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What is the relationship between physical activity and cardiovascular risk factors in stroke survivors post completion of rehabilitation? Protocol for a longitudinal study

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ABSTRACT

Introduction Physical activity (PA) can modify cardiovascular and other health risks in people with stroke, but we know little about long-term PA in this group. This study aims to describe PA levels and investigate relationships between PA, cardiovascular risk factors, mobility and participant characteristics (eg, age, mood and fatigue) in the 2 years following rehabilitation discharge after first stroke.

Methods and analysis This is a longitudinal observational study with follow-up at 6, 12 and 24 months after rehabilitation discharge. Inclusion criteria are broad; excluding only those with previous stroke, palliative diagnosis, living more than 2 hours from the centre or admitted less than 5 days. The primary outcome of interest is duration of moderate to vigorous PA (min/day) measured by the Sensewear MF Armband (SWAB). Secondary outcomes include other PA measures measured with the SWAB; cardiovascular risk factors (eg, systolic blood pressure, fasting lipid profile and smoking status), mobility (10 m walk test), the Hospital Anxiety and Depression Scale and the Fatigue Severity Scale. All outcomes, except blood tests, are gathered at each time point. The target sample size is 77. We will explore associations between PA levels, cardiovascular risk factors, mobility and participant characteristics at baseline compared with 6, 12 and 24 months using random-effects regression modelling. The long-term PA of stroke survivors is largely unknown. We hope to identify factors that influence PA and cardiovascular risk in this population, which may help health professionals target the stroke survivors most at risk and implement appropriate treatment, preventative strategies and education.

Ethics and dissemination Approval was granted from Alfred Hospital and La Trobe University Research Ethics Committees. The study results will be disseminated in a number of ways including journal publication and international conference presentations.

Trial registration number ACTRN12613000196741.

Strengths and limitations of this study

► This study will be the largest longitudinal physical activity (PA) dataset from stroke survivors to date.
► Investigates the important issues of secondary prevention and cardiovascular risk after stroke.
► Measures a number of PA outcomes objectively using a device that has been validated in stroke survivors.
► It is a relatively small, single-centre study.
► Does not measure PA in the acute phase after stroke.
► The follow-up time points are measured from rehabilitation discharge rather than stroke onset as has recently been recommended by the Stroke Recovery and Rehabilitation Roundtable Taskforce.

INTRODUCTION AND RATIONALE

The importance of physical activity (PA) for cardiovascular health is well documented,[1–3] and the detrimental effects of sedentary behaviour are substantial.[4–6] PA guidelines for healthy individuals state that 30 min of moderate to vigorous PA (MVPA) should be undertaken 5 days per week.[7] Adherence to these guidelines is associated with a 14% relative risk reduction in all-cause mortality.[8] To achieve cardiovascular benefits, it is recommended that MVPA be accumulated in bouts of at least 10 min.[9] Long bouts of uninterrupted sitting are associated with an increased rate of cardiovascular and all-cause mortality in healthy populations.[5 6] Recommendations about breaking up sitting time have been highlighted in government documents and recommendations internationally.[10–12] Increasing PA and reducing sedentary behaviour are now global targets for better health in a wide range of populations.

Stroke is a major cause of disability worldwide.[13] Mobility limitations are common following a stroke[14] and are associated with poor participation in PA and higher levels of sedentary behaviour than community-dwelling older adults.[15] Depression and

fatigue, common in stroke, are also associated with lower PA.[16] [17] Almost one-third of stroke patients will suffer another stroke within 5 years,[18] [19] and 50% of people who survive 5–10 years will die of recurrent stroke or another cardiovascular pathology.[20] Increased cardiovascular risk in stroke survivors is largely due to metabolic abnormalities that are further exacerbated by physical inactivity.[20]

While the American Stroke and Heart Associations recommend that stroke survivors engage in regular aerobic exercise and PA to help prevent further stroke and lower cardiovascular disease risk,[19] development of effective interventions is overdue. Many studies have documented low PA[21–28] and high sedentary time following stroke.[15 21 29] Surprisingly, only one small study (n=15) has tracked PA for greater than 1 year.[27] Longitudinal PA data from participants, gathered using the same protocols and the same devices, could help us understand how stroke survivors' PA and cardiovascular risk changes over time.[30] Understanding these associations and their interplay with depression and fatigue would provide a stronger foundation on which to develop treatments that target improved PA in this vulnerable group.

