Community Cycling Exercise for Stroke Survivors is Feasible and Acceptable

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Community Cycling Exercise for Stroke Survivors is Feasible and Acceptable

Abstract

Background

Physical activity is recommended after stroke but levels for stroke survivors are typically low. The use of indoor recumbent cycling, delivered through local government leisure facilities, may increase access to exercise among stroke survivors.

Objective

This study aimed to evaluate the acceptability and feasibility of an indoor cycling programme delivered through existing local government services.

Methods

Participants were recruited through stroke liaison nurses and public advertising. After a home visit to assess eligibility and conduct psychological and general health assessments, participants attended their local leisure centre for an initial fitness test and short battery of physical tests. Then an eight week training programme was designed with weekly goals. Following the programme the assessments were retaken along with an evaluation questionnaire. In-depth, semi-structured, interviews were conducted with 15 participants and 5 fitness coaches.

Results

115 individuals volunteered to participate during a 10 month recruitment period, 77 met the inclusion criteria and consented, 66/77 (86%) completed the programme including all eight non-ambulatory participants. The programme and procedures (recruitment and outcome measures) were feasible and acceptable to participants (81% reported following the programme). Participants were generally very positive about the experience. Significant improvements in sit-to-stand capacity (M_{pre}=25.2s, M_{post}=19.0s, p=.002), activities of daily living (NEADL, M_{pre}=12.2, M_{post}=13.2, p=.002), psychosocial functioning (SAQOL, M_{pre}=3.82, M_{post}=4.15, p=.001), energy (SAQOL,

M_{pre}=3.75, M_{post}=4.02, p=.018) and depression (GHQ, M_{pre}=.97, M_{post}=.55, p=.009) were observed.

Conclusion

A cycling based exercise programme delivered through local leisure centre staff and facilities was shown to be feasible and acceptable for people living with stroke.

Keywords (3 to 5): Stroke, Exercise, Quality of Life, Physical Fitness

Abbreviations

MRC: Medical Research Council

STS: Sit to stand

FTSTST: Five Times Sit-to-Stand Test

PWS: Preferred walking speed

6MWT: Six-Minute Walk Test

NEADL: Nottingham Extended Activities of Daily Living Scale

SAQOL-39: The Stroke and Aphasia Quality of Life Scale

GHQ-28: The General Health Questionnaire

PSQI: The Pittsburgh Sleep Quality Index

MoCA: Montreal Cognitive Assessment

FAS: The Fatigue Assessment Scale

FITT: Frequency, Intensity, Type and Time

Introduction

Physical activity after stroke improves fitness and capacity to carry out daily activities, with growing evidence for positive cognitive[1, 2] and quality of life outcomes.[3] This evidence has been produced consistently across a wide range of high quality studies[4] using well controlled methodologies. The same body of literature, however, reports the persistence of very low levels of physical activity among stroke survivors[5, 6] suggesting difficulties translating research evidence into the real world.

Whilst adherence to physical activity programmes among stroke survivors participating in research trials can be high, for example Mead et al.[7] reported 100% attendance for 59% of participants, this positive response may not reflect experiences outside the controlled environment of a research trial where high levels of resource and support are common. Taking advantage of local government funded leisure facilities may be a more acceptable and economically sustainable model, albeit with the continued involvement of health professionals which has been shown to improve attendance amongst individuals with poorer physical function.[8]

Indoor cycling, particularly with semi-recumbent cycle ergometers, offers specific advantages for stroke survivors attempting to exercise. These ergometers provide a safe stable environment with adaptable positions for wheelchair users and an ability to make incremental changes to cadence and resistance to tailor exercise. The use of cycle ergometers with stroke survivors has been reported to be safe and acceptable with evidence of improvements to balance, strength, general function and motor control.[9, 10] These findings can, at least in part, be explained by the similarity (kinematics and muscle activation) between recumbent cycling and the functional tasks of climbing a step and rising from a chair.[11]

This study investigated the feasibility of community dwelling stroke survivors participating in a cycling based exercise programme delivered through existing local government funded staff and facilities. The primary aim was to assess feasibility and acceptability, this comprised recruitment, assessments, adherence and acceptability of the exercise programme from both the participants and fitness coaches' perspective. Secondly, to collect evidence of any change in outcome measures to inform future controlled trials.

