Research Article

Community exercise programing and its potential influence on quality of life and functional reach for individuals with spinal cord injury*

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Context/Objective: After an individual with a Spinal Cord Injury (SCI) participates in the initial rehabilitation process, they often experience limited access to physical therapy services and other fitness activities. The purpose of this study was to examine previously collected data for changes in quality of life (QoL) and functional reach in individuals with SCI following an 8-week community exercise program.
Design: Secondary analysis of previously collected data.
Setting: Community-based exercise program.
Participants: Twenty-two participants with an average of 9 years post-SCI, both complete and incomplete injuries, and injury levels ranging from C2 to L5.
Interventions: Participants completed an 8-week program, once per week for 4 hours that included a four-station circuit of resistance training, aerobic exercise, trunk stability, and education.
Outcome Measures: Physical function was measured using the modified Functional Reach Test (mFRT). QoL was measured with the Life Satisfaction Questionnaire-9 (LiSAT-9).
Results: The mFRT improved by 2 inches (±7.04) $P < 0.001$ and QoL improved as well, $P < 0.001$.
Conclusion: The findings of this study are consistent with the hypothesis that a supervised post-rehabilitation community exercise program, like Spinal Mobility, may positively impact the QoL and functional reach in individuals with SCI.

Keywords: Spinal cord injury, Community program, Quality of life, Exercise, Function

Introduction

Individuals who suffer a Spinal Cord Injury (SCI) face many challenges adjusting to a new way of life once formal rehabilitation has ended. Approximately 30% of this population is re-hospitalized in a 12-month period due to secondary complications (*e.g.* musculoskeletal, respiratory, and skin diseases) as a result of their injury.[1] Furthermore, persons with SCI often live sedentary lives,[2–5] that put them at a greater risk for conditions such as obesity, high cholesterol, diabetes and heart disease.[6–9] These factors all contribute to lower life expectancies in this population.[1,10] Additionally, changes in rehabilitative care and health management continue to negatively impact this population. Within the past few decades, there has been a 54% decrease in the length of stay allowed for in-patient rehabilitation as well as decreases in reimbursement rates for health services for persons with SCI.[1] Individuals with SCI have also reported a lower quality of life (QoL) in

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comparison to non-disabled individuals[11–13] Many factors can impact QoL in the SCI population including: functional mobility influencing an individual's participation in activities of daily living and fulfilling the roles in his or her life; an individual's perception of their financial stability and his/her potential occupational performance post-injury, the availability of supportive personal and social relationships, and the state of one's mental health, such as presence or history of depression related to adjusting to the disability as well as the individual's subjective overall well-being. [11–13] Therefore, there is a need for post-rehabilitative options that will continue to address the functionality and positively impact these factors of QoL for this population.

Studies have shown that participation in exercise activities has correlated with positive changes in physical functioning and QoL in individuals with SCI.[14–17] Bochkezanian completed a systematic review on exercise interventions in individuals with SCI and revealed that much of the literature is of low quality, however, a few studies on muscle strengthening and QoL demonstrated positive results.[14] Although the literature remains limited, de Oliveira *et al*. demonstrated improvements in functional goals, self-esteem and QoL following an 8 to 12 week exercise program performed twice weekly.[16] Additionally, Van de Scheer *et al.* indicated that exercise could improve fitness and cardiometabolic health in individuals with chronic SCI.[17]

In individuals with SCI, environmental factors such as help at home, accessible transportation, and the natural environment can all influence QoL.[13,18] Persons with SCI also experience barriers to exercise and physical activity in comparison to individuals without SCI, which include: accessible facilities and equipment,[19–21] funding for exercise costs,[19–22] and appropriate exercise guidance.[21–23] It is crucial to encourage participation in and provide adequate access to exercise in this population to combat these challenges. Exercise not only decreases the impact of health risk factors mentioned above, but also increases physical capability and ability to be active participants in the community.[24,25]

