMed: 25082472]
35. Dalton GW, Keating JL. Number needed to treat: a statistic relevant for physical therapists. *Physical therapy*. 2000;80(12):1214–1219. [PubMed: 11087308]

Figure 1:
Pre- and Post-Session Heart Rate (HR) and Rate of Perceived Exertion (RPE) weekly mean values demonstrating efforts that increased HR and were in the “somewhat hard” to “hard” ranges. Left Axis is for HR, and Right Axis is for RPE.

Figure 2:

Positive effect sizes from Pre-Program Assessment to Post-Program Assessment (19 weeks) and Negative effect sizes from Post-Program Assessment to 20 Weeks Post-Program are shown. The following outcome measures were used: Timed Up and Go (mobility, $d=0.67$ to -0.22), Berg Balance Test (balance, $d=0.57$ to -1.22); 5xSS (strength, $d=0.41$ to -0.30); six minute walk test (endurance, $d=0.09$ to -0.19); Fatigue Severity Scale (fatigue, $d=1.02$ to -0.57).

Table 1:

Results of effectiveness measures for each participant. Shaded areas indicate an improvement in the measure, non-shaded areas indicate a decline in the measure.

Pt #	Gender	Age	Years Since Stroke	Baseline 6MWT (m)	Domain	Change Scores	
						Pre to Post	Post to 20 weeks Post
1	Male	67	12	440m	Mobility	-2.94s [*]	+0.26S
					Balance	+2 ⁺	-4 ⁺
					Walking Speed	-0.14 m/s [*]	+0.08 m/s [*]
					Strength	-2.72s	+2.41 s
					Endurance	+55.8 m [*]	-95.8 m [*]
					Fatigue	-14	+3
2	Male	68	6	276m	Mobility	-2.1s	+0.03s
					Balance	+7 [*]	-5 [*]
					Walking Speed	-0.07 m/s [*]	+0.07 m/s [*]
					Strength	-1.37s	+5.4s [*]
					Endurance	+14.33m	-7.33m
					Fatigue	-13	-2
3	Female	64	4	247m	Mobility	-5.09s [*]	+1.08S
					Balance	-2	-2
					Walking Speed	-0.05 m/s	-0.03 m/s
					Strength	+5.69s [*]	-5.86s [*]
					Endurance	-7m	-19.5m
					Fatigue	-12	+15
4	Male	77	2	269m	Mobility	-1.61s	+1.10S
					Balance	+6 [*]	-2
					Walking Speed	-0.04 m/s	-0.03 m/s
					Strength	-5.38s [*]	+2.9s
					Endurance	+51 m [*]	-18.7m
					Fatigue	-14	+11
5	Male	54	8	673m	Mobility	-0.57s	+0.12s
					Balance	+1 [†]	-1
					Walking Speed	-0.22 m/s [*]	+0.03 m/s
					Strength	-1.77s	+1.78S
					Endurance	-31.2m [*]	-17.6m
					Fatigue	-17	+11

Abbreviations: P#, participant number; AFO, ankle foot orthosis; SPC, single point cane; 6MWT, 6 minute walk test; m, meters; s, seconds; Mobility=Timed Up and Go; Balance =Berg Balance Test; Strength=5 times sit to stand; Endurance=6MWT; Fatigue=Fatigue Severity Scale.

* denotes minimal detectable change (MDC)

$\hat{r}$ indicates a maximum score

Note: 5xSS and FSS do not have MDC values