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Home based tele-exercise for people with Chronic Neurological Impairments, COVID-19 and beyond: Protocol for a randomized control trial (RCT)

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3 Home based tele-exercise for people with Chronic Neurological Impairments, COVID-19
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5 and beyond: Protocol for a randomized control trial (RCT)
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55 training.
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Abstract

Introduction: Exercise is vital to staying well and preventing secondary complications in people with Chronic Neurological Impairments (CNI). Appropriate exercise is often inaccessible to this population and effectiveness of virtual programs has seldom been studied. The purpose of the study is to investigate the effects of a 12-week seated virtual exercise program on heart rate, recovery, fatigue, pain, motivation, enjoyment, and quality of life in people with CNI. **Methods and Analysis:** Individuals with CNI will be screened for eligibility, and a total of 60 participants will be randomized into either a live or pre-recorded group. The live group will exercise with an instructor via Zoom while the pre-recorded group will exercise at their chosen time using pre-recorded videos. Heart rate during exercise/recovery, fatigue, motivation, level of pain and exertion will be assessed before and after each session. Physical well-being, enjoyment of physical activity, motivation, and quality of life will be assessed at baseline, midpoint, end of study, and one-month post-study. Adverse events, medication changes, and physical activity will be tracked throughout. Within-group and between-group comparisons will be performed using Wilcoxon Rank-Sum and Kruskal Wallis tests, respectively. **Ethics and Dissemination:** NCT04564495. Registered on September 25, 2020. Protocol version 1, dated May 15, 2022. Funded by Sabrina Cohen Foundation, the Burke Foundation, and grant number UL1 TR 002384 from the National Center for Advancing Translational Sciences (NCATS) of the National Institutes of Health (NIH).

Strengths and Limitations

Strengths

1. This is the first study to evaluate the impact of virtual adaptive seated exercises on cardiovascular function in individuals with chronic neurological impairments during COVID-19.
2. If objectives are met, individuals may be able to participate in virtual exercise programs without any expenditure of cost, travel, or time for community and fitness centers.
3. This study will use a comprehensive set of physiological and behavioral assessment measures to correlate effects of moderate intensity exercises on personal engagement and wellness.

Limitations

1. For those participants with limited technological experience, difficulty using blood pressure devices and heart rate monitors will cause missing data values.
2. The study population includes participants with any neurological diagnosis; thus, it is possible that the findings will not be generalizable to a specific sub-population.

Introduction

Exercise is a vital component to staying well and preventing secondary impairments. Exercise is known to positively influence a range of factors including cardiovascular health, cognition, mental health, bone health, sleep, and quality of life, among many others¹⁻⁸. The benefits of exercise are further amplified in the estimated one billion people worldwide with Chronic (> 6 months) Neurological Impairments (CNI), as the injuries often lead to sedentary lifestyles and thus higher rates of obesity and cardiovascular disease. Incorporating an exercise regimen is vital to preventing secondary complications such as muscular weakness, fatigue, limited mobility, pain, spasticity, bone loss, and increased risk of fractures, falls, diabetes, depression, and obesity⁷⁻¹⁰. Exercise can be neuroprotective and neuro-regenerative by increasing neurotrophic factors, which are involved in neuroprotection, neuroplasticity, and maintenance of neuronal health^{2, 11-15}. Exercise can also improve muscle strength and bone integrity in people with CNI¹⁶⁻¹⁸.

People with CNI often cannot access community exercise centers, as mobility can be more difficult, insurance payments sparse, centers not welcoming or accessible, and assistive exercise equipment too costly for most facilities¹⁹⁻³². The COVID-19 pandemic has further reduced exercise options for people with disabilities, since many of these individuals are at increased risk of COVID-19 complications and therefore often cannot return to fitness centers.

Another key barrier to exercise for people with CNI is transportation³³. Although COVID-19 introduced many new barriers to community participation, it also had some silver

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2
3 linings for people with CNI. COVID-19 resulted in the emergence of many new Zoom or
4
5 online classes tailored to people with CNI, which removed the barrier of transportation.
6
7

8 This study will examine the cardiovascular benefits, as well as differences in
9
10 compliance, motivation and feelings of socialization and exertion between synchronous
11
12 and asynchronous classes. The classes will be held for 12 weeks, 3 times/week using
13
14 seated exercise via Zoom. The instructor will remain the same and alternate between
15
16 boxing, high intensity interval training (HIIT) and power posture classes. We will
17
18 examine the potential benefits of an accessible form of exercise for a population that is
19
20 in urgent need, during times of COVID-19 and beyond. Additionally, by comparing live
21
22 group synchronous and solo pre-recorded asynchronous classes, we will compare user
23
24 compliance, motivation, enjoyment, and socialization.
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29 We hypothesize that individuals in the synchronous class will have better attendance,
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31 more robust exertion as measured by heart rate, and better enjoyment than people in
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33 the asynchronous class, due to the social component of the synchronous classes. We
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35 hypothesize that participants in both groups will show improvement in heart rate
36
37 recovery, physical wellness, quality of life, enjoyment, and motivation/engagement, and
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39 that changes will be greater in the synchronous class due to consistent supervision and
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41 contact.
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49 **Methods and Analysis**

50 **Study Design**

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3 This study is a parallel randomized controlled trial to investigate the effects of a 12-
4 week, 3 times/week, seated tele-exercise program for adults with chronic neurological
5 impairments (Figure 1). All 36 exercise sessions will be completed online via Zoom with
6 the physical exercise instructor (live, synchronous group) or offline using recorded
7 videos (pre-recorded, asynchronous group). Participants will be in their own homes as
8 they complete the exercise classes. Participants can continue their medications,
9 physical, occupational, speech therapies, and existing exercise routines (2 times/week
10 or fewer).

21 22 **Eligibility Criteria and Participants**

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24
25 The eligibility criteria will be kept broad to accommodate all neurological impairments.

26 27 28 Inclusion Criteria:

- 29
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31 1. Participants diagnosed with Chronic (>6 months) Neurological Impairments
 - 32
33 2. Ages 18 to 75 years
 - 34
35 3. Able to sit for at least 1 hour
 - 36
37 4. Stable Heart rate (HR) and Blood Pressure (BP)
 - 38
39 5. Medical clearance to participate in moderate intensity exercises
 - 40
41 6. Can don and doff a wrist HR monitor with or without assistance
 - 42
43 7. Can maintain daily exercise and physical activity during the study
 - 44
45 8. No other neurological, medical or cognitive impairments
 - 46
47 9. Able to access the internet and use the cloud-based Zoom conference platform
 - 48
49 10. Ability to speak and understand English
 - 50
51 11. Currently exercising 2 days or less per week
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3 12. Presence of caregiver or supervisor during exercise, for safety
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6 Exclusion Criteria:
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- 8
9 1. Unstable or uncontrolled medical conditions
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11 2. Medical issues preventing safe participation
12
13 3. Unable to follow simple 2-step commands
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19 **Number of Participants**
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22 We plan to conduct multiple cohorts of participants, each with different participant
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24 populations, e.g., multiple sclerosis, cerebral palsy, stroke, spinal cord injury.
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26
27 For each cohort, with 25 participants in the synchronous and asynchronous groups, we
28
29 will have 80% power to detect a change in mean heart rate from about 80 bpm to 100
30
31 bpm (or greater) at 12 weeks (final session) (in each group, separately), using a paired
32
33 t-test with a 0.05 two-sided significance level. This calculation assumes a conservative
34
35 standard deviation of the pre/post differences in heart rate of 35 bpm at 12 weeks (final
36
37 session). We plan for a 20% dropout rate, which means that we will recruit 30
38
39 participants per group to achieve 80% power.
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47 **Recruitment**
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50 Participants will be recruited via the Sabrina Cohen Foundation, which has a network of
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52 people with chronic neurological disabilities, and by BNI who has a database of
53
54 potential participants from prior studies or programs. We will also post our recruitment
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3 flier on our website, social media, and will mail it to neurological patient advocacy
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5 groups. If we cannot recruit appropriate numbers using these methods, we will pursue
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7 paid advertising in our community.
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10 11 12 13 **Randomization**

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16 One study team member will generate a series of permuted randomized blocks in a
17
18 computerized spreadsheet with a defined block size of 4. Participants will be allocated
19
20 to either the live (synchronous) or pre-recorded (asynchronous) group, with a 1:1 ratio
21
22 between groups. Due to the nature of the intervention, it is not possible to conceal
23
24 allocation from the participants or the study team. However, the two groups will never
25
26 interact with one another.
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34 **Blinding and Rigor of Data**

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37 Due to the nature of the study, blinding of participants and study team members to
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39 group allocation will not be possible. All participants will complete the outcome surveys
40
41 directly online, without input or assistance from the study team. Heart rate data will be
42
43 collected through a heart rate monitor that collects quantitative data without input or
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45 filtering by the study team.
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52 **Intervention**

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3 The exercise intervention will be delivered by a trained professional who specializes in
4 adaptive exercise for individuals with CNI. The instructor will structure each class to
5 ensure standardization in terms of class structure, including warm-up, cool-down, cues
6 for recording heart rate during class, use of additional equipment, and adherence to the
7 general study protocol.
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15 All participants, regardless of allocation to live or pre-recorded groups, will participate in
16 45 minutes of aerobic exercise intervention, three times a week, for a period of 12
17 weeks. The overall exercise session will be up to one hour long to include measuring
18 vitals, answering questions before/after sessions, and rest breaks (if any). Two
19 additional weeks will be provided for making up missed sessions, if applicable. Each
20 intervention will be preceded by a warm-up and followed by a cool-down period. All
21 participants will be asked to document any adverse events and changes in medications
22 before each session. The order of classes will be rotated. Individual aerobic
23 interventions for the first cohort are described below.
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36 High intensity interval training (HIIT): HIIT involves repetitive bouts of high intensity
37 exercises with intermittent periods of rest or active recovery. Exercise intensity could be
38 as high as 80-100 percent of maximal heart rate during the intense circuits, but the
39 duration of each bout of high intensity is about 10-30 seconds. Since this study will
40 include participants with variable neurological impairments, the upper limit of exercise
41 intensity in HIIT will be dependent on instructor's judgement, participant feedback, and
42 rate of perceived exertion.
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53 Boxing: Boxing involves a circuit of individual and combinations of moves like 'jabs',
54 'hooks', and 'uppercuts.' Boxing is a moderate to high intensity aerobic activity by
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3 nature. Traditionally, bouts of upper body punching moves are planned around
4
5 'shuffling' to promote active recovery. All interventions will be done in a seated position
6
7 to ensure participants' safety in their home environments. Active recovery will include
8
9 upper body shuffling motions, relaxed upper body movements, etc. The exercise
10
11 intensity for boxing, as in HIIT, will be subjective for participants based on level of
12
13 perceived exertion as well as exercise heart rate restrictions, if any.
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17 Power posture: Power posture is a HIIT-style strength and endurance class that
18
19 promotes postural awareness. The warm-up period will be 5-10 minutes and focused on
20
21 education of movement with slow, gentle repetitions to prepare the trapezius and other
22
23 supporting scapular muscles for movement. This HIIT workout will target form, with fast
24
25 paced targeted movements for 10-12 minutes. The cool-down will focus on gentle deep
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27 neck flexor/extensor chin tuck exercises, range of motion, and stretching.
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35 **Virtual Nature of the Study**

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38 Each aspect of this study will be performed virtually. Screenings will be performed on
39
40 the telephone, with a standard list of criteria asked of each person. If deemed eligible,
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42 the potential participant will be sent a Zoom link to go through the informed consent on
43
44 a one-to-one basis. The informed consent will be uploaded to REDCap, a secure web
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46 application for building and managing online surveys and databases. REDCap is 21
47
48 CFR Part 11-ready and HIPAA compliant and is specifically geared to support online
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50 and offline data capture for research studies and operations.
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3 To obtain informed consent directly from participants, a study team member will arrange
4 a Zoom call with each participant. The informed consent will be signed virtually by
5 sharing a virtual remote with the participant during the call. If anyone has difficulty, they
6 can be sent the informed consent from REDCap via email and return it to REDCap just
7 as easily. Each participant will be sent a copy of their signed consent form via the same
8 REDCap email system.
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17 Each participant will be mailed a home exercise kit, which will contain a Polar optical
18 heart rate monitor (OH1), yellow and green resistance TheraBands and wrist weights.
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23 All questionnaires and questions to be answered before and after each class will be
24 sent from and stored on REDCap. All heart rate data will be transmitted to the Polar
25 website, which can be accessed only by the participant or the researchers. Then, the
26 data will be analyzed in MATLAB using custom scripts written by the study team.
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36 **Study Safety**

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38 We will monitor side effects before and after each session by having participants
39 complete surveys on REDCap. If pain or blood pressure are higher than usual, we will
40 ask the participant if they wish to continue. If blood pressure rises near limitations
41 prescribed by a participant's doctor, we will discontinue the participant. If any injury
42 occurs during or outside of study sessions that may increase the risk of further injury,
43 we will discontinue the participant.
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53 **Patient and Public Involvement**

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3 Persons with disabilities were involved in the design of this study, and will be involved in
4 the conduct, reporting, and dissemination plans of this research.
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10 11 **Strategies to improve adherence**

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14 The study team will take attendance at each synchronous session and will monitor
15 session completions for the asynchronous group. If a participant misses a class, we will
16 reach out and inquire about their ability to attend future sessions. We have *a priori* set a
17 minimum number of 30 of 36 classes that a participant must attend to be included in the
18 main analyses of the study. We will offer 2 weeks of makeup sessions at the end of the
19 12 weeks. If a participant drops out before completing 30 sessions, we will encourage
20 them to complete the post-study outcome measures and the satisfaction survey. We will
21 use the number of sessions completed as a covariate in the analyses.
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Outcome Measures

Session-specific Measures

Session-specific outcomes will capture changes before, during, and after each exercise session for both groups.

Heart rate tracking

Continuous heart rate tracking is the primary outcome measure for the study. All participants will receive the OH1 Polar HR monitor as part of their exercise kit for the study (Figure 2). Scheduled virtual training sessions will be held to train participants for

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3 donning/doffing the heart rate monitor, using the Polar app, using their Polar accounts,
4
5 syncing the Polar devices with their smartphones and starting/ending their heart rate
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7 tracking during exercise sessions. Heart rate (HR) tracking for exercise sessions begins
8
9 at the start of the session and ends at 10 minutes after completion of session to capture
10
11 heart rate during exercise (at 10Hz) as well as HR recovery after the end of exercise
12
13 sessions. The live group will be supervised by the research team for each session. The
14
15 pre-recorded groups will have the research team available for assistance and
16
17 troubleshooting. Data are stored on the Polar Coach website, where study staff can
18
19 export sessions as CSV files that are then processed in MATLAB (MathWorks). In
20
21 MATLAB, baseline HR, peak HR, HR at end of session, and HR at 30s intervals for
22
23 5min after the end of the session will be analyzed, to measure heart rate recovery.
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29 **Secondary session-specific measures**

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32 On the day of the intervention, participants will complete an online assessment to rate
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34 the level of pain and perceived exertion (RPE), BP, HR, and adverse events before and
35
36 after the exercise session. After the session is over, participants will complete a lab-
37
38 developed survey to rate their experience on a 10-point scale from 1 (not a good
39
40 experience) to 10 (very good experience) on questions related to motivation, energy,
41
42 satisfaction, and performance. In addition, participants will provide information on
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44 changes related to health, falls, or other adverse events.
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52 **Timepoint Measures**

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3 A comprehensive set of outcome measures will be completed by participants at
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5 baseline, mid-study (6 weeks), end of study (12 weeks) and follow-up after one month.
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7 On study completion, participants will complete a study feedback form. The feedback
8
9 will be based on study acceptance, ease of using HR and BP devices and exercise
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11 equipment, and support from the research team. Participants who do not complete the
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13 study will also provide their final timepoint measure at the end of their final exercise
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15 session.
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20 *Physiological Measure*

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23 Polar OH1 Heart Rate (HR) monitor: the Polar OH1 (Polar Electro Inc., Bethpage, NY,
24
25 USA) is an optical heart rate sensor on an armband that records HR activity. It has 6
26
27 LED sensors that record at 1-second intervals³⁴. HR activity is recorded via Bluetooth to
28
29 a phone compatible with the Polar Flow or Polar Beat app. It has validity in moderate to
30
31 vigorous intensity exercises and high endurance sports activities³⁴⁻³⁶.
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35 *Surveys and Questionnaires*

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38 All questionnaires will be self-administered or administered by a trained researcher
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40 virtually using REDCap.
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42

43 Perceived Wellness Survey (PWS): the PWS is a 36-item instrument used to measure
44
45 an individual's perceived health status in physical, psychological, emotional, intellectual,
46
47 spiritual, and social wellness constructs. Items under each construct are scored on a
48
49 scale of 1 (very strongly disagree) to 6 (very strongly agree). Higher scores indicate
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51 better perceived wellness. The PWS has good reliability and validity in healthy and
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53 neurological populations³⁷⁻³⁹.
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3 Physical Activity Enjoyment Scale (PACES): the PACES is a self-assessment measure
4 of enjoyment with their current physical activity. It is an 18-item scale with scoring from
5 1 (I enjoy it) to 7 (I hate it). Scores on the bipolar rating scale are summed with higher
6 scores indicative of more enjoyment. It is reliable and valid in neurological populations⁴⁰⁻
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15 Short Form-36 Health Survey (SF-36): the SF-36 measures physical health and mental
16 health. There are eight scales - Physical Functioning, Physical Role Limitations, Bodily
17 Pain, General Health, Vitality, Social Functioning, Emotional Role Limitations, and
18 Mental Health. It is easy to use with good validity and reliability in neurological
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populations⁴⁴⁻⁴⁷.