Providing avenues for individuals with SCI to participate in physical exercises and become more active can positively influence their functional independence. Triolo *et al*. found that providing stimulation to hip and trunk muscles to assist in providing trunk stability in sitting can positively impact seated posture, extend forward reach, and allow exertion of larger forces on objects in the environment in individuals with SCI.[26] The study suggested that increases in postural control can improve upper extremity function and positively impact these individuals' ability to perform functional tasks. A prospective study conducted by Magnani *et al*. compared physically active and sedentary individuals with SCI.[27] The physically active group had significant improvements over the sedentary group in transfers, self-care activities, sphincter control, anterior and lateral functional reach, and final score of the functional independence measure (FIM). The study suggested that improvements in postural control, or trunk stability, could lead to greater functional independence. Measuring postural control for upright trunk balance while performing activities of daily living is a challenge and few measures exist for individuals with paralysis; however, Lynch *et al.* found the modified Functional Reach Test (mFRT) to be a reliable test for measuring sitting balance for individuals with SCI.[28] The study suggests increasing trunk stability can improve functional reach, and that improvements in functional reach in physically active individuals can positively impact functional independence. Therefore, the evidence points to improvements in functional reach in physically active individuals positively impacting functional independence, and that an improvement in functional reach can also impact QoL.[12,27]

Programs that eliminate barriers and provide targeted facilities, equipment, and guidance for those with SCI are intended to address the lack of post-rehabilitation care within the medical system. A community-based exercise program in New York City, Spinal Mobility, was designed by physical therapists to provide a post-rehabilitation exercise opportunity specifically for people with SCI. This program enables individuals' access to adaptive equipment, education about proper techniques for exercise, and provides a supportive community for individuals with similar limitations.

The purpose of this study was to determine if the community exercise program could impact physical function and QoL in individuals with SCI. We hypothesize that participation in this community program would improve reach function and overall QoL among our sample of individuals with SCI.

Methods

Spinal Mobility is an 8-week community exercise program that meets once a week in a community center setting for four hours and includes a four-station circuit of resistance exercises, aerobic conditioning, trunk stability, and health education. The Spinal Mobility program was designed by a physical therapist

with expertise specific to individuals with SCI and execution was supervised by physical and occupational therapists. The community center setting where the Spinal Mobility program is conducted is operated by the Wheeling Forward organization in New York City. This non-profit organization works with individuals with disabilities to provide mentorship, advocacy, and support services to promote active participation in the community. Spinal Mobility is one of several free-of-cost programs run by Wheeling Forward at the community center. Individuals use public transportation, free ride transportation (Access Ride), have their own vehicle, or are transported by a family or friend in order to participate in the various programs. The organization is financially supported primarily through grant funding. Participants for the Spinal Mobility program are recruited from a variety of sources, including information posted on-line on the Wheeling Forward website and by word of mouth. All interested individuals within the community are welcome to participate in the program at no cost.

Individuals that choose to participate in the Spinal Mobility program sign a participation waiver provided by Wheeling Forward on the first day of the program. There is no exclusion criteria for the program. Participants in the program are informed that the information gathered may be used to study the possible impacts of the program. There is no formal Institutional Review Board (IRB) consent form utilized by Wheeling Forward; individuals who sign the Wheeling Forward waiver can participate in any of the sponsored programs at their community center. The researchers for this secondary analysis received approval from the University IRB to use the de-identified data supplied from Spinal Mobility to examine the program without the need for an institution consent form to be completed by participants.

This secondary analysis examined data from two Spinal Mobility 8-week program sessions. Data were collected at the first session prior to the commencement of the program at week 1 and again following the program's final session at week 8. Data analysis investigated changes in pre and post data using the mFRT and the Life Satisfaction Questionnaire (LiSAT-9). All data were de-identified by program staff that did not participate in the secondary analysis of the data.

Data from 22 participants from two 8-week spinal mobility sessions was included; this included participants for whom data were missing, illegibly recorded, or incorrectly recorded. Complete mFRT data was missing for three participants and the LiSAT-9 was missing complete data for four participants. Participants with incomplete data were not included in the analysis for those outcome measures.

Physical therapist and student physical therapist program volunteers collected all pre and post program data. The program volunteers measured and manually recorded measurement data for the mFRT. Efforts were made to have the same volunteer for each participant for pre and post measurements. Participants completed LiSAT-9 questionnaires independently unless they lacked the hand function to do so. In those cases, questions were read to the participants and responses recorded by program volunteers. Participants were also asked to provide information on the date of spinal cord injury, level of injury, and if the lesion was classified as complete or incomplete. All information regarding injury characteristics was self-reported by the participant, researchers did not have access to patient records or objective diagnostic information.