Material and Methods

This was a mixed methods feasibility trial with a 'pre-post' intervention quasi-experimental design (UKCRN - ID 17583) based on Medical Research Council (MRC) guidelines for the development of complex interventions.[12] The methods conform to the STROBE Guidelines (see supplementary information).

Participants

Participants were medically stable stroke survivors resident within Lanarkshire (Scotland) local council area. The local councils are responsible for providing local services and facilities, including sport and leisure.

Participants responded to verbal invitations from a stroke liaison nurse who routinely see patients during the 12 month period following discharge and recruitment posters placed in community locations and local newspapers. The study was approved by the East of Scotland Research Ethics Committee (14/ES/1080). Individuals interested in participating were invited to contact the research group who screened for eligibility, using the following criteria, and then sent an information package. The recruitment period lasted 10 months (01/12/2014 until 30/09/2015).

Inclusion criteria; a diagnosis of stroke (physician confirmed), over 18 years old and resident in Lanarkshire. Exclusion criteria included; contraindications to physical

activity, a recent injurious fall without medical assessment, cognitive impairment severe enough to prevent protocol adherence, assessed with the Montreal Cognitive Assessment (MoCA)[13] and advice from the clinical team.

Materials

Physical capacity

Four tests of physical capacity were conducted: 1) Five Times Sit-to-Stand Test (FTSTST)[14] where the time to perform 5 sit to stand movements is recorded, 2) preferred walking speed (PWS), timed over 5 meters[15], 3) Six-Minute Walk Test (6MWT) using a standard treadmill[16], where the distance walked during 6 minutes is recorded and 4) the Nottingham Extended Activities of Daily Living Scale (NEADL)[17], which is a widely used self-reported measure of functional mobility with scores ranging from 0-22, higher scores indicating better ability.

Psychological and general health

The Stroke and Aphasia Quality of Life Scale (SAQOL-39)[18]: This is a self-reported measure of quality of life with scores ranging from 0-5, higher scores indicating better quality of life. The General Health Questionnaire (GHQ-28)[19]: A self-reported measure used to assess emotional distress in adults. Scores range from 0-28, with scores above 4 indicating the presence of distress. The Pittsburgh Sleep Quality Index (PSQI)[20]: A self-reported measure with scores ranging from 0-21, scores of five or greater suggesting poor sleep quality. The Fatigue Assessment Scale (FAS)[21]: A self-reported measure used to assess chronic fatigue and its interference on mental functioning and activities of daily living. Scores greater or equal to 22 indicating interference from fatigue.[22]

Semi-structured evaluation questionnaires and interviews

An evaluation questionnaire gathering participants' opinions on the whole experience from recruitment (e.g. how they found out about the programme) to individual sessions

(e.g. were they able to adhere to the exercise protocol) was completed by all participants. These were followed by in-depth semi-structured interviews with participants who were sampled consecutively during the final 2 months of recruitment (n=15). The interview questions were developed by the research team to cover all aspects of the study; they were open ended to promote discussion (see supplementary files for a sample of the interview questions) and were checked for understanding during a pilot with two participants. Similarly, five fitness coaches (one from each participating centre) were interviewed to gather opinions on feasibility and acceptability (e.g. level of support offered to participants during exercise sessions) from the leisure centre's perspective (see supplementary files for a sample of the interview questions). All interviews were conducted by a researcher not directly involved in delivery of the intervention within 3 months of the final exercise programme being completed.

Intervention

The programme was based on the Scottish Government funded 'Best Practice Guidance for the Development of Exercise after Stroke Services in Community Settings'[23]. These guidelines advocate the principle of incremental overload adapted to individual needs and goals and broadly follow the FITT (frequency, intensity, type and time) principles, which have been shown to be feasible and effective in stroke populations[7]. The specific content of the eight week programme was determined by a fitness coach following four principles. 1) Frequency: 2-3 sessions per week, 2) Intensity: A moderate level was targeted based on a rating of perceived exertion24 during the initial fitness test (see below), 3) Type: Cycling was the main feature but other activities could be included for motivational purposes. 4) Time: Increasing duration to a maximum of 30 minutes of cycling per session.

Before recruitment commenced training sessions for the fitness coaches were held at each of the five participating centres and the equipment available for participants was standardised across the centres.