Numerical pain rating (NPR) scale: the NPR is a standardized instrument for pain
assessment in clinical and research practice. It is an 11-point scale from 0 (no pain) to
10 (the most intense pain) at rest and during movement. It is simple to use with high
sensitivity to changes in chronic pain in adult populations^{48, 49}. It is reliable and valid for
pain assessments of neurological populations⁵⁰.

Borg's Rating Scale of Perceived Exertion (RPE): the Borg RPE is a widely used
standardized measure to evaluate perceived intensity of exertion, effort, and fatigue
during physical exercise. The scale ranges from 6 (no exertion at all) to 20 (absolute
maximum). Higher ratings on the scale indicate greater overall body exertion. It is a
reliable and valid measure in neurological populations⁵¹⁻⁵⁸.

Reason for exercise inventory (REI): the REI is a 24-item scale to assess the reason
that motivates a person to exercise. The modified version has 4 subscales:

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2
3 Weight/appearance management, fitness/health management, stress/emotion
4 management, and socialization. A 7-point scale ranges from 1 (not at all important) to 7
5 (extremely important). Higher scores represent greater motivation to exercise⁵⁹.
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10 11 12 13 **Statistical Methods**

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16 Descriptive statistics (including mean, standard deviation, median, interquartile range,
17 frequency, and percent) will be calculated for demographic and clinical characteristics of
18 the study participants. For the primary endpoint, heart rate, the two-sample t-test or
19 nonparametric Wilcoxon Rank-Sum test will be used, as appropriate, to compare the
20 mean (median) heart rate between the live and pre-recorded groups at 12 weeks (final
21 session). The paired t-test or Wilcoxon Rank-Sum test will be used, as appropriate, to
22 compare mean (median) heart rate before and after the final session (at 12 weeks) for
23 the live and pre-recorded groups, separately. Similar analyses for heart rate (i.e.,
24 between and within groups) will also be performed after each session. Analysis of
25 Covariance (ANCOVA) will be used to evaluate the independent effect of live versus
26 pre-recorded group status on heart rate (at 12 weeks, final session), after controlling for
27 baseline heart rate and any other factors that may remain imbalanced between groups
28 after randomization. Adjusted mean differences in heart rate (at 12 weeks, final session)
29 between the live and pre-recorded groups and 95% confidence intervals for these
30 differences will be estimated from the multivariable ANCOVA model. Similar analyses
31 as described above will be performed for other continuous outcomes (primary and
32 secondary), including blood pressure, Borg's RPE scale, mood, motivation, and pain
33 scales, Perceived Wellness Survey, SF-36v2 score, etc., at 12 weeks (final session)
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3 and other time points of interest. Categorical variables (e.g., safety questions, adverse
4 events, medication changes, etc.) will be compared between the live and pre-recorded
5 groups (at baseline, 6 weeks, and 12 weeks) by the chi-square test or Fisher's exact
6 test, as appropriate. Generalized estimating equations (GEE) modeling will also be
7 explored to evaluate between-group differences over repeated assessments, and to
8 account for potential missing data in some of the outcome variables at one or more of
9 the evaluation time points. All estimates from the multivariable models will serve as
10 preliminary data (i.e., hypothesis-generating) for future studies. All p-values will be two-
11 sided with statistical significance evaluated at the 0.05 alpha level. Ninety-five percent
12 confidence intervals for all parameters of interest will be calculated to assess the
13 precision of the obtained estimates. All analyses will be performed in R and SPSS.
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32 **Data Management**

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34 Participant identifying information will be kept confidential by providing a unique
35 identification number (ID number) for the course of the study. To maintain privacy, only
36 authorized research investigators involved in the study will have access to participant
37 information. Password protected laptops, online documents, and access to cloud-based
38 servers will prevent leaks in data privacy. All records including informed consent,
39 screening tools, medical records, and participant surveys will be completed, and
40 documented on REDCap, a HIPAA-compliant online research database.
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51 Privacy on Zoom platform: Our institutional Zoom account (through Weill Cornell
52 Medicine) is compliant with HIPAA guidelines. Participant profile names will be updated
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3 to display their ID. After each session, the recorded video will be uploaded to the
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5 password protected WCM cloud-based server. Respective group participants will be
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7 given the live Zoom links (synchronous) or passwords to access the asynchronous
8
9 Zoom sessions.
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13 Polar OH1 HR monitor (Optical HR sensor): Participants' profiles using allotted ID's will
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15 be created in the Polar Beat App and the Flow for Coach cloud-based online platform.
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17 All information uploaded to the platform will be accessible by the investigators using a
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19 secured login ID and password.
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23 Adverse events, change in medications, and protocol deviation will be documented and
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25 updated before and after each class on REDCap. The study team will perform weekly
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27 self-audits to ensure data quality and completeness.
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30 *Procedure for handling missing data*

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33 This study is an intention-to-treat trial. If data are missing, we will use a mixed linear
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35 regression model that accounts for uneven numbers of data points across participants.
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41 **Data Monitoring and Stopping Rules**

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45 Since this is a low-risk study, our IRB determined that a data monitoring committee is
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47 not necessary. We will audit our data weekly and assess safety data at each session. If
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49 we find an increase in pain by 25% or a decrease in quality of life measures by 25%
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51 across participants in a cohort, we will pause the trial and evaluate how to improve the
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53 safety of the study.
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Resource Sharing Plan

We plan to use the concept, methods and analysis as a framework to develop evidence-based protocols for future cohorts and studies. We have made a commitment to publish all relevant scientific information in a timely manner. Unpublished information may be available to interested individuals or organizations by request to the Principal Investigator.

Ethics and Dissemination

The study has been approved by the BRANY Institutional Review Board 20-08-388-512. All protocol deviations, adverse events, and protocol modifications will be reported to the IRB immediately. The results of the study will be disseminated to the academic community via publications and presentations. The deidentified study data will be shared on our laboratory website.

Trial Registration: Clinicaltrials.gov NCT04564495.

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3 **Contributors:** KMF is the Principal Investigator. KMF, AAD and AB were responsible
4 for ethics applications and reporting. AAD, AB, DSK, RMG, LC and KMF drafted the
5 final version of this manuscript. All authors have contributed to the writing and critical
6 review of the manuscript and have approved the final version.
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12
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23 **Role of Funder in Study:** The Sabrina Cohen Foundation has established the tele-
24 exercise classes we are studying and will assist with recruitment. The Sabrina Cohen
25 Foundation and Burke Foundation will have no role in data collection, analyses,
26 interpretation, or publication of the work.
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33 **Competing Interests:** None to declare
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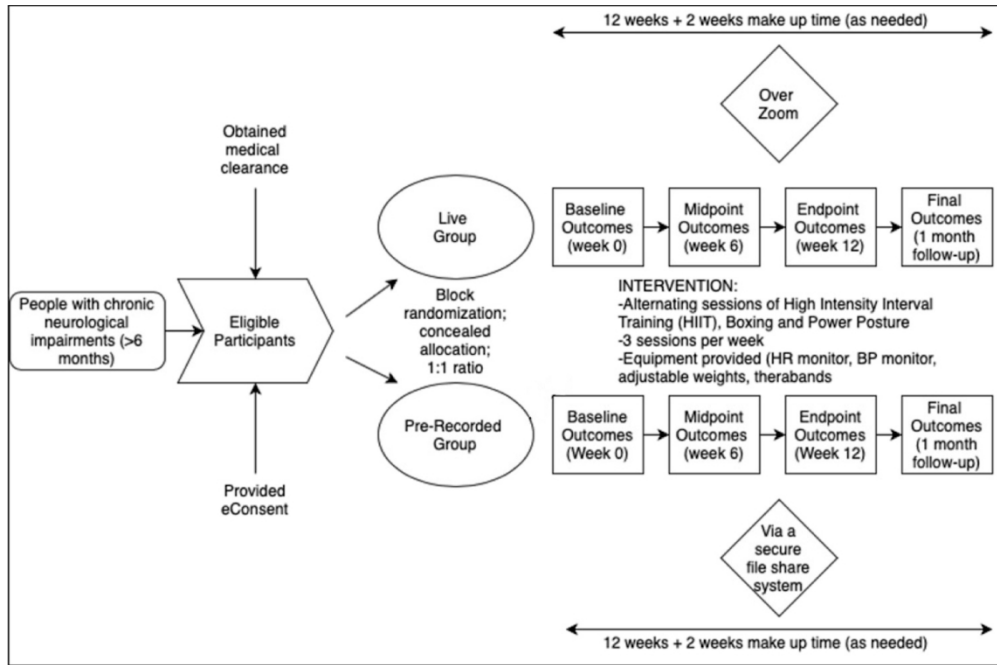
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Figure Legends

Figure 1: Study flow diagram.

Figure 2: Polar OH1 Heart Rate monitor. A. Picture of the monitor and charger. B. Proper placement of the monitor, with the device on the forearm. C. The Polar Beat app on a smart phone streams data in real time from the OH1 monitor via Bluetooth. D. After a session, data are retrievable from the Polar Coach website, where it is exported to a CSV file and processed in MATLAB.

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Study flow diagram.

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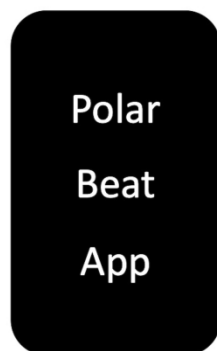
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Polar OH1 Heart Rate monitor. A. Picture of the monitor and charger. B. Proper placement of the monitor, with the device on the forearm. C. The Polar Beat app on a smart phone streams data in real time from the OH1 monitor via Bluetooth. D. After a session, data are retrievable from the Polar Coach website, where it is exported to a CSV file and processed in MATLAB.

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Informed Consent Form

This form explains our study and asks you to agree to participate. Please read the form carefully. A member of our study team will talk with you over Zoom to explain the study. Thank you so much for your interest in our study!

BIOMEDICAL RESEARCH ALLIANCE OF NEW YORK
THE BURKE NEUROLOGICAL INSTITUTE

SUBJECT INFORMATION AND INFORMED CONSENT

Project Title: Home-Based Exercise for People with Chronic Neurological Impairments
Principal Investigator: Kathleen Friel, PhD
Institution Name: Burke Neurological Institute
Institution Address: 785 Mamaroneck Ave, White Plains, NY 10605
Telephone: 914-368-3116, 646-351-9063 (24 hour)
Protocol # TELEX

ABOUT VOLUNTEERING FOR THIS RESEARCH STUDY

You are invited to participate in a research study. The purpose of the study is to determine the effect of a home-based exercise program on cardiovascular fitness and your quality of life. We will assess your motivation, enjoyment and compliance to either a live or pre recorded exercise class on Zoom.

You are eligible for this study because you have a neurological impairment that you've had for at least six months. A neurological impairment is weakness in your arms and/or legs that was caused by a stroke, brain injury, spinal cord injury, or any other condition that affects your brain or spinal cord.

WHY IS THIS STUDY BEING DONE?

Scientists at The Burke Neurological Institute (BNI) are partnering with the Sabrina Cohen Foundation (SCF) to test whether a home-based exercise program can improve cardiovascular health and quality of life in people who have had a chronic neurological impairment. We designed this study after the onset of COVID-19 in the United States. Since COVID-19 limits accessibility to gyms and other types of exercise venues, we hope to learn and understand the physiological and behavioral aspects of this rehabilitation strategy to optimize wellness after a neurological injury. You were selected as a possible participant in this study because you've had a neurological impairment for at least six months.

WHAT WILL I DO IF I AGREE TO BE IN THIS STUDY?

If you agree to be in the study, you will participate in 36 at-home, Zoom-based exercise classes. Classes will be held three times a week, for twelve weeks. You will be randomized to either a live class with other video participants, or a pre-recorded class that you will take on your own.

Before the first class, we will review your medical history with you to be sure it is safe for you to be in the study. If you qualify for the study, we will send you a kit that contains items you will need for the study, including a heart rate monitor, blood pressure cuff and adjustable wrist weights. We will also send you some surveys that ask about your ability to do everyday activities, such as dressing and cooking.

After you receive your home exercise kit, we will have an orientation Zoom class. You will meet the other people in the exercise class. During the orientation, the study team will teach you how to use the heart rate monitor. If you cannot put on the heart rate monitor, we will ask that a caregiver be present to assist you during each class.

You will download one applications onto your phone or computer that will allow us to access the information from your heart rate monitor. No one but the research team will be able to see this information aside from you.

Each exercise class will take approximately one hour. Each session will begin with instructions and questions from the study team regarding your pain level, level of motivation, and blood pressure. The exercise portion of the class will take 45 minutes. At the end of the class, the study team will ask you additional questions, such as how hard you worked, pain level, level of motivation and blood pressure.

The class instructor will tailor exercises to different abilities, so everyone can be active and safe. The entire class will be done in a seated position.

1 Approximately 100 people will be enrolled in the live class, and 100 in the pre-recorded class.
2

3 After the 18th class, which is midway through the study, we will send you another set of the same surveys you
4 completed before the first class. We will send you a third set of surveys after the final class.
5

6 RISKS AND INCONVENIENCES OF THE STUDY

7 Your participation in the project might involve the following risks:

8
9 The largest risk in this study is the risk of fatigue and muscle aches. These symptoms are common with exercise. The
10 instructor will offer modifications of each exercise, to offer easier or more difficult options. You will always be
11 welcome to use a modification, request an additional modification, or rest.
12

13 The risk of fall in this study is small, since you will be seated. If you normally have trouble with stability of your torso
14 while you are seated, we will ask that a caregiver be present in case a fall occurs.
15

16 There is a risk that your personal health information be disclosed in error. For this study, we are using secure Zoom
17 settings from an academic medical center, and we will require a password for each class, to mitigate this risk. The
18 app containing your heart rate information will also be secure.
19

20 PERMISSION FOR PHOTOGRAPHY

21 We will record each live class, video and audio. Since we are not together in one space, we need to record each
22 class for purposes of data collection. Therefore, we require each participant to agree to being recorded. We want to
23 make sure that you understand this.
24

25 Do you agree to be photographed in this study?

Yes

No

29 Please initial here to confirm your choice about being
30 photographed during the study:
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34 NEW INFORMATION

35 You will be told about any new significant findings developed during the course of the study that might affect your
36 willingness to continue in the research.
37

38 COST OF STUDY TO PARTICIPANTS

39 There is no cost to you for participating in the research study.
40

41 BENEFITS OF THIS STUDY

42 Participation in this study is not guaranteed to benefit you. This study is only for the purpose of research. You may
43 feel stronger by the end of the study, but there is no guarantee that this will occur. However, the information learned
44 from this study may help other people in the future.
45

46 ALTERNATIVES TO STUDY PARTICIPATION

47 You do not have to participate in this research study to receive treatment for your condition. Your participation in
48 this study is voluntary. If you decide to participate, you are free to discontinue participation at any time. Your
49 participation in this study may be terminated without your consent by the study team or regulatory authorities, in
50 certain circumstances, such as, if the investigator determines it is in your best interest, you cannot adhere to the
51 study procedures, or in the event the study is terminated.
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53 IN CASE OF INJURY

54 In accordance with Federal regulation, we are obligated to inform you about our policy in the event injury occurs. For
55 medical emergencies, call 911. If, as a result of your participation, you experience injury from known or unknown
56 risks of the research procedures as described, emergency medical care and treatment will be provided on our
57 premises to the extent possible. We will assist you in obtaining additional medical care, as needed, but you will be
58 responsible for the costs of such further medical treatment, either directly or through your medical insurance and/or
59 other forms of medical coverage. No other compensation will be offered by or Burke Neurological Institute or the
60 Biomedical Research Alliance of New York. Further information can be obtained from Dr Kathleen Friel (914
368-3116). You are not waiving any legal right to seek additional compensation through the courts by signing this
form.

CONFIDENTIALITY

To the extent allowed by law, every effort will be made to keep your personal information confidential. However, information from this study will be submitted to the study sponsor and to the U.S. Food and Drug Administration. It may be submitted to governmental agencies in other countries where the study product may be considered for approval. Medical records, which identify you and the consent form signed by you, will be looked at by the sponsor or the sponsor's representatives and may be looked at by the FDA and other regulatory agencies, the Institutional Review Board, and the Biomedical Research Alliance of New York. While these parties are aware of the need to keep your information confidential, total confidentiality cannot be guaranteed. The results of this research project may be presented at meetings or in publications; however, you will not be identified in these presentations and/or publications.