Measures

Functional reach was modified for a seated position and was measured as the farthest distance the seated subject could reach forward and return to the starting position independently. The program volunteers took the measurement from the distal end of the third metacarpal along a wall-mounted yardstick placed at the height of the acromion of the participant's dominant extremity.[25,27] Measurements were reported in centimeters. The mFRT is a reliable outcome measure for measuring forward reach and sitting balance in persons with SCI who are unable to stand.[28,29] Measuring functional changes in a community setting can pose a problem if an expensive equipment is required. Lynch *et al.* conducted a study with thirty individuals with SCI to determine if the functional reach test could be modified for non-standing individuals as a clinical measure to assess sitting balance. The mFRT was found to have good test re-test reliability for individuals with SCI in both higher level injury groups C5 to C6 and injuries with T1 to T4 levels.[28] This measure of seated forward reach can easily be performed in a clinical setting with a yard stick. There are few measures available to clinicians for assessing postural control or seated balance for individuals with SCI. It is therefore an easily adapted tool for a community program as a functional measure.

The LiSAT-9 is valid and reliable in determining general life satisfaction as well as satisfaction with familial and social relationships.[30,31] The LiSAT-9 includes nine questions, is domain-specific, and asks participants to rank how satisfied or dissatisfied individuals are on a scale of: 1 (very dissatisfying), 2 (dissatisfying), 3 (rather

dissatisfying), 4 (rather satisfying), 5 (satisfying), 6 (very satisfied). The questionnaire contains one overall QoL question and eight additional questions in the domains of: self-care, leisure, vocation, finances, sexuality, partner relationship, family, and social contacts. The LiSAT-9 was scored by adding the individual score of each question into a total sum. The total sum of each LiSAT-9 questionnaire was used as the data point for that participant. There is no established cut-off score for the LiSAT-9 in the SCI population.[30]

Data analyses

Twenty-two participants filled out intake paperwork at week 1 for two program sessions, three participants were excluded for the mFRT and four participants were excluded for the LiSAT-9 due to week 8 questionnaires that were illegible or incompletely answered. The mFRT analysis included 19 participants and the LiSAT-9 analysis included 18 participants. Data were analyzed with IBM SPSS Statistics for Windows (Version 24). Descriptive statistics were used for participant characteristics. Time since the injury was calculated as mean with standard deviation. Injury level was calculated as a frequency. The significance level was set at $P \leq 0.05$. A Shapiro-Wilk test indicated normally distributed data for both mFRT and LiSAT-9. Data from the mFRT were normally distributed ratio data indicating that a parametric analysis was appropriate; a paired t-test was used to analyze the data from the mFRT. Data from LiSAT-9 were normally distributed ordinal data. Due to the ordinal data generated by this test, a non-parametric analysis was used; a Wilcoxon signed-rank test was used to analyze the data from the LiSAT-9.

Results

Participant characteristics

For all participants, time since injury varied from 1.5 to 29 years with a mean of 8.6 ± 6.3 years (Table 1). The level of injury ranged from C2 to L5 and included both complete and incomplete SCI classifications (Table 1). Of the participants, 52% reported cervical injury levels, 37% reported thoracic injury levels, and 10% reported lumbar injury levels. All demographic information was self-reported by the participants.

mFRT

The paired t-test for the mFRT demonstrated a statistically significant ($P < 0.001$) improvement of 5 cm from 27.1 cm (SD ± 16.7) to 32.1 cm (SD ± 17.6) for participants at the conclusion of the 8-week Spinal Mobility program (Table 2).

LiSAT-9

The Wilcoxon signed-rank test indicated a statistically significant ($P = 0.017$) improvement on the LiSAT-9 after completion of the 8-week program (Table 3).

Discussion

This secondary analysis of two 8-week community-based exercise programs catered towards individuals with SCI offers possible optimism for improving post-rehabilitation QoL and functional reach. Improvements in self-esteem, QoL, and fitness levels have been reported following community exercise programs in individuals with SCI.[16,17,27,28,30–32] This study revealed a statistically significant increase in QoL, as demonstrated by the LiSAT-9 outcome measure. Garshick *et al.* found a similar positive association between prescribed exercise programs and a higher satisfaction of life for individuals with SCI.[32] As traditional rehabilitation allowances decline, post-rehabilitative programs, such as Spinal Mobility, may be the key to preserving and improving QoL, functionality, and overall health in individuals with SCI several years post- injury.