Procedure

Following consent participants met with a researcher at home who assisted them in completing the MoCA, SAQOL-39, GHQ-28, PSQI and FAS. Participants were then given an appointment at their nearest participating leisure centre where a fitness coach administered the NEADL and supervised a fitness test comprising cycling with an initial resistance of 25 watts which was increased by 10 watts every 2 minutes until the participant indicated they could not continue or had reached 80% of their maximal heart rate (208 - 0.7 x age). Based on this, and information regarding stroke related impairments and other conditions, the coach constructed a weekly programme. Participants with insufficient strength to turn one or both pedals were instructed in the use of a MOTOmed® (RECK-Technik, Betzenweiler, Germany) assisted bicycle and given progressive targets based on assistance from the bike's motor.

The eight week personal training plan was then explained to participants and weekly goals set collaboratively. Participants were provided with an educational pack describing the benefits and side effects of physical activity, as well as practical information about the leisure centre including public transport. They were then left to follow the training plan with supervision from the fitness coaches who had specific qualifications delivering exercise to mobility impaired individuals. Attendance at the leisure centre was recorded using magnetic swipe cards and participants and fitness coaches were given activity logs with weekly individual targets for participants to record their activity. Fitness coaches were asked to record adverse events. After eight

weeks participants were asked to repeat the outcome measures and an evaluation questionnaire, face-to-face, over the telephone, or by post.

Analysis procedure

The semi-structured interviews were transcribed and coded using NVivo11 software and analysed using the principles of thematic coding until data saturation was reached[25]. Descriptive statistics and t-tests were used to analyse change in the outcome measures.

Results

Recruitment and adherence

Recruitment lasted 10 months with a limit of two new participants per week due to the research team's capacity. 115 participants expressed an interest in the study, 38 were not consented as they; decided not to take part (16), did not fulfil the eligibility criteria (15), required better set up of services, including a closer centre or transport difficulties, (5) and expressed an interest after recruitment had ended (2). A total of 77 participants were therefore consented during the recruitment period giving a recruitment rate of 7.7 per month. They had a mean age of 63.7 years (SD 12.6, range 21-85) and were 34.4 months (SD 46.3, range 5-231), on average, post stroke. 46/77 (60%) were male, 39/77 (51%) had experienced an Ischaemic stroke, 13/77 (17%) had a Haemorrhagic stroke and 25/77 (32%) were unknown. The majority (49/77, 64%) used some form of walking aid and 9/77 (12%) were wheelchair users.

From 77 participants who started the programme 66 completed (86% retention rate). 11 participants did not complete; 5 failed to attend any session, 3 had ill-health, 2 decided they no longer wished to participate and 1 participant died.

Suitability of assessments

Completion rates, at baseline and outcome, were high for the STS (91%), while only 55% completed the 6MWT. All participants completed the bicycle fitness test with 69% using a recumbent or upright bike and 31% using the power assisted bicycle.

From the evaluation questionnaire, 79% reported they were able to complete the tests relatively easily, however 6% reported some difficulties. The interview data produced similar findings with most reporting that they had no issues with the physical assessments. The coaches who were also interviewed were happy with the testing procedures but noted difficulties for the more severely impaired participants to complete the treadmill test.

Completion rates, at baseline and outcome, for the psychological questionnaires ranged from 89% to 94%. The researcher was present and assisted in the majority of cases, however, a minority chose to complete them on their own with 5% of participants returning questionnaires with missing items and 3% not returning them at all. Of the 64 participants who completed the eight week evaluation questionnaire, 48% specifically mentioned that they required help and/or appreciated assistance from the researcher to complete the measures. 40% stated that they had no issues in particular with the questionnaires but 11% indicated they had some issue with the more sensitive items in the General Health Questionnaire.

Acceptability

The programme was acceptable to both ambulatory and non-ambulatory participants. 12% of participants were wheelchair users and 64% individuals required a mobility aid such as a cane or walking frame.

Almost all (98%) of participants who completed the evaluation questionnaire responded positively to the programme, stating that it met their needs, and they would recommend it to other stroke survivors. Some potential improvements were given such

as adapting the programme to include upper limb exercises (9%), having more local programmes (5%) and greater staff awareness of the wider consequences of stroke and related co-morbidities (5%).