Federal regulations give you certain rights related to your health information. These include the right to know who will be able to get the information and why they may be able to get it. The study doctor must get your authorization (permission) to use or give out any health information that might identify you. If you choose to be in this study, the study doctor will get personal information about you. This may include information that might identify you. The study doctor may also get information about your health, including:

- Past and present medical records
- Research records
- Records about phone calls made as part of this research
- Records about your study visits
- Information obtained during this research about laboratory test results
- Results from diagnostic and medical procedures including but not limited to X-rays, physical examinations and medical history
- Billing records

Information about your health may be used and given to others by the study doctor and staff. They might see the research information during and after the study. Your information may be given to the sponsor of this research. "Sponsor" includes any persons or companies that are working for or with the sponsor, or are owned by the sponsor. Information about you and your health which might identify you may be given to:

- The U.S. Food and Drug Administration
- Department of Health and Human Services agencies
- Governmental agencies in other countries
- Biomedical Research Alliance of New York (BRANY)
- The Institutional Review Board
- Accrediting agencies

Your personal health information may be further shared by the groups above. If shared by them, the information will no longer be covered by the U.S. federal privacy laws. However, these groups are committed to keeping your personal health information confidential. If you give permission to give your identifiable health information to a person or business, the information may no longer be protected. There is a risk that your information will be released to others without your permission.

Information about you and your health that might identify you may be given to others to carry out the research study. The sponsor will analyze and evaluate the results of the study. In addition, people from the sponsor and its consultants will be visiting the research site. They will follow how the study is done, and they will be reviewing your information for this purpose. The information may be given to the FDA. It may also be given to governmental agencies in other countries. This is done so the sponsor can receive marketing approval for new products resulting from this research. The information may also be used to meet the reporting requirements of governmental agencies.

This authorization does not have an expiration date. If you do not withdraw this authorization in writing, it will remain in effect indefinitely.

By signing this consent form, you are giving permission to use and give out the health information listed above for the purposes described above. You do not have to sign this consent form. If you choose not to sign this consent form, you will not be able to be in this research study. Your decision not to sign this consent form will not have any effect on your medical care and you will not lose any benefits or legal rights to which you are entitled. You have the right to review and copy your health information. However, if you decide to be in this study and sign this permission form, you may not be allowed to look at or copy your information until after the research is completed.

You may withdraw or take away your permission to use and disclose your health information at any time. You do this by sending written notice to the study doctor at the address on the front of this informed consent form. If you withdraw your permission, you will not be able to continue being in this study, but you will not have any penalty or loss of access to treatment or other benefits to which you are entitled. When you withdraw your permission, no new health information which might identify you will be gathered after that date. Information that has already been gathered may still be used and given to others. This would be done if it were necessary for the research to be reliable.

1 Notice Concerning HIV-Related Information: HIV-related information that either is collected as part of the research or
2 that may already exist in your medical record might be accessed for the research by the research staff and the study
3 sponsor, but will not be shared with others without your authorization, unless federal or state law requires the
4 disclosure. You have a right to request a list of people who may receive or use your HIV-related information without
5 authorization. If you experience discrimination because of the release or disclosure of HIV-related information, you
6 may contact the New York State Division of Human Rights or New York City Commission on Human Rights. These
7 agencies are responsible for protecting your rights.

8 QUESTIONS ABOUT THIS STUDY

9 If you have any questions or requests for information relating to this research study or your participation in it, or if
10 you want to voice a complaint or concern about this research, or if you have a study related injury, you may contact
11 Dr. Friel at 914-368-3116, 646-351-9063 (24 hour).

12 If you have any questions about your rights as a research subject or complaints regarding this research study, or you
13 are unable to reach the research staff, you may contact a person independent of the research team at the
14 Biomedical Research Alliance of New York Institutional Review Board at 516-318-6877. Questions, concerns or
15 complaints about research can also be registered with the Biomedical Research Alliance of New York Institutional
16 Review Board at www.branyirb.com/concerns-about-research.

17 You will be given a copy of this form to keep.

18 A description of this clinical trial will be available on <http://www.ClinicalTrials.gov> as required by U.S. Law This Web
19 site will not include information that can identify you. At most, the Web site will include a summary of the results.
20 You can research this Web site at any time.

21 You are making a decision as to whether or not to participate. Your signature indicates that the above information
22 has been reviewed with you and that you have decided to participate. You may withdraw at any time without
23 prejudice after signing this form should you choose to discontinue participation in this study.

24 Signature:

25 _____

26 Date:

27 _____

28 Time:

29 _____

30 Upload a copy of informed consent here, if the
31 participant chose to provide consent on paper



SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description	Addressed on page number
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	2
	2b	All items from the World Health Organization Trial Registration Data Set	1, 2, 3, 7, 8-10, 12-15-18, 20
Protocol version	3	Date and version identifier	2
Funding	4	Sources and types of financial, material, and other support	2
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	1, 19
	5b	Name and contact information for the trial sponsor	N/A
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	20
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	N/A

1 **Introduction**

2

3 Background and rationale 6a Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention 4-5

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6 6b Explanation for choice of comparators 4-5

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8 Objectives 7 Specific objectives or hypotheses 5

9

10 Trial design 8 Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory) 5-6

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14 **Methods: Participants, interventions, and outcomes**

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16 Study setting 9 Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained 6

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19 Eligibility criteria 10 Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists) 6-7

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22 Interventions 11a Interventions for each group with sufficient detail to allow replication, including how and when they will be administered 8-10

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25 11b Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease) 11

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28 11c Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests) 11-12

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31 11d Relevant concomitant care and interventions that are permitted or prohibited during the trial 6

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34 Outcomes 12 Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended 12-15

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40 Participant timeline 13 Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure) 13 and Fig 1

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1	Sample size	14	Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations	7
2				
3				
4	Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	7
5				
6				
7	Methods: Assignment of interventions (for controlled trials)			
8	Allocation:			
9				
10	Sequence	16a	Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions	8
11	generation			
12				
13				
14				
15				
16	Allocation	16b	Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned	8
17	concealment			
18	mechanism			
19				
20	Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	8
21				
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23				
24	Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	9
25				
26				
27		17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	9
28				
29				
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31	Methods: Data collection, management, and analysis			
32				
33	Data collection	18a	Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol	12-15
34	methods			
35				
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39		18b	Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols	11-12
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1	Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	17-18
2				
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4				
5	Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	15-17
6				
7				
8		20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	15-17
9				
10		20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	18
11				
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14	Methods: Monitoring			
15				
16	Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	18
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22		21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	18
23				
24				
25	Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	18
26				
27				
28		23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	18
29				
30				
31				
32	Ethics and dissemination			
33				
34	Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	19
35				
36				
37	Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	19
38				
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1	Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	10-11
2				
3				
4		26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	N/A
5				
6				
7	Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	17-18
8				
9				
10	Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	20
11				
12				
13	Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	17
14				
15				
16	Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	no plans for post-trial care, compensation plan due to injury listed in ICF p2 "In Case of Injury"
17				
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25	Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	19
26				
27				
28				
29		31b	Authorship eligibility guidelines and any intended use of professional writers	19
30				
31		31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	19
32				
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34	Appendices			
35				
36	Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	supplemental
37				
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39	Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	N/A
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1 *It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items.
2 Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons
3 [“Attribution-NonCommercial-NoDerivs 3.0 Unported”](#) license.
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For peer review only

BMJ Open

Effects of a 12-week, seated virtual home-based tele-exercise program compared with a pre-recorded video-based exercise program in people with chronic neurological impairments: protocol for a randomized control trial (RCT)

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3 Effects of a 12-week, seated virtual home-based tele-exercise program compared with a
4
5 pre-recorded video-based exercise program in people with chronic neurological
6
7 impairments: protocol for a randomized control trial (RCT)
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12

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52 Keywords: Tele-exercise, chronic neurological impairments, home-based, virtual
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54 training.
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Abstract

Introduction: Exercise is vital to staying well and preventing secondary complications in people with Chronic Neurological Impairments (CNI). Appropriate exercise is often inaccessible to this population. The purpose of the study is to investigate the effects of a seated virtual exercise program on heart rate, recovery, fatigue, pain, motivation, enjoyment, and quality of life in people with CNI. **Methods and Analysis:** Individuals with CNI will be screened for eligibility, and 60 participants will be randomized 1:1 into either a live or pre-recorded group. There is no geographic limitation to where participants reside, since participation is virtual. The study will be coordinated by one site in White Plains, NY, USA. The live group will exercise with an instructor via Zoom while the pre-recorded group will exercise at their chosen time using pre-recorded videos, 3x/week for 12 weeks. Primary outcome measure: change in heart rate during exercise/recovery. Secondary outcome measures: fatigue, motivation, level of pain and exertion, physical well-being, enjoyment of physical activity, motivation, and quality of life. Outcomes will be assessed at baseline, midpoint, end of study, and one-month post-study. Adverse events, medication changes, and physical activity will be tracked throughout. Within-group and between-group comparisons will be performed using Analysis of Covariance and regression. **Ethics and Dissemination:** BRANY IRB approval: 09/22/2020. All participants will provide written informed consent. Results will be disseminated through presentations, publications, and clinicaltrials.gov. Trial registration number: [ClinicalTrials.gov](https://clinicaltrials.gov), NCT04564495.

Strengths and Limitations of This Study

1. This study will use a comprehensive set of physiological and behavioral assessments to assess effects of exercise.
2. The virtual design of the study enables people to participate without commuting to our institute.
3. For those participants with limited technological experience, difficulty using blood pressure devices and heart rate monitors will cause missing data values.
4. The virtual design of the study prohibits hands-on evaluations.

Introduction

Exercise is a vital component to staying well and preventing secondary impairments. Exercise is known to positively influence a range of factors including cardiovascular health, cognition, mental health, bone health, sleep, and quality of life, among many others¹⁻⁸. The benefits of exercise are further amplified in the estimated one billion people worldwide with Chronic (> 6 months) Neurological Impairments (CNI), as the injuries often lead to sedentary lifestyles and thus higher rates of obesity and cardiovascular disease⁹⁻¹¹. Incorporating an exercise regimen is vital to preventing secondary complications such as muscular weakness, fatigue, limited mobility, pain, spasticity, bone loss, and increased risk of fractures, falls, diabetes, depression, and obesity^{7, 8, 12, 13}. Exercise can be neuroprotective and neuro-regenerative by increasing neurotrophic factors, which are involved in neuroprotection, neuroplasticity, and maintenance of neuronal health^{2, 14-18}. Exercise can also improve muscle strength and bone integrity in people with CNI¹⁹⁻²¹.

People with CNI often cannot access community exercise centers, as mobility can be more difficult, insurance payments sparse, centers not welcoming or accessible, and assistive exercise equipment too costly for most facilities²²⁻³⁵.

Another key barrier to exercise for people with CNI is transportation³⁶. Although COVID-19 introduced many new barriers to community participation, it also had some silver linings for people with CNI. COVID-19 resulted in the emergence of many new Zoom or online classes tailored to people with CNI, which removed the barrier of transportation.

Although there has been an explosion of virtual-based exercise opportunities since 2020, much is unknown regarding optimal delivery models to bring exercise to people

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2
3 with CNI. Two general types of virtual exercise delivery models exist. In synchronous
4 exercise, one or more participants join a virtual space via videoconferencing, and
5 interact with the trainer in real time. Synchronous exercise enables the trainer to provide
6 feedback as participants exercise. In contrast, in asynchronous exercise, trainers record
7 instructional videos, which participants complete on their own time, without being in the
8 same virtual space with the trainer at the same time. Asynchronous exercise provides
9 scheduling flexibility to participants but does not allow for real time interaction and
10 feedback from the trainer. There has only been one study directly comparing
11 synchronous versus asynchronous exercise training in people with CNI.
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24 In a recent study, forty adults with spinal cord injury were randomized to either
25 synchronous or asynchronous tele-exercise. While there was no significant difference in
26 average daily workload between the interventions, the synchronous tele-exercise found
27 significantly higher values for adherence and successful data recording of the exercise,
28 resulting in greater weekly training loads³⁷. Virtual exercise platforms are part of society
29 even as the pandemic wanes. Thus, it is important to determine optimal delivery models
30 for specific groups of participants.
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41 This study will examine the cardiovascular benefits, as well as differences in
42 compliance, motivation and feelings of socialization and exertion between synchronous
43 and asynchronous classes. The classes will be held for 12 weeks, 3 times/week using
44 seated exercise via Zoom. The instructor will remain the same and alternate between
45 boxing, high intensity interval training (HIIT) and power posture classes. We will
46 examine the potential benefits of an accessible form of exercise for a population that is
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3 in urgent need. Additionally, by comparing synchronous and asynchronous classes, we
4
5 will compare user compliance, motivation, enjoyment, and socialization.
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8 We hypothesize that individuals in the synchronous class will have better attendance,
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10 more robust exertion as measured by heart rate, and better enjoyment than people in
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12 the asynchronous class, due to the social component of the synchronous classes. We
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14 hypothesize that participants in both groups will show improvement in heart rate
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16 recovery, physical wellness, quality of life, enjoyment, and motivation/engagement, and
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18 that changes will be greater in the synchronous class due to consistent supervision and
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20 contact.
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28 **Methods and Analysis**

29 **Study Design**

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33 This study is a parallel randomized controlled trial to investigate the effects of a 12-
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35 week, 3 times/week, seated tele-exercise program for adults with CNI (Figure 1). All 36
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37 exercise sessions will be completed online via Zoom with the physical exercise
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39 instructor (live, synchronous group) or offline using recorded videos (pre-recorded,
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41 asynchronous group). Participants will be in their own homes as they complete the
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43 exercise classes. Participants can continue their medications, physical, occupational,
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45 speech therapies, and existing exercise routines (2 times/week or fewer).
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53 **Eligibility Criteria and Participants**

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55 The eligibility criteria will be kept broad to accommodate all neurological impairments.
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Inclusion Criteria:

1. Participants diagnosed with Chronic (>6 months) Neurological Impairments
2. Ages 18 to 75 years
3. Able to sit for at least 1 hour
4. Stable Heart rate (HR) and Blood Pressure (BP)
5. Medical clearance to participate in moderate intensity exercises
6. Can don and doff a wrist HR monitor with or without assistance
7. Can maintain daily exercise and physical activity during the study
8. No other neurological, medical or cognitive impairments
9. Able to access the internet and use the cloud-based Zoom conference platform
10. Ability to speak and understand English
11. Currently exercising 2 days or less per week
12. Presence of caregiver or supervisor during exercise, for safety

Exclusion Criteria:

1. Unstable or uncontrolled medical conditions
2. Medical issues preventing safe participation
3. Unable to follow simple 2-step commands

Number of Participants

We plan to conduct multiple cohorts of participants, each with different participant populations, e.g., multiple sclerosis, cerebral palsy, stroke, spinal cord injury.

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3 For each cohort, with 27 participants in the synchronous and asynchronous groups, we
4 will have 80% power to detect a change in maximum heart rate during exercise from
5 about 80 bpm to 100 bpm (or greater), from the first session to the last session of the
6 intervention. This calculation assumes a conservative standard deviation of the pre/post
7 differences in heart rate of 35 bpm. We plan for a 30% dropout rate, which is an
8 estimate based on our feasibility pilot study (see below), which means that we will
9 recruit 35 participants per group to achieve 80% power.
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22 **Recruitment**

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25 Participants will be recruited via the Sabrina Cohen Foundation, which has a network of
26 people with CNI, and by the Burke Neurological Institute, who has a database of
27 potential participants from prior studies or programs. We will also post our recruitment
28 flier on our website, social media, and will mail it to neurological patient advocacy
29 groups. If we cannot recruit appropriate numbers using these methods, we will pursue
30 paid advertising in our community.
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42 **Randomization**

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45 A person not affiliated with the study will generate a series of permuted randomized
46 blocks in a computerized spreadsheet with a defined block size of 4. Participants will be
47 allocated to either the live (synchronous) or pre-recorded (asynchronous) group, with a
48 1:1 ratio between groups. Due to the nature of the intervention, it is not possible to
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3 conceal allocation from the participants or the study team. However, the two groups will
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5 never interact with one another.
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10 11 **Blinding and Rigor of Data** 12

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14 Due to the nature of the study, blinding of participants and study team members to
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16 group allocation will not be possible. All participants will complete the outcome surveys
17
18 directly online, without input or assistance from the study team. Heart rate data will be
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20 collected through a heart rate monitor that collects quantitative data without input or
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22 filtering by the study team.
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28 29 **Intervention** 30

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32 The exercise intervention will be delivered by a trained professional who specializes in
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34 adaptive exercise for individuals with CNI. The instructor will structure each class to
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36 ensure standardization in terms of class structure, including warm-up, cool-down, cues
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38 for recording heart rate during class, use of additional equipment, and adherence to the
39
40 general study protocol. The instructor has extensive experience in offering adaptations
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42 to exercises in a virtual setting. He offers alternative ways to perform the exercises,
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44 such that everyone in class will be able to fully participate safely.
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49 All participants, regardless of allocation to live or pre-recorded groups, will participate in
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51 45 minutes of aerobic exercise intervention, three times a week, for a period of 12
52
53 weeks. The overall exercise session will be up to one hour long to include measuring
54
55 vitals, answering questions before/after sessions, and rest breaks (if any). Two
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additional weeks will be provided for making up missed sessions, if applicable. Each intervention will be preceded by a warm-up and followed by a cool-down period. All participants will be asked to document any adverse events and changes in medications before each session. The order of classes will be rotated. Individual aerobic interventions for the first cohort are described below and summarized in Table 1.