Aims and hypotheses
Overarching aim
To describe PA levels and their relationship to cardiovascular risk factors over the 2 years following discharge from rehabilitation after first ever stroke.

Specific aim 1
To establish PA levels at rehabilitation discharge (baseline) and 6, 12 and 24 months later.

Specific aim 2
To determine the relationship between PA levels and cardiovascular risk factors at rehabilitation discharge (baseline) and 6, 12 and 24 months later.

Specific aim 3
To explore the participant characteristics that are associated with PA (eg, MVPA duration and steps per day) and mobility (eg, walking ability, speed and endurance) at 12 and 24 months. Participant characteristics include demographics (eg, age and stroke severity), mood and fatigue.

Specific hypothesis 1
PA levels will not approach levels recommended for cardiovascular risk factor reduction at any time point.

Specific hypothesis 2
a. There will be an association between PA measures (eg, MVPA duration, sedentary time, energy expenditure and steps per day) and cardiovascular risk factors (eg, systolic blood pressure, total cholesterol (TC) and smoking status) at baseline and 6, 12 and 24 months.
b. At 12 months postdischarge from rehabilitation, low MVPA duration will be associated with higher systolic blood pressure.

Specific hypothesis 3
a. Better mobility will be associated with higher levels of PA.
b. Further, older stroke survivors who at baseline have poor mobility and high levels of fatigue and depression are at risk of a reduction in PA at 12 and 24 months post rehabilitation discharge.

METHODS
Design
Single-centre, prospective longitudinal observational study, with participants assessed on four occasions: baseline, that is, discharge from outpatient physiotherapy (or inpatient discharge if they do not receive follow-up physiotherapy) and at 6, 12 and 24 months after discharge. Recruitment commenced in October 2012 and is anticipated that the 24-month follow-ups will be completed by the end of 2017.

Population
Inclusion criteria are broad: all patients admitted to a large metropolitan rehabilitation hospital (Caulfield Hospital, Melbourne) with first ever stroke, as defined by WHO, will be invited to participate. Exclusion criteria: previous stroke (transient ischaemic attack (TIA) allowed), concomitant diagnosis leading to palliative care, admitted for less than 5 days or living greater than 2 hours from Caulfield Hospital (to improve feasibility and reduce dropouts).

Procedure
Demographic details including age, gender, medical history, type, location and initial severity of stroke (National Institutes of Health Stroke Scale), stroke and cardiovascular disease family history, living arrangements, social supports and employment will be collected at baseline.

Outcomes and assessment time points are in table 1. Baseline assessment will occur on completion of all physical rehabilitation, to ensure that physiotherapy (specifically encouragement from the physiotherapist and attendance at physiotherapy sessions) would not impact on PA levels.

Primary outcome
The primary outcome is duration of MVPA (average min/day) measured by the Sensewear MF Armband (SWAB). MVPA is defined as >3 metabolic equivalent tasks (METS). PA is a continuum, beginning with sedentary behaviour at <1.5 METS to light PA (LPA) at 1.5 to 3 METS and up to MVPA at >3 METs. The SWAB measures the amount of time spent in these different activity levels. The SWAB is a triaxial accelerometer that uses multiple sensors to measure steps, motion, galvanic skin response, skin temperature and heat flux. It is valid and reliable for measuring PA and energy expenditure in people with chronic conditions including stroke[31–34] and reliably measures steps in stroke.[35]

Table 1 Assessment time points and outcomes

Outcomes measured	Baseline	6 months	12 months	24 months
Demographics	✓			
MVPA duration	✓	✓	✓	✓
Other PA outcomes	✓	✓	✓	✓
Fasting lipid profile and plasma glucose	✓		✓	✓
Blood pressure, waist circumference and BMI	✓	✓	✓	✓
Mobility measures	✓	✓	✓	✓
Questions regarding further stroke and cardiovascular events		✓	✓	✓
Questions regarding cardiovascular risk factors and PA	✓	✓	✓	✓
HADS, FSS and MOCA	✓	✓	✓	✓
Self-Report Barthel Index	✓	✓	✓	✓

BMI, body mass index; FSS, fatigue severity scale; HADS, hospital anxiety and depression scale; MOCA, Montreal cognitive assessment; MVPA, moderate to vigorous physical activity; PA, physical activity.