The vast majority (98%) of participants felt comfortable in the leisure centre, reporting that there was not much else the staff could have done to improve their experience. Some negative aspects were mentioned, for example, 23% reported they would have liked improvements in equipment or facilities, 5% would have like more contact with staff and 3% reported that better organisation was required.

Interviewed participants felt supported, consistently stating that they felt the programme was beneficial and support was available from both the research team and fitness coaches:

"Very good, I felt that it was something that I needed and it came just at the right time and it just has made me go from strength to strength so I can't praise it enough" (P111)

"Yes, I did find it helpful, because I think that if I walked into the gym, I would probably would have walked out again" (P67)

Adherence

Different objectives for the exercise programme were created for participants (see Table 1 for details). 29% (19/66) of participants aimed to increase duration with 84% managing to adhere to this, however, there was considerable variation of actual change in cycling time, ranging from 5 to 90 minutes. 29% (19/66) of participants were given a plan to maintain the same exercise routine for the whole 8 weeks as incrementing was not considered appropriate. None of the plans aimed to increase frequency or the combination of frequency, duration and intensity.

Entry swipe card data proved to be an unreliable measure of adherence and only 65% of participants returned their activity logs. From the returned logs 73% of

participants adhered to their plan, however, when asked in the evaluation questionnaire 81% participants reported they had adhered to the programme, and 69% reported that they enjoyed the goal-oriented aspect of the programme. 22% reported negative or partially negative responses, with 8% reporting pain flares up or other physical issues.

The interview data revealed that participants felt the plan had contributed to their adherence with improved motivation through monitoring of progress.

"I think I need that discipline. And again I think with a gym, if you've got a tailored plan then that that's your routine – that's what you stick to" (P73)

The coaches reported no problems in developing tailored plans. Alterations to the plans were made depending on how the participants felt and this was carried fluidly between coach and participant.

Improvements in fitness and quality of life

49/77 (64%) of participants were able to complete the STS test (Table 2) at baseline, 91% of whom took longer than 12s, indicating substantial impairment[14]. These scores significantly improved after the programme (Mpre=25.2s, Mpost=19.0s, $t(48)=3.28$, $p=.002$), with an average reduction in time of 4.81s. By outcome 18% of participants had reduced their score to below 12s. Walking speed at baseline was slow (PWS: Mpre=0.69 m/s, range=0.2m/s – 1.9m/s) and this improved, though not statistically significantly, following the programme ($t(45)=1.94$, $p=.059$). The distance walked in six minutes (6MWT) was completed by 19 participants and showed no significant change after the programme ($t(18)=.05$, $p=.96$). Activities of daily living (NEADL), however, did significantly improve (Mpre=12.2, Mpost=13.2, $t(52)=3.26$, $p=.002$).

The scores for the SAQOL-39 were relatively high at baseline and improved significantly post-programme, with improvements in the subscales of psychosocial functioning (Mpre=3.82, Mpost=4.15, $t(56)=3.42$, $p=.001$) and energy (Mpre=3.75,

Mpost=4.02, t(57)=2.44, p = .018). Similarly, overall levels of distress were low at baseline and improved significantly (Mpre=6.18, Mpost=4.19, t(56) = 2.19, p = .033) with significant changes on the depression subscale (Mpre=.97, Mpost=.55, t(57)=2.70, p=.009) but not the other subscales. Reasonably good baseline sleep scores (PSQI) did not suggest extreme sleep problems, however, 63% of participants had a score of 5 or more at baseline indicating poor sleep quality. Overall significant changes in PSQI scores were not found, but further analyses of ambulatory participants showed a significant improvement (t(50)=2.27, p=.028) for this sub-group.

Finally, the FAS showed 31% of participants were experiencing substantial or extreme fatigue at baseline and there was no overall significant improvements in this following the programme. Some participants did report changes though:

"What I am finding more is that I'm sleeping more at night, basically when I go to bed I usually hit the pillow and I'm out anyway, but I think it's mainly because of the exercise." (P29)

Seven adverse events were noted over the recruitment period, two attributable to the study involving minor injury through falling off a treadmill.

Discussion

This quasi-experimental study was conducted primarily to test the feasibility and acceptability of a physical activity programme that was designed to be sustainable through the use of existing local government facilities and accessible to all stroke survivors by using standard and powered cycling ergometers.