Table 1: Summary of Exercise Sessions

Minutes into Session	HIIT	Boxing	Power Posture
5	Warm up	Warm up	Warm up
10	Intervals of 30 sec high intensity movements, 1-2 min lower intensity	Intervals of 30 sec high intensity boxing movements, 1-2 min lower intensity	Stretching
15			Fast paced movements targeting trunk, posture
20			Stretching
25			
30			
35	Cool down	Cool down	Cool down
40			
45	End	End	End

High intensity interval training (HIIT): In HIIT sessions, participants will do repetitive bouts of high intensity exercises, with intermittent periods of rest or active recovery. Examples of high intensity movements used in these sessions include fast punching movements, repeatedly rapidly lifting one's arms overhead (with or without weights, as tolerated by each participant), and abdominal crunches. The duration of each bout of high intensity is about 10-30 seconds. Since this study will include participants with variable neurological impairments, the upper limit of exercise intensity in HIIT will be

1
2
3 dependent on instructor's judgement, participant feedback, rate of perceived exertion,
4
5 and any exercise heart rate restrictions given by their doctor in the medical screening.
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8 Boxing: In boxing sessions, participants will do a circuit of individual and combinations
9
10 of various arm strikes and punches. Boxing is a moderate to high intensity aerobic
11
12 activity by nature. During the session, participants will do bouts of high intensity
13
14 movements, similar to HIIT, along with periods of lower intensity arm movements such
15
16 as practicing defensive blocks of punches from an imaginary boxing opponent. The
17
18 exercise intensity for boxing, as in HIIT, will be subjective for participants based on level
19
20 of perceived exertion as well as exercise heart rate restrictions, if any.
21
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23

24 Power posture: Power posture is a HIIT-style strength and endurance class in which
25
26 participants will move in ways that train trunk stability and control of sitting with correct
27
28 posture. In these sessions, there will be a warm-up period of 5-10 minutes, focused on
29
30 slow, gentle repetitions to prepare the trapezius and other supporting scapular muscles
31
32 for movement. This workout will target postural form, with fast paced targeted
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34 movements for 10-15 minutes. After the fast paced movements, a cool-down period will
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36 focus on gentle deep neck flexor/extensor chin tuck exercises, range of motion, and
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38 stretching.
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46 **Virtual Nature of the Study**

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49 Each aspect of this study will be performed virtually. Screenings will be performed on
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51 the telephone, with a standard list of criteria asked of each person. If deemed eligible,
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53 the potential participant will be sent a Zoom link to go through the informed consent on
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3 a one-to-one basis. The informed consent will be uploaded to REDCap, a secure web
4 application for building and managing online surveys and databases. REDCap is 21
5 CFR Part 11-ready and HIPAA compliant and is specifically geared to support online
6 and offline data capture for research studies and operations.
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12 To obtain informed consent directly from participants, a study team member will arrange
13 a Zoom call with each participant. The informed consent will be signed virtually by
14 sharing a virtual remote with the participant during the call. If anyone has difficulty, they
15 can be sent the informed consent from REDCap via email and return it to REDCap just
16 as easily. Each participant will be sent a copy of their signed consent form via the same
17 REDCap email system (see Supplemental Material for a sample consent form).
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27 Each participant will be mailed a home exercise kit, which will contain a Polar optical
28 heart rate monitor (OH1), blood pressure monitor, yellow and green resistance
29 TheraBands and wrist weights.
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34 After the home kits have been received by the participants and before the intervention
35 begins, we will hold a series of training videoconferencing calls to acquaint participants
36 with the study procedures and the use of all devices.
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42 *Polar OH1 heart rate monitor:* we will train participants in donning/doffing the heart rate
43 monitor, using the Polar app, using their Polar accounts, syncing the Polar devices with
44 their smartphones and starting/ending their heart rate tracking during exercise sessions.
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49 *Blood pressure monitor:* we will send each participant a commercially available
50 automatic blood pressure (BP) monitor. We will train each person to use it, and we have
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1
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3 embedded an instructional video into the REDCap data entry form on which participants
4
5 will input their BP.
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8 *Checking compliance:* after each session, a study team member will review each
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10 participant's data entry forms and syncing of their heart rate data with the Polar app.
11
12 For the synchronous group, this will occur before the participant leaves the session. For
13
14 the asynchronous group, this will occur within one day of when the participant
15
16 completes the session.
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19
20 All questionnaires and questions to be answered before and after each class will be
21
22 sent from and stored on REDCap. All heart rate data will be transmitted to the Polar
23
24 website, which can be accessed only by the participant or the researchers. Then, the
25
26 data will be analyzed in MATLAB using custom scripts written by the study team.
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32 **Study Safety**

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35 We will monitor side effects before and after each session by having participants
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37 complete surveys on REDCap. If pain or blood pressure are higher than usual, we will
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39 ask the participant if they wish to continue. If blood pressure rises near limitations
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41 prescribed by a participant's doctor, we will discontinue the participant. If any injury
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43 occurs during or outside of study sessions that may increase the risk of further injury,
44
45 we will discontinue the participant.
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52 **Patient and Public Involvement**

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3 Persons with disabilities were involved in the design of this study, and will be involved in
4 the conduct, reporting, and dissemination plans of this research.
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10 **Strategies to improve adherence**

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13 In this study, adherence is defined as the number of sessions a participant completed.
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16 The study team will take attendance at each synchronous session and will monitor
17 session completions for the asynchronous group. Completion for the asynchronous
18 group will be monitored via REDCap. Each time a person completes a data entry form
19 before and after the session, it will be automatically saved and time stamped in
20 REDCap.
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28 If a participant misses a class, we will reach out and inquire about their ability to attend
29 future sessions. We have *a priori* set a minimum number of 30 of 36 classes that a
30 participant must attend to be included in the main analyses of the study. We will offer 2
31 weeks of makeup sessions at the end of the 12 weeks. If a participant drops out before
32 completing 30 sessions, we will encourage them to complete the post-study outcome
33 measures and the satisfaction survey. We will use the number of sessions completed as
34 a covariate in the analyses.
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48 **Outcome Measures**

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50 All outcome measures are summarized in Table 2.
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53 Table 2: Outcome Measures
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PRIMARY OUTCOME MEASURE			
Measure	Modality Assessed	Method of Ascertainment	Timepoints
Peak heart rate	Cardiovascular function	Polar OH1/Polar Beat app	Each session
SECONDARY OUTCOME MEASURES			
Measure	Modality Assessed	Method of Ascertainment	Timepoints
Demographics	--	REDCap survey	Before first session
Attendance	Adherence	REDCap time stamps	Each session
Baseline heart rate	Cardiovascular function	Polar OH1/Polar Beat app	Each session
Heart rate at end of session	Cardiovascular function	Polar OH1/Polar Beat app	Each session
Heart rate recovery	Cardiovascular function	Polar OH1/Polar Beat app	Each session
Blood pressure	Cardiovascular function	Automatic BP device	Before and after each session
Rate of Perceived Exertion	Cardiopulmonary fitness	REDCap survey	Before and after each session
Perceived Wellness Survey	Wellness	REDCap survey	Baseline, weeks 6, 12, 16
Physical Activity Enjoyment Scale	Enjoyment of exercise	REDCap survey	Baseline, weeks 6, 12, 16
Short Form-36	Physical and mental health	REDCap survey	Baseline, weeks 6, 12, 16
Numerical Pain Rating Scale	Pain	REDCap survey	Baseline, weeks 6, 12, 16
Reason for Exercise Inventory	Motivation to exercise	REDCap survey	Baseline, weeks 6, 12, 16
Participant Feedback Survey	Participant satisfaction	REDCap survey	End of study or at dropout

Demographics

We will collect the following demographics by having each participant complete a demographics data entry form on REDCap: age, gender, neurological diagnosis, time of diagnosis, and comorbid health issues (e.g., diabetes, high blood pressure, etc.). We will also document whether a person needs assistance with walking or transfers. In addition, we will require each participant to receive written medical clearance by their doctor to participate in the study, and if any exercise restrictions need to be followed.

Primary outcome measure: Peak heart rate during exercise

Continuous heart rate tracking is the primary outcome measure for the study. All participants will receive the OH1 Polar HR monitor as part of their exercise kit for the study (Figure 2). The Polar OH1 (Polar Electro Inc., Bethpage, NY, USA) is an optical heart rate sensor on an armband that records HR activity. It has 6 LED sensors that record at 1-second intervals³⁸. HR activity is recorded via Bluetooth to a phone compatible with the Polar Flow or Polar Beat app. It has validity in moderate to vigorous intensity exercises and high endurance sports activities³⁸⁻⁴⁰.

Immediately before each exercise session, participants will turn on their OH1 monitor. Then, the participant will open the Polar Beat app on their smart phone and hit “start” when the exercise session begins. The Polar OH1 continuously records heart rate (HR) at 10Hz when the device is powered on and the Polar Beat app recording has been started. Participants will record HR through the entire exercise session and for 10 minutes after completion of the session to capture HR during exercise as well as HR

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2
3 recovery for 10 minutes after the end of exercise sessions. The live group will be
4 supervised by the research team for each session. The pre-recorded groups will have
5 the research team available for assistance and troubleshooting. Data are stored on the
6 Polar Coach website, where study staff can export sessions as CSV files that are then
7 processed in MATLAB (MathWorks). In MATLAB, peak HR (primary measure) will be
8 calculated.
9

17 **Secondary outcome measures**

19 *Measures acquired at each exercise session*

20 We will calculate secondary measures of HR in MATLAB using the same Polar CSV
21 files mentioned above: baseline HR, HR at end of session, and HR at 30s intervals for
22 10min after the end of the session will be analyzed, to measure heart rate recovery.
23

24 At each session, participants will complete an online assessment to rate the level of
25 pain and perceived exertion (RPE), BP, HR, and adverse events before and after the
26 exercise session. Additionally, as described above, attendance will be taken at each
27 session as a measure of adherence. After the session is over, participants will complete
28 a lab-developed survey to rate their experience on a 10-point scale from 1 (not a good
29 experience) to 10 (very good experience) on questions related to motivation, energy,
30 satisfaction, and performance. In addition, participants will provide information on
31 changes related to health, falls, or other adverse events.
32

33 *Measures acquired at specified times during the intervention*

34 A comprehensive set of secondary outcome measures will be completed by participants
35 at baseline, mid-study (6 weeks), end of study (12 weeks) and follow-up after one
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3 month. All questionnaires will be self-administered or administered by a trained
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5 researcher virtually using REDCap.
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8 Perceived Wellness Survey (PWS): Participants will quantify their perceived health
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10 status by completing the PWS. The PWS is a 36-item instrument used to measure an
11
12 individual's perceived health status in physical, psychological, emotional, intellectual,
13
14 spiritual, and social wellness constructs. Items under each construct are scored on a
15
16 scale of 1 (very strongly disagree) to 6 (very strongly agree). Higher scores indicate
17
18 better perceived wellness. The PWS has good reliability and validity in healthy and
19
20 neurological populations⁴¹⁻⁴³.
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24 Physical Activity Enjoyment Scale (PACES): the PACES is a self-assessment measure
25
26 of enjoyment with their current physical activity. It is an 18-item scale with scoring from
27
28 1 (I enjoy it) to 7 (I hate it). Scores on the bipolar rating scale are summed with higher
29
30 scores indicative of more enjoyment. It is reliable and valid in neurological populations<sup>44-
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32 47</sup>.
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36 Short Form-36 Health Survey (SF-36): the SF-36 measures physical health and mental
37
38 health. There are eight scales - Physical Functioning, Physical Role Limitations, Bodily
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40 Pain, General Health, Vitality, Social Functioning, Emotional Role Limitations, and
41
42 Mental Health. It is easy to use with good validity and reliability in neurological
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44 populations⁴⁸⁻⁵¹.
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48 Numerical pain rating (NPR) scale: the NPR is a standardized instrument for pain
49
50 assessment in clinical and research practice. It is an 11-point scale from 0 (no pain) to
51
52 10 (the most intense pain) at rest and during movement. It is simple to use with high
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3 sensitivity to changes in chronic pain in adult populations^{52, 53}. It is reliable and valid for
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5 pain assessments of neurological populations⁵⁴.
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8 Borg's Rating Scale of Perceived Exertion (RPE): the Borg RPE is a widely used
9
10 standardized measure to evaluate perceived intensity of exertion, effort, and fatigue
11
12 during physical exercise. The scale ranges from 6 (no exertion at all) to 20 (absolute
13
14 maximum). Higher ratings on the scale indicate greater overall body exertion. It is a
15
16 reliable and valid measure in neurological populations⁵⁵⁻⁶².
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20 Reason for exercise inventory (REI): the REI is a 24-item scale to assess the reason
21
22 that motivates a person to exercise. The modified version has 4 subscales:
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24 Weight/appearance management, fitness/health management, stress/emotion
25
26 management, and socialization. A 7-point scale ranges from 1 (not at all important) to 7
27
28 (extremely important). Higher scores represent greater motivation to exercise⁶³.
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32 Participant feedback: on study completion, or when withdrawn/dropped out from the
33
34 study, participants will complete a study feedback form. The feedback will be based on
35
36 study acceptance, ease of using HR and BP devices and exercise equipment, and
37
38 support from the research team. Participants who do not complete the study will also
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40 provide their final timepoint measure at the end of their final exercise session.
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47 **Statistical Methods**

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49 Descriptive statistics (including mean, standard deviation, median, interquartile range,
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51 frequency, and percent) will be calculated for demographic and clinical characteristics of
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53 the study participants.. Analysis of Covariance (ANCOVA) will be used to evaluate the
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3 independent effect of synchronous versus asynchronous group status on change in
4 peak heart rate (first session versus final session), after controlling for baseline heart
5 rate and any other factors that may remain imbalanced between groups after
6 randomization. Adjusted mean differences in peak heart rate (first session versus final
7 session) between the synchronous and asynchronous groups and 95% confidence
8 intervals for these differences will be estimated from the multivariable ANCOVA model.
9
10 Similar analyses as described above will be performed for other continuous outcomes
11 (primary and secondary), including Borg's RPE scale, mood, motivation, and pain
12 scales, Perceived Wellness Survey, SF-36v2 score, and PACES score. Categorical
13 variables (e.g., safety questions, adverse events, medication changes, etc.) will be
14 compared between the synchronous and asynchronous groups (at baseline, 6 weeks,
15 and 12 weeks) by the chi-square test or Fisher's exact test, as appropriate. Generalized
16 estimating equations (GEE) modeling will also be explored to evaluate between-group
17 differences over repeated assessments, and to account for potential missing data in
18 some of the outcome variables at one or more of the evaluation time points. All
19 estimates from the multivariable models will serve as preliminary data (i.e., hypothesis-
20 generating) for future studies. All p-values will be two-sided with statistical significance
21 evaluated at the 0.05 alpha level. Ninety-five percent confidence intervals for all
22 parameters of interest will be calculated to assess the precision of the obtained
23 estimates. All analyses will be performed in R and SPSS by a person blinded to
24 treatment allocation.
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55 **Data Management**

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3 Participant identifying information will be kept confidential by providing a unique
4 identification number (ID number) for the course of the study. To maintain privacy, only
5 authorized research investigators involved in the study will have access to participant
6 information. Password protected laptops, online documents, and access to cloud-based
7 servers will prevent leaks in data privacy. All records including informed consent,
8 screening tools, medical records, and participant surveys will be completed, and
9 documented on REDCap, a HIPAA-compliant online research database.
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20 Privacy on Zoom platform: Our institutional Zoom account (through Weill Cornell
21 Medicine) is compliant with HIPAA guidelines. Participant profile names will be updated
22 to display their ID. After each session, the recorded video will be uploaded to the
23 password protected WCM cloud-based server. Respective group participants will be
24 given the live Zoom links (synchronous) or passwords to access the asynchronous
25 Zoom sessions.
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34 Polar OH1 HR monitor (Optical HR sensor): Participants' profiles using allotted ID's will
35 be created in the Polar Beat App and the Flow for Coach cloud-based online platform.
36 All information uploaded to the platform will be accessible by the investigators using a
37 secured login ID and password.
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44 Adverse events, change in medications, and protocol deviation will be documented and
45 updated before and after each class on REDCap. The study team will perform weekly
46 self-audits to ensure data quality and completeness.
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51 *Procedure for handling missing data*
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3 This study is an intention-to-treat trial. If data are missing, we will use a mixed linear
4 regression model that accounts for uneven numbers of data points across participants.
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10 11 **Data Monitoring and Stopping Rules**