Table 2 Paired *t*-test results, mFRT.

n	Pre-intervention mean, cm (± SD)	Post-intervention mean, cm (± SD)	P value
19	27.1 ± 16.7	32.1 ± 17.6	<0.001*

*Significant $P \leq 0.05$.

Table 3 Wilcoxon signed-rank test results, LiSAT-9.

n	Pre-intervention median	Post-intervention median	Z	P value
18	38	43	-2.39	0.017*

*Significant $P \leq 0.05$.

Table 1 Descriptive demographic data for mFRT and LiSAT-9.

	n	Average years since injury	Range years since injury	Level of Injury	Complete	Incomplete	Unknown
mFRT	19	8.6	1.5 – 29	C2 – L5	6	10	3
LiSAT-9	18	8.6	1.5 – 29	C2 – L5	7	10	1

Improvements in physical function have also been shown to positively impact health behavior and overall QoL as demonstrated by Ginis *et al.*[33] Individuals who are able to reach forward further, as captured by the mFRT, also demonstrate improved seated balance and postural control.[34,35] Ability to reach forward could potentially help conserve energy with everyday tasks, perhaps enabling those with SCI to have increased participation in exercise. Recently Lundström *et al.*, found that aging individuals with SCI had decreased participation in planned exercise secondary to variables including spasticity and decreased strength.[36] This is likely attributed to energy conservation in daily activities.[37] There is a positive relationship between increased time spent in recreational therapy and motor Functional Independence Measure (mFIM) scores one-year post discharge.[37] Therefore, participation in community exercise may be critical to maintain mFIM scores, improve overall function, and prevent a decline in the scores post discharge.[37]

Compared to the able bodied community, individuals with SCI tend to have a lower QoL and lack accessible and targeted community programs.[15–17] Additionally, individuals with SCI have increasing life expectancy, as well as, increasing risk of secondary health conditions.[1, 10] Community-based programs, such as Spinal Mobility, address the aforementioned barriers to exercise at no cost to participants and may be the framework for providing exercise opportunities for the aging population. It is possible that community programs may provide an accessible cost effective option for exercise equipment. However, the feasibility of such programs requires access to transportation and financial support. This may be obtained through grant funding that commenced and continues to support Spinal Mobility. Despite these barriers, Spinal Mobility and programs alike may potentially have a positive impact on improving the QoL and participation in those with SCI, which is consistent with this study's hypothesis.

Limitations

Recruitment of participants was not randomized and participants were recruited from one non-profit organization in New York City, for these reasons selection bias is a factor in recruitment for this study. This study was a program evaluation and therefore the data set had irretrievable missing data, which limited the total number of subjects included in each outcome measure. Additionally, participants were only measured again at the end of the 8-week formal program. At this time it is unknown if any gains made by participants would persist past the intervention period. As a cohort study, randomization of participants to control and experimental groups was impossible, limiting the ability to identify cause and effect in this study. Additionally, due to the nature of this study, the reliability of the data collection process was unable to be verified. The small sample from only one community exercise program in the New York metropolitan area and heterogeneity among participants limits generalizability to this location only.

Conclusion

The findings of this study are consistent with the hypothesis that a supervised post-rehabilitation community exercise program, like Spinal Mobility, may positively impact the QoL and functional reach in individuals with SCI.

Future research

Though small in sample, this program evaluation and the supporting evidence of improved QoL and physical functionality through participation in Spinal Mobility and like programs, is a basis for additional research and improvements in post-rehabilitation care for individuals with SCI. Enabling exercise under supervision with accessible equipment and designed specifically for individuals with SCI may provide a mechanism to reduce health risks and complications post discharge. Larger sample sizes with a broader geographic area are required to support the current findings. As future research emerges, hopefully it will stimulate growth and funding for community-based exercise programs.

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Conflict of interest Authors have no conflict of interests.

Ethics approval This work was approved by the institutional review board.

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