The programme was popular, with 115 individuals expressing an interest, representing around 1% of the estimated stroke population living within the NHS Lanarkshire health board area. A promising outcome from the recruitment process was the number of non-ambulatory participants (n=9), which contrasts with most other

studies of physical activity in stroke populations which typically include individuals with at least minimal ambulatory ability[26]. In this regard the study is in line with guidelines for wider access to physical activity for stroke survivors[27].

The recruitment figures support the use of leisure centres for delivering physical activity classes to the whole stroke survivor population, and the leisure centre staff also found the programme to be feasible and acceptable. It should be noted however that the average age of participants (63.37 years) was relatively young, suggesting the programme may be less appealing to older people or that the stroke liaison nurse was less likely to approach them.

The high level of adherence (81%) to the programme was a very positive outcome. While exercise adherence is not well reported in stroke studies[8] it is generally considered to be low, for example Miller et al.[28] report a 65% adherence rate. This reinforces the benefits of using local leisure centres which not only have fitness coaches to supervise the activities but a range of exercise equipment to tailor the programme to the changing needs of the individual. The social reward in attending the centre may also have contributed to this high adherence rate.

In terms of the assessment measures these were acceptable except for the high numbers who could not complete the treadmill six minute walk test. It should be noted that the completion of questionnaires typically required assistance and some participants raised concerns about the more sensitive elements of the General Health Questionnaire. The statistically significant improvements in STS ability are consistent with the principle of training specificity as the motor pattern of recumbent cycling and STS are similar[11]. Upright cycling has a motor pattern considered comparable to walking[29] and, if used, might have promoted greater recovery of walking function. While these

improvements did not impact on walking function, the improved STS capacity is nevertheless a valuable outcome given the importance of this movement in daily life[30].

Significant improvements to quality of life and general health, specifically psychosocial functioning, energy and depression, were encouraging as these can be difficult to alter following stroke[31, 32]. The improvement in sleep quality in the ambulatory participants was also positive as other reports have indicated that up to 37% of stroke survivors experience insomnia one year post-stroke[33]. However, it should be noted that the study participants did not demonstrate particularly poor levels of quality of life, distress or sleep at baseline.

Study limitations

The study had a number of limitations; firstly the activity logs and entrance swipe card monitoring used in this study did not yield sufficiently reliable data, more efficacious ways of tracking exercise participation should be considered. Secondly, similar to previous studies, this study attracted younger participants with relatively high psychosocial functioning compromising external validity to the wider stroke community. Thirdly, using treadmills was too demanding for many participants and were related to the two related adverse events.

Conclusions

The most important findings of this study were the willingness of participants to undertake an exercise programme in their local leisure centre despite ongoing disability. The study achieved its primary goal of testing the acceptability and feasibility of this method of exercise delivery in the local community using recumbent cycle ergometers as the focus of the programme due to their close similarity in the motor pattern of the STS movement and their general accessibility.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, [AK]. The data are not publicly available due to restrictions on information that could compromise the privacy of research participants.

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480 Table 1: Programme objectives and percentage of participants (n=66) who followed

481 them

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	Objective	Followed plan	% Who followed
Duration	↑19	16	84
Intensity	↑2	1	50
Frequency	↑0		
Duration and intensity	↑11	7	64
Duration and frequency	↑0		
Intensity and frequency	↑1	1	100
Duration, intensity and frequency	↑0		
Maintain	↑19	13	68
Programme not returned	14	Not known	
Total	66	38	58

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484 Table 2: Outcome measures at baseline and following programme (outcome)

Test	Baseline Mean (SD)	Outcome Mean (SD)	p
STS (s), n=49	25.2 (20.2)	19.0 (10.9)	.002
Preferred walking speed (m/s), n=46	0.7 (0.4)	0.9 (0.5)	.059
6 minute walk test (m), n=20	327.7 (228.9)	325.5 (292.2)	.960
NEADL, n=53	12.2 (6.1)	13.2 (6.4)	.002
SAQOL-39 Total, n=55	3.9 (0.7)	4.1 (0.7)	.007
GHQ-28 Total, n=57	6.2 (4.7)	5.0 (3.9)	.033
PSQI, n=56	6.2 (4.4)	5.3 (3.8)	.071
Fatigue Assessment Scale, n=57	19.9 (8.8)	18.8 (7.3)	.120

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