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13 Since this is a low-risk study, our IRB determined that a data monitoring committee is
14 not necessary. We will audit our data weekly and assess safety data at each session. If
15 we find an increase in pain by 25% or a decrease in quality of life measures by 25%
16 across participants in a cohort, we will pause the trial and evaluate how to improve the
17 safety of the study.
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29 **Current Status of Study**

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31 We have performed a feasibility cohort, with people with a range of abilities and
32 diagnoses. The first participant was consented on 01/22/2021, for an intervention that
33 began on 03/24/2021 and ended on 06/28/2021. In this feasibility study, we determined
34 that participants could readily complete the online assessments, exercise sessions, and
35 could effectively use Zoom, the Polar OH1 sensor and Polar Beat app, and the blood
36 pressure measurement device. Our next step will be to enroll separate cohorts of
37 people with specific neurological diagnoses, such as cerebral palsy, stroke, and multiple
38 sclerosis. This will begin in 2023.
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53 **Resource Sharing Plan**

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3 We plan to use the concept, methods and analysis as a framework to develop evidence-
4 based protocols for future cohorts and studies. We have made a commitment to publish
5 all relevant scientific information in a timely manner. Unpublished information may be
6 available to interested individuals or organizations by request to the Principal
7 Investigator.
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14 15 16 17 18 **Ethics and Dissemination**

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20 The study was approved by the BRANY Institutional Review Board on 9/22/2020,
21 protocol #20-08-388-512. All study participants will provide written informed consent
22 before participation. All protocol deviations, adverse events, and protocol modifications
23 will be reported to the IRB immediately. The results of the study will be disseminated to
24 the academic community via publications and presentations. The deidentified study data
25 will be shared on our laboratory website.
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38 **Trial Registration:** Clinicaltrials.gov NCT04564495.
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40
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42 commitment to assist with study development and recruitment. We thank Devon
43 Palermo at DPI Adaptive Fitness who will serve as the adaptive fitness instructor for this
44 study.
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51 **Contributors:** KMF is the Principal Investigator. KMF, AAD and AB were responsible
52 for ethics applications and reporting. AAD, AB, DSK, RMG, LEJC, TAC and KMF
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3 drafted the final version of this manuscript. All authors have contributed to the writing
4
5 and critical review of the manuscript and have approved the final version.
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7

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11
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13
14 Institutes of Health (NIH).
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18 **Role of Funder in Study:** The Sabrina Cohen Foundation has established the tele-
19
20 exercise classes we are studying and will assist with recruitment. The Sabrina Cohen
21
22 Foundation and Burke Foundation will have no role in data collection, analyses,
23
24 interpretation, or publication of the work.
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28 **Competing Interests:** None to declare
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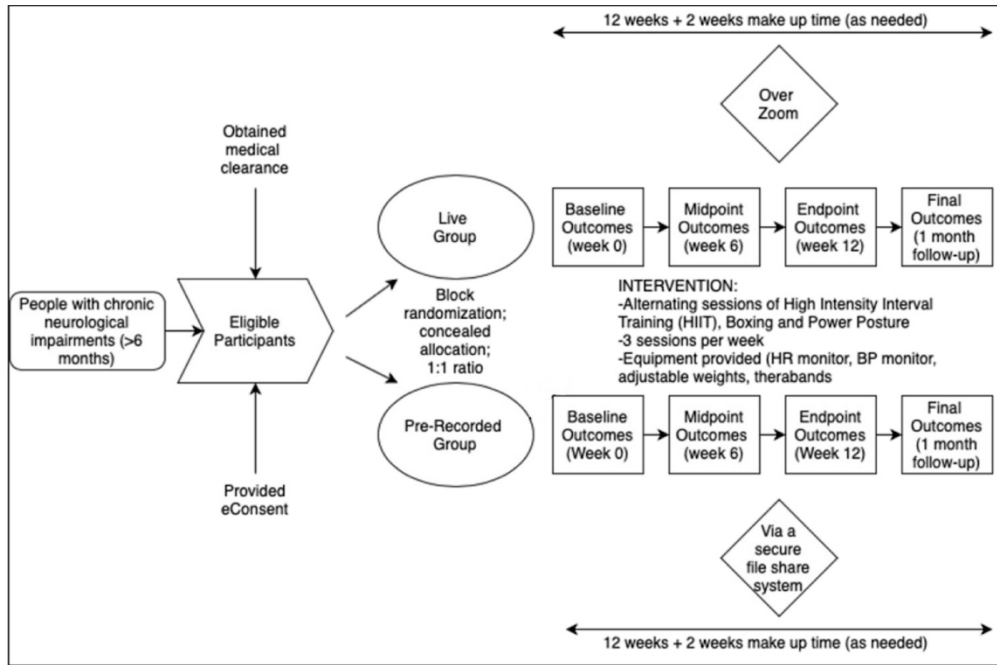
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Figure Legends

Figure 1: Study flow diagram.

Figure 2: Polar OH1 Heart Rate monitor. A. Picture of the monitor and charger. B. Proper placement of the monitor, with the device on the forearm. C. The Polar Beat app on a smart phone streams data in real time from the OH1 monitor via Bluetooth. D. After a session, data are retrievable from the Polar Coach website, where it is exported to a CSV file and processed in MATLAB.

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Study flow diagram.

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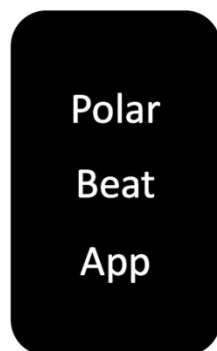
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Polar OH1 Heart Rate monitor. A. Picture of the monitor and charger. B. Proper placement of the monitor, with the device on the forearm. C. The Polar Beat app on a smart phone streams data in real time from the OH1 monitor via Bluetooth. D. After a session, data are retrievable from the Polar Coach website, where it is exported to a CSV file and processed in MATLAB.

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Informed Consent Form

This form explains our study and asks you to agree to participate. Please read the form carefully. A member of our study team will talk with you over Zoom to explain the study. Thank you so much for your interest in our study!

BIOMEDICAL RESEARCH ALLIANCE OF NEW YORK
THE BURKE NEUROLOGICAL INSTITUTE

SUBJECT INFORMATION AND INFORMED CONSENT

Project Title: Home-Based Exercise for People with Chronic Neurological Impairments
Principal Investigator: Kathleen Friel, PhD
Institution Name: Burke Neurological Institute
Institution Address: 785 Mamaroneck Ave, White Plains, NY 10605
Telephone: 914-368-3116, 646-351-9063 (24 hour)
Protocol # TELEX

ABOUT VOLUNTEERING FOR THIS RESEARCH STUDY

You are invited to participate in a research study. The purpose of the study is to determine the effect of a home-based exercise program on cardiovascular fitness and your quality of life. We will assess your motivation, enjoyment and compliance to either a live or pre recorded exercise class on Zoom.

You are eligible for this study because you have a neurological impairment that you've had for at least six months. A neurological impairment is weakness in your arms and/or legs that was caused by a stroke, brain injury, spinal cord injury, or any other condition that affects your brain or spinal cord.

WHY IS THIS STUDY BEING DONE?

Scientists at The Burke Neurological Institute (BNI) are partnering with the Sabrina Cohen Foundation (SCF) to test whether a home-based exercise program can improve cardiovascular health and quality of life in people who have had a chronic neurological impairment. We designed this study after the onset of COVID-19 in the United States. Since COVID-19 limits accessibility to gyms and other types of exercise venues, we hope to learn and understand the physiological and behavioral aspects of this rehabilitation strategy to optimize wellness after a neurological injury. You were selected as a possible participant in this study because you've had a neurological impairment for at least six months.

WHAT WILL I DO IF I AGREE TO BE IN THIS STUDY?

If you agree to be in the study, you will participate in 36 at-home, Zoom-based exercise classes. Classes will be held three times a week, for twelve weeks. You will be randomized to either a live class with other video participants, or a pre-recorded class that you will take on your own.

Before the first class, we will review your medical history with you to be sure it is safe for you to be in the study. If you qualify for the study, we will send you a kit that contains items you will need for the study, including a heart rate monitor, blood pressure cuff and adjustable wrist weights. We will also send you some surveys that ask about your ability to do everyday activities, such as dressing and cooking.

After you receive your home exercise kit, we will have an orientation Zoom class. You will meet the other people in the exercise class. During the orientation, the study team will teach you how to use the heart rate monitor. If you cannot put on the heart rate monitor, we will ask that a caregiver be present to assist you during each class.

You will download one applications onto your phone or computer that will allow us to access the information from your heart rate monitor. No one but the research team will be able to see this information aside from you.

Each exercise class will take approximately one hour. Each session will begin with instructions and questions from the study team regarding your pain level, level of motivation, and blood pressure. The exercise portion of the class will take 45 minutes. At the end of the class, the study team will ask you additional questions, such as how hard you worked, pain level, level of motivation and blood pressure.

The class instructor will tailor exercises to different abilities, so everyone can be active and safe. The entire class will be done in a seated position.

1 Approximately 100 people will be enrolled in the live class, and 100 in the pre-recorded class.
2

3 After the 18th class, which is midway through the study, we will send you another set of the same surveys you
4 completed before the first class. We will send you a third set of surveys after the final class.
5

6 RISKS AND INCONVENIENCES OF THE STUDY

7 Your participation in the project might involve the following risks:
8

9 The largest risk in this study is the risk of fatigue and muscle aches. These symptoms are common with exercise. The
10 instructor will offer modifications of each exercise, to offer easier or more difficult options. You will always be
11 welcome to use a modification, request an additional modification, or rest.
12

13 The risk of fall in this study is small, since you will be seated. If you normally have trouble with stability of your torso
14 while you are seated, we will ask that a caregiver be present in case a fall occurs.
15

16 There is a risk that your personal health information be disclosed in error. For this study, we are using secure Zoom
17 settings from an academic medical center, and we will require a password for each class, to mitigate this risk. The
18 app containing your heart rate information will also be secure.
19

20 PERMISSION FOR PHOTOGRAPHY

21 We will record each live class, video and audio. Since we are not together in one space, we need to record each
22 class for purposes of data collection. Therefore, we require each participant to agree to being recorded. We want to
23 make sure that you understand this.
24

25 Do you agree to be photographed in this study?

Yes

No

29 Please initial here to confirm your choice about being
30 photographed during the study:
31

34 NEW INFORMATION

35 You will be told about any new significant findings developed during the course of the study that might affect your
36 willingness to continue in the research.
37

38 COST OF STUDY TO PARTICIPANTS

39 There is no cost to you for participating in the research study.
40

41 BENEFITS OF THIS STUDY

42 Participation in this study is not guaranteed to benefit you. This study is only for the purpose of research. You may
43 feel stronger by the end of the study, but there is no guarantee that this will occur. However, the information learned
44 from this study may help other people in the future.
45

46 ALTERNATIVES TO STUDY PARTICIPATION

47 You do not have to participate in this research study to receive treatment for your condition. Your participation in
48 this study is voluntary. If you decide to participate, you are free to discontinue participation at any time. Your
49 participation in this study may be terminated without your consent by the study team or regulatory authorities, in
50 certain circumstances, such as, if the investigator determines it is in your best interest, you cannot adhere to the
51 study procedures, or in the event the study is terminated.
52

53 IN CASE OF INJURY

54 In accordance with Federal regulation, we are obligated to inform you about our policy in the event injury occurs. For
55 medical emergencies, call 911. If, as a result of your participation, you experience injury from known or unknown
56 risks of the research procedures as described, emergency medical care and treatment will be provided on our
57 premises to the extent possible. We will assist you in obtaining additional medical care, as needed, but you will be
58 responsible for the costs of such further medical treatment, either directly or through your medical insurance and/or
59 other forms of medical coverage. No other compensation will be offered by or Burke Neurological Institute or the
60 Biomedical Research Alliance of New York. Further information can be obtained from Dr Kathleen Friel (914
368-3116). You are not waiving any legal right to seek additional compensation through the courts by signing this
form.

CONFIDENTIALITY

To the extent allowed by law, every effort will be made to keep your personal information confidential. However, information from this study will be submitted to the study sponsor and to the U.S. Food and Drug Administration. It may be submitted to governmental agencies in other countries where the study product may be considered for approval. Medical records, which identify you and the consent form signed by you, will be looked at by the sponsor or the sponsor's representatives and may be looked at by the FDA and other regulatory agencies, the Institutional Review Board, and the Biomedical Research Alliance of New York. While these parties are aware of the need to keep your information confidential, total confidentiality cannot be guaranteed. The results of this research project may be presented at meetings or in publications; however, you will not be identified in these presentations and/or publications.

Federal regulations give you certain rights related to your health information. These include the right to know who will be able to get the information and why they may be able to get it. The study doctor must get your authorization (permission) to use or give out any health information that might identify you. If you choose to be in this study, the study doctor will get personal information about you. This may include information that might identify you. The study doctor may also get information about your health, including:

- Past and present medical records
- Research records
- Records about phone calls made as part of this research
- Records about your study visits
- Information obtained during this research about laboratory test results
- Results from diagnostic and medical procedures including but not limited to X-rays, physical examinations and medical history
- Billing records

Information about your health may be used and given to others by the study doctor and staff. They might see the research information during and after the study. Your information may be given to the sponsor of this research. "Sponsor" includes any persons or companies that are working for or with the sponsor, or are owned by the sponsor. Information about you and your health which might identify you may be given to:

- The U.S. Food and Drug Administration
- Department of Health and Human Services agencies
- Governmental agencies in other countries
- Biomedical Research Alliance of New York (BRANY)
- The Institutional Review Board
- Accrediting agencies

Your personal health information may be further shared by the groups above. If shared by them, the information will no longer be covered by the U.S. federal privacy laws. However, these groups are committed to keeping your personal health information confidential. If you give permission to give your identifiable health information to a person or business, the information may no longer be protected. There is a risk that your information will be released to others without your permission.

Information about you and your health that might identify you may be given to others to carry out the research study. The sponsor will analyze and evaluate the results of the study. In addition, people from the sponsor and its consultants will be visiting the research site. They will follow how the study is done, and they will be reviewing your information for this purpose. The information may be given to the FDA. It may also be given to governmental agencies in other countries. This is done so the sponsor can receive marketing approval for new products resulting from this research. The information may also be used to meet the reporting requirements of governmental agencies.

This authorization does not have an expiration date. If you do not withdraw this authorization in writing, it will remain in effect indefinitely.

By signing this consent form, you are giving permission to use and give out the health information listed above for the purposes described above. You do not have to sign this consent form. If you choose not to sign this consent form, you will not be able to be in this research study. Your decision not to sign this consent form will not have any effect on your medical care and you will not lose any benefits or legal rights to which you are entitled. You have the right to review and copy your health information. However, if you decide to be in this study and sign this permission form, you may not be allowed to look at or copy your information until after the research is completed.

You may withdraw or take away your permission to use and disclose your health information at any time. You do this by sending written notice to the study doctor at the address on the front of this informed consent form. If you withdraw your permission, you will not be able to continue being in this study, but you will not have any penalty or loss of access to treatment or other benefits to which you are entitled. When you withdraw your permission, no new health information which might identify you will be gathered after that date. Information that has already been gathered may still be used and given to others. This would be done if it were necessary for the research to be reliable.

1 Notice Concerning HIV-Related Information: HIV-related information that either is collected as part of the research or
2 that may already exist in your medical record might be accessed for the research by the research staff and the study
3 sponsor, but will not be shared with others without your authorization, unless federal or state law requires the
4 disclosure. You have a right to request a list of people who may receive or use your HIV-related information without
5 authorization. If you experience discrimination because of the release or disclosure of HIV-related information, you
6 may contact the New York State Division of Human Rights or New York City Commission on Human Rights. These
7 agencies are responsible for protecting your rights.

8 QUESTIONS ABOUT THIS STUDY

9 If you have any questions or requests for information relating to this research study or your participation in it, or if
10 you want to voice a complaint or concern about this research, or if you have a study related injury, you may contact
11 Dr. Friel at 914-368-3116, 646-351-9063 (24 hour).

12 If you have any questions about your rights as a research subject or complaints regarding this research study, or you
13 are unable to reach the research staff, you may contact a person independent of the research team at the
14 Biomedical Research Alliance of New York Institutional Review Board at 516-318-6877. Questions, concerns or
15 complaints about research can also be registered with the Biomedical Research Alliance of New York Institutional
16 Review Board at www.branyirb.com/concerns-about-research.

17 You will be given a copy of this form to keep.

18 A description of this clinical trial will be available on <http://www.ClinicalTrials.gov> as required by U.S. Law This Web
19 site will not include information that can identify you. At most, the Web site will include a summary of the results.
20 You can research this Web site at any time.

21 You are making a decision as to whether or not to participate. Your signature indicates that the above information
22 has been reviewed with you and that you have decided to participate. You may withdraw at any time without
23 prejudice after signing this form should you choose to discontinue participation in this study.

24 Signature:

25 _____

26 Date:

27 _____

28 Time:

29 _____

30 Upload a copy of informed consent here, if the
31 participant chose to provide consent on paper



STANDARD PROTOCOL ITEMS: RECOMMENDATIONS FOR INTERVENTIONAL TRIALS

SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description	Addressed on page number
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	2
	2b	All items from the World Health Organization Trial Registration Data Set	1, 2, 3, 7, 8-10, 12-15-18, 20
Protocol version	3	Date and version identifier	2
Funding	4	Sources and types of financial, material, and other support	2
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	1, 19
	5b	Name and contact information for the trial sponsor	N/A
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	20
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	N/A

1 **Introduction**

2

3 Background and rationale 6a Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention 4-5

4

5

6 6b Explanation for choice of comparators 4-5

7

8 Objectives 7 Specific objectives or hypotheses 5

9

10 Trial design 8 Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory) 5-6

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14 **Methods: Participants, interventions, and outcomes**

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16 Study setting 9 Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained 6

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19 Eligibility criteria 10 Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists) 6-7

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21

22 Interventions 11a Interventions for each group with sufficient detail to allow replication, including how and when they will be administered 8-10

23

24

25 11b Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease) 11

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28 11c Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests) 11-12

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31 11d Relevant concomitant care and interventions that are permitted or prohibited during the trial 6

32

33

34 Outcomes 12 Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended 12-15

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40 Participant timeline 13 Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure) 13 and Fig 1

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1 Sample size 14 Estimated number of participants needed to achieve study objectives and how it was determined, including 7
 2 clinical and statistical assumptions supporting any sample size calculations

3
 4 Recruitment 15 Strategies for achieving adequate participant enrolment to reach target sample size 7
 5

6
 7 **Methods: Assignment of interventions (for controlled trials)**

8 Allocation:
 9

10 Sequence 16a Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any 8
 11 generation factors for stratification. To reduce predictability of a random sequence, details of any planned restriction
 12 (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants
 13 or assign interventions
 14
 15

16 Allocation 16b Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, 8
 17 concealment opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned
 18 mechanism
 19

20 Implementation 16c Who will generate the allocation sequence, who will enrol participants, and who will assign participants to 8
 21 interventions
 22
 23

24 Blinding (masking) 17a Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome 9
 25 assessors, data analysts), and how
 26

27 17b If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's 9
 28 allocated intervention during the trial
 29
 30

31 **Methods: Data collection, management, and analysis**
 32

33 Data collection 18a Plans for assessment and collection of outcome, baseline, and other trial data, including any related 12-15
 34 methods processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of
 35 study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known.
 36 Reference to where data collection forms can be found, if not in the protocol
 37

38 18b Plans to promote participant retention and complete follow-up, including list of any outcome data to be 11-12
 39 collected for participants who discontinue or deviate from intervention protocols
 40
 41
 42

1	Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	17-18
2				
3				
4				
5	Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	15-17
6				
7				
8		20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	15-17
9				
10		20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	18
11				
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14	Methods: Monitoring			
15				
16	Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	18
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22		21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	18
23				
24				
25	Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	18
26				
27				
28		23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	18
29				
30				
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32	Ethics and dissemination			
33				
34	Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	19
35				
36				
37	Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	19
38				
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42				

1	Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	10-11
2				
3				
4		26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	N/A
5				
6				
7	Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	17-18
8				
9				
10	Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	20
11				
12				
13	Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	17
14				
15				
16	Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	no plans for post-trial care, compensation plan due to injury listed in ICF p2 "In Case of Injury"
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25	Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	19
26				
27				
28				
29		31b	Authorship eligibility guidelines and any intended use of professional writers	19
30				
31		31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	19
32				
33				
34	Appendices			
35				
36	Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	supplemental
37				
38				
39	Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	N/A
40				
41				
42				

1 *It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items.
2 Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons
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For peer review only

BMJ Open

Effects of a 12-week, seated, virtual, home-based tele-exercise program compared with a pre-recorded video-based exercise program in people with chronic neurological impairments: protocol for a randomized controlled trial

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3 **Effects of a 12-week, seated, virtual, home-based tele-exercise program**
4 **compared with a pre-recorded video-based exercise program in people with**
5 **chronic neurological impairments: protocol for a randomized controlled trial**
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52 training.
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Abstract

Introduction: Exercise is vital to staying well and preventing secondary complications in people with Chronic Neurological Impairments (CNI). Appropriate exercise is often inaccessible to this population. The purpose of the study is to investigate the effects of a seated, virtual exercise program on heart rate, recovery, fatigue, pain, motivation, enjoyment, and quality of life in people with CNI.

Methods and analysis: Individuals with CNI will be screened for eligibility, and 60 participants will be randomized 1:1 into either a live or pre-recorded group. There is no geographic limitation to where participants reside, since participation is virtual. The study will be coordinated by one site in White Plains, NY, USA. The live group will exercise with an instructor via Zoom while the pre-recorded group will exercise at their chosen time using pre-recorded videos, 3x/week for 12 weeks. Primary outcome measure: change in heart rate during exercise/recovery. Secondary outcome measures: fatigue, motivation, level of pain and exertion, physical well-being, enjoyment of physical activity, motivation, and quality of life. Outcomes will be assessed at baseline, midpoint, end of study, and one-month post-study. Adverse events, medication changes, and physical activity will be tracked throughout. Within-group and between-group comparisons will be performed using Analysis of Covariance and regression.

Ethics and dissemination: BRANY IRB approval: 09/22/2020, protocol #20-08-388-512. All participants will provide written informed consent. Results will be disseminated through presentations, publications, and clinicaltrials.gov.

Trial registration number: [ClinicalTrials.gov](https://clinicaltrials.gov), NCT04564495.

Strengths and limitations of this study

- This study will use a comprehensive set of physiological and behavioral assessments to assess effects of exercise.
- The virtual design of the study enables people to participate without commuting to our institute.
- For those participants with limited technological experience, difficulty using blood pressure devices and heart rate monitors will cause missing data values.
- The virtual design of the study prohibits hands-on evaluations.

Introduction

Exercise is a vital component to staying well and preventing secondary impairments. Exercise is known to positively influence a range of factors including cardiovascular health, cognition, mental health, bone health, sleep, and quality of life, among many others¹⁻⁸. The benefits of exercise are further amplified in the estimated one billion people worldwide with Chronic (> 6 months) Neurological Impairments (CNI), as the injuries often lead to sedentary lifestyles and thus higher rates of obesity and cardiovascular disease⁹⁻¹¹. Incorporating an exercise regimen is vital to preventing secondary complications such as muscular weakness, fatigue, limited mobility, pain, spasticity, bone loss, and increased risk of fractures, falls, diabetes, depression, and obesity^{7, 8, 12, 13}. Exercise can be neuroprotective and neuro-regenerative by increasing neurotrophic factors, which are involved in neuroprotection, neuroplasticity, and maintenance of neuronal health^{2, 14-18}. Exercise can also improve muscle strength and bone integrity in people with CNI¹⁹⁻²¹.

People with CNI often cannot access community exercise centers, as mobility can be more difficult, insurance payments sparse, centers not welcoming or accessible, and assistive exercise equipment too costly for most facilities²²⁻³⁵.

Another key barrier to exercise for people with CNI is transportation³⁶. Although COVID-19 introduced many new barriers to community participation, it also had some silver linings for people with CNI. COVID-19 resulted in the emergence of many new Zoom or online classes tailored to people with CNI, which removed the barrier of transportation.

Although there has been an explosion of virtual-based exercise opportunities since 2020, much is unknown regarding optimal delivery models to bring exercise to people

1
2
3 with CNI. Two general types of virtual exercise delivery models exist. In synchronous
4 exercise, one or more participants join a virtual space via videoconferencing, and
5 interact with the trainer in real time. Synchronous exercise enables the trainer to provide
6 feedback as participants exercise. In contrast, in asynchronous exercise, trainers record
7 instructional videos, which participants complete on their own time, without being in the
8 same virtual space with the trainer at the same time. Asynchronous exercise provides
9 scheduling flexibility to participants but does not allow for real time interaction and
10 feedback from the trainer. There has only been one study directly comparing
11 synchronous versus asynchronous exercise training in people with CNI.
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24 In a recent study, forty adults with spinal cord injury were randomized to either
25 synchronous or asynchronous tele-exercise. While there was no significant difference in
26 average daily workload between the interventions, the synchronous tele-exercise found
27 significantly higher values for adherence and successful data recording of the exercise,
28 resulting in greater weekly training loads³⁷. Virtual exercise platforms are part of society
29 even as the pandemic wanes. Thus, it is important to determine optimal delivery models
30 for specific groups of participants.
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41 This study will examine the cardiovascular benefits, as well as differences in
42 compliance, motivation and feelings of socialization and exertion between synchronous
43 and asynchronous classes. The classes will be held for 12 weeks, 3 times/week using
44 seated exercise via Zoom. The instructor will remain the same and alternate between
45 boxing, high intensity interval training (HIIT) and power posture classes. We will
46 examine the potential benefits of an accessible form of exercise for a population that is
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3 in urgent need. Additionally, by comparing synchronous and asynchronous classes, we
4
5 will compare user compliance, motivation, enjoyment, and socialization.
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7

8 We hypothesize that individuals in the synchronous class will have better attendance,
9
10 more robust exertion as measured by heart rate, and better enjoyment than people in
11
12 the asynchronous class, due to the social component of the synchronous classes. We
13
14 hypothesize that participants in both groups will show improvement in heart rate
15
16 recovery, physical wellness, quality of life, enjoyment, and motivation/engagement, and
17
18 that changes will be greater in the synchronous class due to consistent supervision and
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20 contact.
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27

28 **Methods and analysis**

29 **Study design**

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31
32
33 This study is a parallel randomized controlled trial to investigate the effects of a 12-
34
35 week, 3 times/week, seated tele-exercise program for adults with CNI (Figure 1). All 36
36
37 exercise sessions will be completed online via Zoom with the physical exercise
38
39 instructor (live, synchronous group) or offline using recorded videos (pre-recorded,
40
41 asynchronous group). Participants will be in their own homes as they complete the
42
43 exercise classes. Participants can continue their medications, physical, occupational,
44
45 speech therapies, and existing exercise routines (2 times/week or fewer).
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53 **Eligibility criteria and participants**

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55 The eligibility criteria will be kept broad to accommodate all neurological impairments.
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3 Inclusion criteria:
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5

- 6 1. Participants diagnosed with Chronic (>6 months) Neurological Impairments
- 7
- 8 2. Ages 18 to 75 years
- 9
- 10 3. Able to sit for at least 1 hour
- 11
- 12 4. Stable Heart rate (HR) and Blood Pressure (BP)
- 13
- 14 5. Medical clearance to participate in moderate intensity exercises
- 15
- 16 6. Can don and doff a wrist HR monitor with or without assistance
- 17
- 18 7. Can maintain daily exercise and physical activity during the study
- 19
- 20 8. No other neurological, medical or cognitive impairments
- 21
- 22 9. Able to access the internet and use the cloud-based Zoom conference platform
- 23
- 24 10. Ability to speak and understand English
- 25
- 26 11. Currently exercising 2 days or less per week
- 27
- 28 12. Presence of caregiver or supervisor during exercise, for safety
- 29
- 30
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- 32
- 33

34 Exclusion criteria:
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- 37 1. Unstable or uncontrolled medical conditions
- 38
- 39 2. Medical issues preventing safe participation
- 40
- 41 3. Unable to follow simple 2-step commands
- 42
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47 **Number of participants**
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49 We plan to conduct multiple cohorts of participants, each with different participant
50 populations, e.g., multiple sclerosis, cerebral palsy, stroke, spinal cord injury.
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3 For each cohort, with 27 participants in the synchronous and asynchronous groups, we
4 will have 80% power to detect a change in maximum heart rate during exercise from
5 about 80 bpm to 100 bpm (or greater), from the first session to the last session of the
6 intervention. This calculation assumes a conservative standard deviation of the pre/post
7 differences in heart rate of 35 bpm. We plan for a 30% dropout rate, which is an
8 estimate based on our feasibility pilot study (see below), which means that we will
9 recruit 35 participants per group to achieve 80% power.
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23 **Recruitment**

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25 Participants will be recruited via the Sabrina Cohen Foundation (SCF), which has a
26 network of people with CNI, and by the Burke Neurological Institute (BNI), who has a
27 database of potential participants from prior studies or programs. We will also post our
28 recruitment flier on our website, social media, and will mail it to neurological patient
29 advocacy groups. We will send the study flier to all above mentioned entities, without
30 prioritizing any database or group over another. If we cannot recruit appropriate
31 numbers using these methods, we will pursue paid advertising in our community.
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45 **Randomization**

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47 A person not affiliated with the study will generate a series of permuted randomized
48 blocks in a computerized spreadsheet with a defined block size of 4. Participants will be
49 allocated to either the live (synchronous) or pre-recorded (asynchronous) group, with a
50 1:1 ratio between groups. Due to the nature of the intervention, it is not possible to
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3 conceal allocation from the participants or the study team. However, the two groups will
4
5 never interact with one another.
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10 11 **Blinding and rigor of data** 12

13
14 Due to the nature of the study, blinding of participants and study team members to
15
16 group allocation will not be possible. All participants will complete the outcome surveys
17
18 directly online, without input or assistance from the study team. Heart rate data will be
19
20 collected through a heart rate monitor that collects quantitative data without input or
21
22 filtering by the study team.
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27

28 29 **Intervention** 30

31
32 The exercise intervention will be delivered by a trained professional who specializes in
33
34 adaptive exercise for individuals with CNI. The instructor will structure each class to
35
36 ensure standardization in terms of class structure, including warm-up, cool-down, cues
37
38 for recording heart rate during class, use of additional equipment, and adherence to the
39
40 general study protocol. The instructor has extensive experience in offering adaptations
41
42 to exercises in a virtual setting. He offers alternative ways to perform the exercises,
43
44 such that everyone in class will be able to fully participate safely.
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47

48
49 All participants, regardless of allocation to live or pre-recorded groups, will participate in
50
51 45 minutes of aerobic exercise intervention, three times a week, for a period of 12
52
53 weeks. The overall exercise session will be up to one hour long to include measuring
54
55 vitals, answering questions before/after sessions, and rest breaks (if any). Two
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additional weeks will be provided for making up missed sessions, if applicable. Each intervention will be preceded by a warm-up and followed by a cool-down period. All participants will be asked to document any adverse events and changes in medications before each session. The order of classes will be rotated. Individual aerobic interventions for the first cohort are described below and summarized in Table 1.

Table 1: Summary of exercise sessions

Minutes into Session	HIIT	Boxing	Power Posture
5	Warm up	Warm up	Warm up
10	Intervals of 30 sec high intensity movements, 1-2 min lower intensity	Intervals of 30 sec high intensity boxing movements, 1-2 min lower intensity	Stretching
15			Fast paced movements targeting trunk, posture
20			Stretching
25			
30			
35	Cool down	Cool down	Cool down
40			
45	End	End	End

High intensity interval training (HIIT): In HIIT sessions, participants will do repetitive bouts of high intensity exercises, with intermittent periods of rest or active recovery. Examples of high intensity movements used in these sessions include fast punching movements, repeatedly rapidly lifting one's arms overhead (with or without weights, as tolerated by each participant), and abdominal crunches. The duration of each bout of high intensity is about 10-30 seconds. Since this study will include participants with variable neurological impairments, the upper limit of exercise intensity in HIIT will be

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2
3 dependent on instructor's judgement, participant feedback, rate of perceived exertion,
4
5 and any exercise heart rate restrictions given by their doctor in the medical screening.
6
7

8 Boxing: In boxing sessions, participants will do a circuit of individual and combinations
9
10 of various arm strikes and punches. Boxing is a moderate to high intensity aerobic
11
12 activity by nature. During the session, participants will do bouts of high intensity
13
14 movements, similar to HIIT, along with periods of lower intensity arm movements such
15
16 as practicing defensive blocks of punches from an imaginary boxing opponent. The
17
18 exercise intensity for boxing, as in HIIT, will be subjective for participants based on level
19
20 of perceived exertion as well as exercise heart rate restrictions, if any.
21
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23

24 Power posture: Power posture is a HIIT-style strength and endurance class in which
25
26 participants will move in ways that train trunk stability and control of sitting with correct
27
28 posture. In these sessions, there will be a warm-up period of 5-10 minutes, focused on
29
30 slow, gentle repetitions to prepare the trapezius and other supporting scapular muscles
31
32 for movement. This workout will target postural form, with fast paced targeted
33
34 movements for 10-15 minutes. After the fast-paced movements, a cool-down period will
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36 focus on gentle deep neck flexor/extensor chin tuck exercises, range of motion, and
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38 stretching.
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47 **Virtual nature of the study**

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49 Each aspect of this study will be performed virtually. Screenings will be performed on
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51 the telephone, with a standard list of criteria asked of each person. If deemed eligible,
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53 the potential participant will be sent a Zoom link to go through the informed consent on
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3 a one-to-one basis. The informed consent will be uploaded to REDCap, a secure web
4 application for building and managing online surveys and databases. REDCap is 21
5 CFR Part 11-ready and HIPAA compliant and is specifically geared to support online
6 and offline data capture for research studies and operations.
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12 To obtain informed consent directly from participants, a study team member will arrange
13 a Zoom call with each participant. The informed consent will be signed virtually by
14 sharing a virtual remote with the participant during the call. If anyone has difficulty, they
15 can be sent the informed consent from REDCap via email and return it to REDCap just
16 as easily. Each participant will be sent a copy of their signed consent form via the same
17 REDCap email system (see Supplemental Material for a sample consent form).
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26
27 Each participant will be mailed a home exercise kit, which will contain a Polar optical
28 heart rate monitor (OH1), blood pressure monitor, yellow and green resistance
29 TheraBands and wrist weights.
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34 After the home kits have been received by the participants and before the intervention
35 begins, we will hold a series of training videoconferencing calls to acquaint participants
36 with the study procedures and the use of all devices.
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42 *Polar OH1 heart rate monitor:* we will train participants in donning/doffing the heart rate
43 monitor, using the Polar app, using their Polar accounts, syncing the Polar devices with
44 their smartphones and starting/ending their heart rate tracking during exercise sessions.
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49 *Blood pressure monitor:* we will send each participant a commercially available
50 automatic blood pressure (BP) monitor. We will train each person to use it, and we have
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1
2
3 embedded an instructional video into the REDCap data entry form on which participants
4
5 will input their BP.
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7

8 *Checking compliance:* after each session, a study team member will review each
9
10 participant's data entry forms and syncing of their heart rate data with the Polar app.
11
12 For the synchronous group, this will occur before the participant leaves the session. For
13
14 the asynchronous group, this will occur within one day of when the participant
15
16 completes the session.
17
18

19
20 All questionnaires and questions to be answered before and after each class will be
21
22 sent from and stored on REDCap. All heart rate data will be transmitted to the Polar
23
24 website, which can be accessed only by the participant or the researchers. Then, the
25
26 data will be analyzed in MATLAB using custom scripts written by the study team.
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28
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32

33 **Study safety**

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35 We will monitor side effects before and after each session by having participants
36
37 complete surveys on REDCap. If pain or blood pressure are higher than usual, we will
38
39 ask the participant if they wish to continue. If blood pressure rises near limitations
40
41 prescribed by a participant's doctor, we will discontinue the participant. If any injury
42
43 occurs during or outside of study sessions that may increase the risk of further injury,
44
45 we will discontinue the participant.
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52 **Patient and public involvement**

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3 Persons with disabilities were involved in the design of this study, and will be involved in
4 the conduct, reporting, and dissemination plans of this research. Our pilot study
5 participants provided constructive feedback on the study, in surveys and in a zoom
6 discussion group after they completed the study. Our class instructor owns and
7 operated an adaptive gym for people with disabilities, and received feedback from his
8 clients when designing the exercise classes. We will continue to involve these people as
9 we complete the study, through regular meetings and surveys.
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22 **Strategies to improve adherence**

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25 In this study, adherence is defined as the number of sessions a participant completed.
26
27 The study team will take attendance at each synchronous session and will monitor
28 session completions for the asynchronous group. Completion for the asynchronous
29 group will be monitored via REDCap. Each time a person completes a data entry form
30 before and after the session, it will be automatically saved and time stamped in
31 REDCap.
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40 If a participant misses a class, we will reach out and inquire about their ability to attend
41 future sessions. We have *a priori* set a minimum number of 30 of 36 classes that a
42 participant must attend to be included in the main analyses of the study. We will offer 2
43 weeks of makeup sessions at the end of the 12 weeks. If a participant drops out before
44 completing 30 sessions, we will encourage them to complete the post-study outcome
45 measures and the satisfaction survey. We will use the number of sessions completed as
46 a covariate in the analyses.
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Outcome measures

All outcome measures are summarized in Table 2.

Table 2: Outcome measures

PRIMARY OUTCOME MEASURE			
Measure	Modality Assessed	Method of Ascertainment	Timepoints
Peak heart rate	Cardiovascular function	Polar OH1/Polar Beat app	Each session
SECONDARY OUTCOME MEASURES			
Measure	Modality Assessed	Method of Ascertainment	Timepoints
Demographics	--	REDCap survey	Before first session
Attendance	Adherence	REDCap time stamps	Each session
Baseline heart rate	Cardiovascular function	Polar OH1/Polar Beat app	Each session
Heart rate at end of session	Cardiovascular function	Polar OH1/Polar Beat app	Each session
Heart rate recovery	Cardiovascular function	Polar OH1/Polar Beat app	Each session
Blood pressure	Cardiovascular function	Automatic BP device	Before and after each session
Rate of Perceived Exertion	Cardiopulmonary fitness	REDCap survey	Before and after each session
Perceived Wellness Survey	Wellness	REDCap survey	Baseline, weeks 6, 12, 16
Physical Activity Enjoyment Scale	Enjoyment of exercise	REDCap survey	Baseline, weeks 6, 12, 16
Short Form-36	Physical and mental health	REDCap survey	Baseline, weeks 6, 12, 16
Numerical Pain Rating Scale	Pain	REDCap survey	Baseline, weeks 6, 12, 16

Reason for Exercise Inventory	Motivation to exercise	REDCap survey	Baseline, weeks 6, 12, 16
Participant Feedback Survey	Participant satisfaction	REDCap survey	End of study or at dropout

Demographics

We will collect the following demographics by having each participant complete a demographics data entry form on REDCap: age, gender, neurological diagnosis, time of diagnosis, and comorbid health issues (e.g., diabetes, high blood pressure, etc.). We will also document whether a person needs assistance with walking or transfers. In addition, we will require each participant to receive written medical clearance by their doctor to participate in the study, and if any exercise restrictions need to be followed.

Primary outcome measure: peak heart rate during exercise

Continuous heart rate tracking is the primary outcome measure for the study. All participants will receive the OH1 Polar HR monitor as part of their exercise kit for the study (Figure 2). The Polar OH1 (Polar Electro Inc., Bethpage, NY, USA) is an optical heart rate sensor on an armband that records HR activity. It has 6 LED sensors that record at 1-second intervals³⁸. HR activity is recorded via Bluetooth to a phone compatible with the Polar Flow or Polar Beat app. It has validity in moderate to vigorous intensity exercises and high endurance sports activities³⁸⁻⁴⁰.

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3 Immediately before each exercise session, participants will turn on their OH1 monitor.
4
5 Then, the participant will open the Polar Beat app on their smart phone and hit “start”
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7 when the exercise session begins. The Polar OH1 continuously records heart rate (HR)
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9 at 10Hz when the device is powered on and the Polar Beat app recording has been
10
11 started. Participants will record HR through the entire exercise session and for 10
12
13 minutes after completion of the session to capture HR during exercise as well as HR
14
15 recovery for 10 minutes after the end of exercise sessions. The live group will be
16
17 supervised by the research team for each session. The pre-recorded groups will have
18
19 the research team available for assistance and troubleshooting. Data are stored on the
20
21 Polar Coach website, where study staff can export sessions as CSV files that are then
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23 processed in MATLAB (MathWorks). In MATLAB, peak HR (primary measure) will be
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25 calculated.
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31 **Secondary outcome measures**

32 *Measures acquired at each exercise session*

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34 We will calculate secondary measures of HR in MATLAB using the same Polar CSV
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36 files mentioned above: baseline HR, HR at end of session, and HR at 30s intervals for
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38 10min after the end of the session will be analyzed, to measure heart rate recovery.
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44 At each session, participants will complete an online assessment to rate the level of
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46 pain and perceived exertion (RPE), BP, HR, and adverse events before and after the
47
48 exercise session. Additionally, as described above, attendance will be taken at each
49
50 session as a measure of adherence. After the session is over, participants will complete
51
52 a lab-developed survey to rate their experience on a 10-point scale from 1 (not a good
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54 experience) to 10 (very good experience) on questions related to motivation, energy,
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3 satisfaction, and performance. In addition, participants will provide information on
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5 changes related to health, falls, or other adverse events.
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8 *Measures acquired at specified times during the intervention*

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11 A comprehensive set of secondary outcome measures will be completed by participants
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13 at baseline, mid-study (6 weeks), end of study (12 weeks) and follow-up after one
14
15 month. All questionnaires will be self-administered or administered by a trained
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17 researcher virtually using REDCap.
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21 Perceived Wellness Survey (PWS): Participants will quantify their perceived health
22
23 status by completing the PWS. The PWS is a 36-item instrument used to measure an
24
25 individual's perceived health status in physical, psychological, emotional, intellectual,
26
27 spiritual, and social wellness constructs. Items under each construct are scored on a
28
29 scale of 1 (very strongly disagree) to 6 (very strongly agree). Higher scores indicate
30
31 better perceived wellness. The PWS has good reliability and validity in healthy and
32
33 neurological populations⁴¹⁻⁴³.
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38 Physical Activity Enjoyment Scale (PACES): the PACES is a self-assessment measure
39
40 of enjoyment with their current physical activity. It is an 18-item scale with scoring from
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42 1 (I enjoy it) to 7 (I hate it). Scores on the bipolar rating scale are summed with higher
43
44 scores indicative of more enjoyment. It is reliable and valid in neurological populations⁴⁴⁻
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46 ⁴⁷.
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50 Short Form-36 Health Survey (SF-36): the SF-36 measures physical health and mental
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52 health. There are eight scales - Physical Functioning, Physical Role Limitations, Bodily
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54 Pain, General Health, Vitality, Social Functioning, Emotional Role Limitations, and
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3 Mental Health. It is easy to use with good validity and reliability in neurological
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5 populations⁴⁸⁻⁵¹.

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8 Numerical pain rating (NPR) scale: the NPR is a standardized instrument for pain
9
10 assessment in clinical and research practice. It is an 11-point scale from 0 (no pain) to
11
12 10 (the most intense pain) at rest and during movement. It is simple to use with high
13
14 sensitivity to changes in chronic pain in adult populations^{52, 53}. It is reliable and valid for
15
16 pain assessments of neurological populations⁵⁴.

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18
19 Borg's Rating Scale of Perceived Exertion (RPE): the Borg RPE is a widely used
20
21 standardized measure to evaluate perceived intensity of exertion, effort, and fatigue
22
23 during physical exercise. The scale ranges from 6 (no exertion at all) to 20 (absolute
24
25 maximum). Higher ratings on the scale indicate greater overall body exertion. It is a
26
27 reliable and valid measure in neurological populations⁵⁵⁻⁶².

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29
30 Reason for exercise inventory (REI): the REI is a 24-item scale to assess the reason
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32 that motivates a person to exercise. The modified version has 4 subscales:
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34 Weight/appearance management, fitness/health management, stress/emotion
35
36 management, and socialization. A 7-point scale ranges from 1 (not at all important) to 7
37
38 (extremely important). Higher scores represent greater motivation to exercise⁶³.

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41 Participant feedback: on study completion, or when withdrawn/dropped out from the
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43 study, participants will complete a study feedback form. The feedback will be based on
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45 study acceptance, ease of using HR and BP devices and exercise equipment, and
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47 support from the research team. Participants who do not complete the study will also
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49 provide their final timepoint measure at the end of their final exercise session.
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Statistical methods

Descriptive statistics (including mean, standard deviation, median, interquartile range, frequency, and percent) will be calculated for demographic and clinical characteristics of the study participants.. Analysis of Covariance (ANCOVA) will be used to evaluate the independent effect of synchronous versus asynchronous group status on change in peak heart rate (first session versus final session), after controlling for baseline heart rate and any other factors that may remain imbalanced between groups after randomization. Adjusted mean differences in peak heart rate (first session versus final session) between the synchronous and asynchronous groups and 95% confidence intervals for these differences will be estimated from the multivariable ANCOVA model. Similar analyses as described above will be performed for other continuous outcomes (primary and secondary), including Borg's RPE scale, mood, motivation, and pain scales, Perceived Wellness Survey, SF-36v2 score, and PACES score. Categorical variables (e.g., safety questions, adverse events, medication changes, etc.) will be compared between the synchronous and asynchronous groups (at baseline, 6 weeks, and 12 weeks) by the chi-square test or Fisher's exact test, as appropriate. Generalized estimating equations (GEE) modeling will also be explored to evaluate between-group differences over repeated assessments, and to account for potential missing data in some of the outcome variables at one or more of the evaluation time points. All estimates from the multivariable models will serve as preliminary data (i.e., hypothesis-generating) for future studies. All p-values will be two-sided with statistical significance evaluated at the 0.05 alpha level. Ninety-five percent confidence intervals for all

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3 parameters of interest will be calculated to assess the precision of the obtained
4 estimates. All analyses will be performed in R and SPSS by a person blinded to
5 treatment allocation.
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10 11 12 13 **Data management**

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16 Participant identifying information will be kept confidential by providing a unique
17 identification number (ID number) for the course of the study. To maintain privacy, only
18 authorized research investigators involved in the study will have access to participant
19 information. Password protected laptops, online documents, and access to cloud-based
20 servers will prevent leaks in data privacy. All records including informed consent,
21 screening tools, medical records, and participant surveys will be completed, and
22 documented on REDCap, a HIPAA-compliant online research database.
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32 Privacy on Zoom platform: Our institutional Zoom account (through Weill Cornell
33 Medicine) is compliant with HIPAA guidelines. Participant profile names will be updated
34 to display their ID. After each session, the recorded video will be uploaded to the
35 password protected WCM cloud-based server. Respective group participants will be
36 given the live Zoom links (synchronous) or passwords to access the asynchronous
37 Zoom sessions.
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47 Polar OH1 HR monitor (Optical HR sensor): Participants' profiles using allotted ID's will
48 be created in the Polar Beat App and the Flow for Coach cloud-based online platform.
49 All information uploaded to the platform will be accessible by the investigators using a
50 secured login ID and password.
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3 Adverse events, change in medications, and protocol deviation will be documented and
4 updated before and after each class on REDCap. The study team will perform weekly
5 self-audits to ensure data quality and completeness.
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9 10 *Procedure for handling missing data*

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13 This study is an intention-to-treat trial. If data are missing, we will use a mixed linear
14 regression model that accounts for uneven numbers of data points across participants.
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18 19 20 21 **Data monitoring and stopping rules**

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24 Since this is a low-risk study, our IRB determined that a data monitoring committee is
25 not necessary. We will audit our data weekly and assess safety data at each session. If
26 we find an increase in pain by 25% or a decrease in quality of life measures by 25%
27 across participants in a cohort, we will pause the trial and evaluate how to improve the
28 safety of the study.
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39 40 41 **Current status of the study**

42 We have performed a feasibility cohort, with people with a range of abilities and
43 diagnoses. The first participant was consented on 01/22/2021, for an intervention that
44 began on 03/24/2021 and ended on 06/28/2021. In this feasibility study, we determined
45 that participants could readily complete the online assessments, exercise sessions, and
46 could effectively use Zoom, the Polar OH1 sensor and Polar Beat app, and the blood
47 pressure measurement device. Our next step will be to enroll separate cohorts of
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3 people with specific neurological diagnoses, such as cerebral palsy, stroke, and multiple
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5 sclerosis. This will begin in 2023.
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10 11 **Resource sharing plan**

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13 We plan to use the concept, methods and analysis as a framework to develop evidence-
14 based protocols for future cohorts and studies. We have made a commitment to publish
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16 all relevant scientific information in a timely manner. Unpublished information may be
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18 available to interested individuals or organizations by request to the Principal
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20 Investigator.
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28 29 **Ethics and dissemination**

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31 The study was approved by the BRANY Institutional Review Board on 9/22/2020,
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33 protocol #20-08-388-512. All study participants will provide written informed consent
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35 before participation. All protocol deviations, adverse events, and protocol modifications
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37 will be reported to the IRB immediately. The results of the study will be disseminated to
38
39 the academic community via publications and presentations. The deidentified study data
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41 will be shared on our laboratory website. The trial is registered at Clinicaltrials.gov,
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43 number NCT04564495.
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4
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10

11
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13
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15
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17
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19
20

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27
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29
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31
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33
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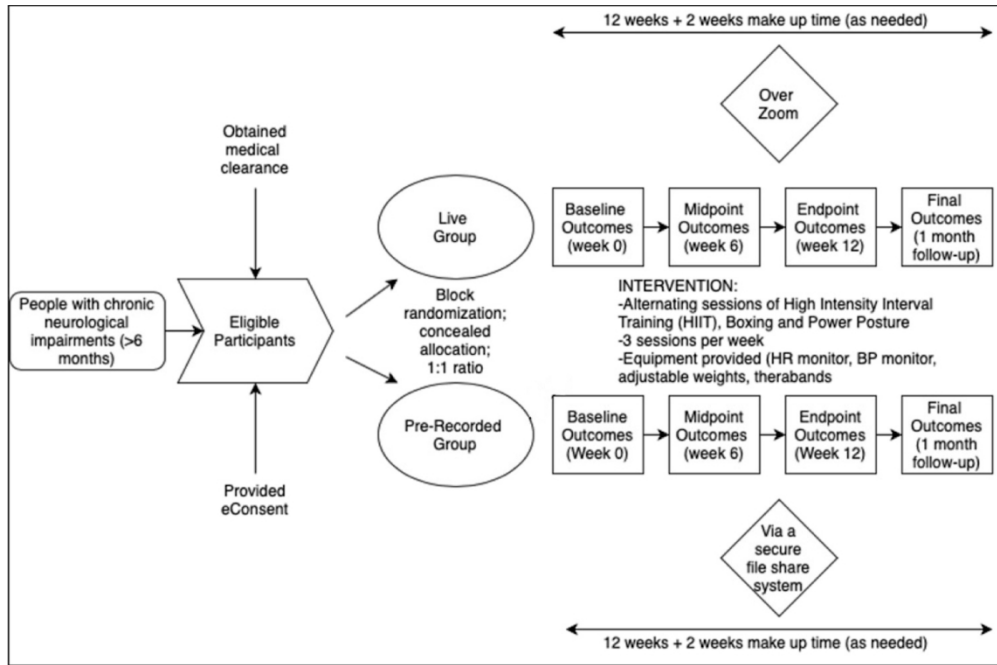
Figure legends

Figure 1: Study flow diagram

Figure 2: Polar OH1 heart rate monitor

A. Picture of the monitor and charger. B. Proper placement of the monitor, with the device on the forearm. C. The Polar Beat app on a smart phone streams data in real time from the OH1 monitor via Bluetooth. D. After a session, data are retrievable from the Polar Coach website, where it is exported to a CSV file and processed in MATLAB.

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Study flow diagram.

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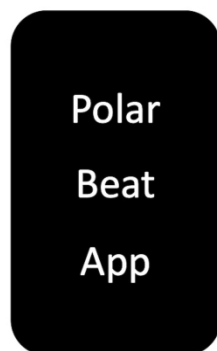
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Polar OH1 Heart Rate monitor. A. Picture of the monitor and charger. B. Proper placement of the monitor, with the device on the forearm. C. The Polar Beat app on a smart phone streams data in real time from the OH1 monitor via Bluetooth. D. After a session, data are retrievable from the Polar Coach website, where it is exported to a CSV file and processed in MATLAB.

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Informed Consent Form

This form explains our study and asks you to agree to participate. Please read the form carefully. A member of our study team will talk with you over Zoom to explain the study. Thank you so much for your interest in our study!

BIOMEDICAL RESEARCH ALLIANCE OF NEW YORK
THE BURKE NEUROLOGICAL INSTITUTE

SUBJECT INFORMATION AND INFORMED CONSENT

Project Title: Home-Based Exercise for People with Chronic Neurological Impairments
Principal Investigator: Kathleen Friel, PhD
Institution Name: Burke Neurological Institute
Institution Address: 785 Mamaroneck Ave, White Plains, NY 10605
Telephone: 914-368-3116, 646-351-9063 (24 hour)
Protocol # TELEX

ABOUT VOLUNTEERING FOR THIS RESEARCH STUDY

You are invited to participate in a research study. The purpose of the study is to determine the effect of a home-based exercise program on cardiovascular fitness and your quality of life. We will assess your motivation, enjoyment and compliance to either a live or pre recorded exercise class on Zoom.

You are eligible for this study because you have a neurological impairment that you've had for at least six months. A neurological impairment is weakness in your arms and/or legs that was caused by a stroke, brain injury, spinal cord injury, or any other condition that affects your brain or spinal cord.

WHY IS THIS STUDY BEING DONE?

Scientists at The Burke Neurological Institute (BNI) are partnering with the Sabrina Cohen Foundation (SCF) to test whether a home-based exercise program can improve cardiovascular health and quality of life in people who have had a chronic neurological impairment. We designed this study after the onset of COVID-19 in the United States. Since COVID-19 limits accessibility to gyms and other types of exercise venues, we hope to learn and understand the physiological and behavioral aspects of this rehabilitation strategy to optimize wellness after a neurological injury. You were selected as a possible participant in this study because you've had a neurological impairment for at least six months.

WHAT WILL I DO IF I AGREE TO BE IN THIS STUDY?

If you agree to be in the study, you will participate in 36 at-home, Zoom-based exercise classes. Classes will be held three times a week, for twelve weeks. You will be randomized to either a live class with other video participants, or a pre-recorded class that you will take on your own.

Before the first class, we will review your medical history with you to be sure it is safe for you to be in the study. If you qualify for the study, we will send you a kit that contains items you will need for the study, including a heart rate monitor, blood pressure cuff and adjustable wrist weights. We will also send you some surveys that ask about your ability to do everyday activities, such as dressing and cooking.

After you receive your home exercise kit, we will have an orientation Zoom class. You will meet the other people in the exercise class. During the orientation, the study team will teach you how to use the heart rate monitor. If you cannot put on the heart rate monitor, we will ask that a caregiver be present to assist you during each class.

You will download one applications onto your phone or computer that will allow us to access the information from your heart rate monitor. No one but the research team will be able to see this information aside from you.

Each exercise class will take approximately one hour. Each session will begin with instructions and questions from the study team regarding your pain level, level of motivation, and blood pressure. The exercise portion of the class will take 45 minutes. At the end of the class, the study team will ask you additional questions, such as how hard you worked, pain level, level of motivation and blood pressure.

The class instructor will tailor exercises to different abilities, so everyone can be active and safe. The entire class will be done in a seated position.

1 Approximately 100 people will be enrolled in the live class, and 100 in the pre-recorded class.
2

3 After the 18th class, which is midway through the study, we will send you another set of the same surveys you
4 completed before the first class. We will send you a third set of surveys after the final class.
5

6 RISKS AND INCONVENIENCES OF THE STUDY

7 Your participation in the project might involve the following risks:
8

9 The largest risk in this study is the risk of fatigue and muscle aches. These symptoms are common with exercise. The
10 instructor will offer modifications of each exercise, to offer easier or more difficult options. You will always be
11 welcome to use a modification, request an additional modification, or rest.
12

13 The risk of fall in this study is small, since you will be seated. If you normally have trouble with stability of your torso
14 while you are seated, we will ask that a caregiver be present in case a fall occurs.
15

16 There is a risk that your personal health information be disclosed in error. For this study, we are using secure Zoom
17 settings from an academic medical center, and we will require a password for each class, to mitigate this risk. The
18 app containing your heart rate information will also be secure.
19

20 PERMISSION FOR PHOTOGRAPHY

21 We will record each live class, video and audio. Since we are not together in one space, we need to record each
22 class for purposes of data collection. Therefore, we require each participant to agree to being recorded. We want to
23 make sure that you understand this.
24

25 Do you agree to be photographed in this study?

- 26 Yes
27 No
28

29 Please initial here to confirm your choice about being
30 photographed during the study:
31

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33

34 NEW INFORMATION

35 You will be told about any new significant findings developed during the course of the study that might affect your
36 willingness to continue in the research.
37

38 COST OF STUDY TO PARTICIPANTS

39 There is no cost to you for participating in the research study.
40

41 BENEFITS OF THIS STUDY

42 Participation in this study is not guaranteed to benefit you. This study is only for the purpose of research. You may
43 feel stronger by the end of the study, but there is no guarantee that this will occur. However, the information learned
44 from this study may help other people in the future.
45

46 ALTERNATIVES TO STUDY PARTICIPATION

47 You do not have to participate in this research study to receive treatment for your condition. Your participation in
48 this study is voluntary. If you decide to participate, you are free to discontinue participation at any time. Your
49 participation in this study may be terminated without your consent by the study team or regulatory authorities, in
50 certain circumstances, such as, if the investigator determines it is in your best interest, you cannot adhere to the
51 study procedures, or in the event the study is terminated.
52

53 IN CASE OF INJURY

54 In accordance with Federal regulation, we are obligated to inform you about our policy in the event injury occurs. For
55 medical emergencies, call 911. If, as a result of your participation, you experience injury from known or unknown
56 risks of the research procedures as described, emergency medical care and treatment will be provided on our
57 premises to the extent possible. We will assist you in obtaining additional medical care, as needed, but you will be
58 responsible for the costs of such further medical treatment, either directly or through your medical insurance and/or
59 other forms of medical coverage. No other compensation will be offered by or Burke Neurological Institute or the
60 Biomedical Research Alliance of New York. Further information can be obtained from Dr Kathleen Friel (914
368-3116). You are not waiving any legal right to seek additional compensation through the courts by signing this
form.

CONFIDENTIALITY

To the extent allowed by law, every effort will be made to keep your personal information confidential. However, information from this study will be submitted to the study sponsor and to the U.S. Food and Drug Administration. It may be submitted to governmental agencies in other countries where the study product may be considered for approval. Medical records, which identify you and the consent form signed by you, will be looked at by the sponsor or the sponsor's representatives and may be looked at by the FDA and other regulatory agencies, the Institutional Review Board, and the Biomedical Research Alliance of New York. While these parties are aware of the need to keep your information confidential, total confidentiality cannot be guaranteed. The results of this research project may be presented at meetings or in publications; however, you will not be identified in these presentations and/or publications.

Federal regulations give you certain rights related to your health information. These include the right to know who will be able to get the information and why they may be able to get it. The study doctor must get your authorization (permission) to use or give out any health information that might identify you. If you choose to be in this study, the study doctor will get personal information about you. This may include information that might identify you. The study doctor may also get information about your health, including:

- Past and present medical records
- Research records
- Records about phone calls made as part of this research
- Records about your study visits
- Information obtained during this research about laboratory test results
- Results from diagnostic and medical procedures including but not limited to X-rays, physical examinations and medical history
- Billing records

Information about your health may be used and given to others by the study doctor and staff. They might see the research information during and after the study. Your information may be given to the sponsor of this research. "Sponsor" includes any persons or companies that are working for or with the sponsor, or are owned by the sponsor. Information about you and your health which might identify you may be given to:

- The U.S. Food and Drug Administration
- Department of Health and Human Services agencies
- Governmental agencies in other countries
- Biomedical Research Alliance of New York (BRANY)
- The Institutional Review Board
- Accrediting agencies

Your personal health information may be further shared by the groups above. If shared by them, the information will no longer be covered by the U.S. federal privacy laws. However, these groups are committed to keeping your personal health information confidential. If you give permission to give your identifiable health information to a person or business, the information may no longer be protected. There is a risk that your information will be released to others without your permission.

Information about you and your health that might identify you may be given to others to carry out the research study. The sponsor will analyze and evaluate the results of the study. In addition, people from the sponsor and its consultants will be visiting the research site. They will follow how the study is done, and they will be reviewing your information for this purpose. The information may be given to the FDA. It may also be given to governmental agencies in other countries. This is done so the sponsor can receive marketing approval for new products resulting from this research. The information may also be used to meet the reporting requirements of governmental agencies.

This authorization does not have an expiration date. If you do not withdraw this authorization in writing, it will remain in effect indefinitely.

By signing this consent form, you are giving permission to use and give out the health information listed above for the purposes described above. You do not have to sign this consent form. If you choose not to sign this consent form, you will not be able to be in this research study. Your decision not to sign this consent form will not have any effect on your medical care and you will not lose any benefits or legal rights to which you are entitled. You have the right to review and copy your health information. However, if you decide to be in this study and sign this permission form, you may not be allowed to look at or copy your information until after the research is completed.

You may withdraw or take away your permission to use and disclose your health information at any time. You do this by sending written notice to the study doctor at the address on the front of this informed consent form. If you withdraw your permission, you will not be able to continue being in this study, but you will not have any penalty or loss of access to treatment or other benefits to which you are entitled. When you withdraw your permission, no new health information which might identify you will be gathered after that date. Information that has already been gathered may still be used and given to others. This would be done if it were necessary for the research to be reliable.

1 Notice Concerning HIV-Related Information: HIV-related information that either is collected as part of the research or
2 that may already exist in your medical record might be accessed for the research by the research staff and the study
3 sponsor, but will not be shared with others without your authorization, unless federal or state law requires the
4 disclosure. You have a right to request a list of people who may receive or use your HIV-related information without
5 authorization. If you experience discrimination because of the release or disclosure of HIV-related information, you
6 may contact the New York State Division of Human Rights or New York City Commission on Human Rights. These
7 agencies are responsible for protecting your rights.

8 QUESTIONS ABOUT THIS STUDY

9 If you have any questions or requests for information relating to this research study or your participation in it, or if
10 you want to voice a complaint or concern about this research, or if you have a study related injury, you may contact
11 Dr. Friel at 914-368-3116, 646-351-9063 (24 hour).

12 If you have any questions about your rights as a research subject or complaints regarding this research study, or you
13 are unable to reach the research staff, you may contact a person independent of the research team at the
14 Biomedical Research Alliance of New York Institutional Review Board at 516-318-6877. Questions, concerns or
15 complaints about research can also be registered with the Biomedical Research Alliance of New York Institutional
16 Review Board at www.branyirb.com/concerns-about-research.

17 You will be given a copy of this form to keep.

18 A description of this clinical trial will be available on <http://www.ClinicalTrials.gov> as required by U.S. Law This Web
19 site will not include information that can identify you. At most, the Web site will include a summary of the results.
20 You can research this Web site at any time.

21 You are making a decision as to whether or not to participate. Your signature indicates that the above information
22 has been reviewed with you and that you have decided to participate. You may withdraw at any time without
23 prejudice after signing this form should you choose to discontinue participation in this study.

24 Signature:

25 _____

26 Date:

27 _____

28 Time:

29 _____

30 Upload a copy of informed consent here, if the
31 participant chose to provide consent on paper



STANDARD PROTOCOL ITEMS: RECOMMENDATIONS FOR INTERVENTIONAL TRIALS

SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description	Addressed on page number
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	2
	2b	All items from the World Health Organization Trial Registration Data Set	1, 2, 3, 7, 8-10, 12-15-18, 20
Protocol version	3	Date and version identifier	2
Funding	4	Sources and types of financial, material, and other support	2
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	1, 19
	5b	Name and contact information for the trial sponsor	N/A
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	20
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	N/A

1 **Introduction**

2

3 Background and rationale 6a Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention 4-5

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6 6b Explanation for choice of comparators 4-5

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8 Objectives 7 Specific objectives or hypotheses 5

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10 Trial design 8 Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory) 5-6

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14 **Methods: Participants, interventions, and outcomes**

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16 Study setting 9 Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained 6

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19 Eligibility criteria 10 Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists) 6-7

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22 Interventions 11a Interventions for each group with sufficient detail to allow replication, including how and when they will be administered 8-10

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25 11b Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease) 11

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28 11c Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests) 11-12

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31 11d Relevant concomitant care and interventions that are permitted or prohibited during the trial 6

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34 Outcomes 12 Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended 12-15

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40 Participant timeline 13 Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure) 13 and Fig 1

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1 Sample size 14 Estimated number of participants needed to achieve study objectives and how it was determined, including 7
 2 clinical and statistical assumptions supporting any sample size calculations

3
 4 Recruitment 15 Strategies for achieving adequate participant enrolment to reach target sample size 7
 5

6 **Methods: Assignment of interventions (for controlled trials)**
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8 Allocation:
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10 Sequence 16a Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any 8
 11 generation factors for stratification. To reduce predictability of a random sequence, details of any planned restriction
 12 (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants
 13 or assign interventions
 14
 15

16 Allocation 16b Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, 8
 17 concealment opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned
 18 mechanism
 19

20 Implementation 16c Who will generate the allocation sequence, who will enrol participants, and who will assign participants to 8
 21 interventions
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 23

24 Blinding (masking) 17a Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome 9
 25 assessors, data analysts), and how
 26

27 17b If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's 9
 28 allocated intervention during the trial
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 30

31 **Methods: Data collection, management, and analysis**
 32

33 Data collection 18a Plans for assessment and collection of outcome, baseline, and other trial data, including any related 12-15
 34 methods processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of
 35 study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known.
 36 Reference to where data collection forms can be found, if not in the protocol
 37

38 18b Plans to promote participant retention and complete follow-up, including list of any outcome data to be 11-12
 39 collected for participants who discontinue or deviate from intervention protocols
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1	Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	17-18
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5	Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	15-17
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8		20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	15-17
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10		20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	18
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14	Methods: Monitoring			
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16	Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	18
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22		21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	18
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25	Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	18
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28		23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	18
29				
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32	Ethics and dissemination			
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34	Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	19
35				
36				
37	Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	19
38				
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1	Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	10-11
2				
3				
4		26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	N/A
5				
6				
7	Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	17-18
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10	Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	20
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13	Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	17
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16	Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	no plans for post-trial care, compensation plan due to injury listed in ICF p2 "In Case of Injury"
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25	Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	19
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29		31b	Authorship eligibility guidelines and any intended use of professional writers	19
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31		31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	19
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34	Appendices			
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36	Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	supplemental
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39	Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	N/A
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1 *It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items.
2 Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons
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