The SWAB will be worn for 7 days, including at least one full weekend day, at each of the four assessment points, and will be removed only for water-based activities. It will be placed on the unaffected upper arm, which provides more accurate data due to blood flow changes that occur in hemiplegic limbs.[36] Participants will be instructed to partake in their normal activities, not more or less because they are wearing the armband. In line with best practice, we will include PA data for those who have a minimum of 13 hours per day wear time for a minimum of 3 days.[37 38]

Secondary outcomes
Physical activity
Other measures of PA measured by the SWAB will be collected as secondary outcomes: sedentary time, LPA duration, number of MVPA and sedentary bouts (≥10 min)[9] and their duration, energy expenditure (kJ) and number of steps taken per day.

Physical measurements of cardiovascular risk factors
Systolic blood pressure, an important indicator of cardiovascular risk, is included in the most rigorous cardiovascular disease risk algorithms.[39] Blood pressure will be measured with a portable sphygmomanometer with the participant sitting for approximately 30 min prior (after the questionnaires and prior to the mobility assessments), and the average of two-seated measurements will be used in accordance with guidelines proposed by the National Vascular Disease Prevention Alliance (NVDPA).[40 41] Fasting lipid profile (TC, low-density lipoprotein cholesterol, high-density lipoprotein (HDL) cholesterol, TC–HDL ratio and triglycerides) and plasma glucose samples will be obtained by a phlebotomist. Waist circumference will be measured, along with height and weight to calculate body mass index.[40 41]

Mobility
To assess walking speed, balance, endurance and ability, the 10 m walk test, timed up and go test, 6 min walk test and Functional Ambulation Classification will be undertaken. These measures are considered valid and reliable in stroke survivors.[42] The 6 min walk test will be measured on a 40 m track. Participants will be instructed to cover as much distance as possible in the 6 min and will be informed as each minute elapses, with standardised phrases of encouragement.

Further stroke and cardiovascular events
At each follow-up assessment, participants will be asked if they have had a TIA, stroke or other cardiovascular event, procedure or diagnosis since the previous assessment.

Brief questions regarding cardiovascular risk factors
Cigarette smoking, alcohol intake and diet will be established using the NVDPA standard guidelines.[40 41] The following questions will be asked: "Have you ever smoked? If so, are you still a smoker? If not, how long ago did you stop? How many packs did you smoke per day and for how many years? Do you have more than 2 standard alcoholic drinks per day? Do you maintain a diet high in fruit and vegetables and low in fat, sugar and salt?"

Questions regarding PA
At each time point, we will acquire information about PA undertaken in a regular week, its duration and frequency. Specific questions include: "Do you participate in regular PA? If so, what activities do you do? How often do you do them in a regular week? How long do you do them for each time?" At the baseline assessment, we will use the same standard questions to acquire premorbid PA levels.

Mood, fatigue and cognition
The Hospital Anxiety and Depression Scale[43] and the Fatigue Severity Scale (FSS) will be administered. The FSS has been validated in stroke survivors.[44] The Montreal Cognitive Assessment, a brief valid cognitive screening tool in stroke,[45] will also be administered.

Disability

The Self-Report Barthel Index, a valid and reliable measure of disability in stroke population,[46] will be assessed.

Additional physiotherapy

Any further physiotherapy or activity-based intervention since originally completing their therapy will be noted.

Sample size estimates

We hypothesise an inverse relationship between MVPA duration and systolic blood pressure at 12 months post-baseline assessment. Evidence suggests that an increase in MVPA of 30 min/day over 12 months is associated with a 10 mm Hg reduction in systolic blood pressure.[47] Assuming that the SD of the independent variable (MVPA) is 29 min/day[32] and the SD of the dependent variable is 14.2 mm Hg,[48] then 70 subjects would be required for a probability of 80% that the study will detect a relationship between the independent and the dependent variables at a two-sided 0.05 significance level, if the true change in the dependent variables is 0.167 units per unit change in the independent variable.[49] Allowing for a 10% loss to follow-up over 12 months, the target sample size is 77.

Statistical analyses

Specific aim 1

The PA and cardiovascular risk profile of participants at baseline and 6, 12 and 24 months and the number of participants who have another stroke or cardiovascular event or diagnosis will be reported descriptively. The percentage of people achieving recommended activity levels to influence cardiovascular risk (30 min of MVPA per day) will be described.

Specific aim 2

a. The association between PA measures (eg, MVPA duration, sedentary time, energy expenditure and steps per day) and cardiovascular risk factors (eg, systolic blood pressure, TC and smoking status) at baseline and 6, 12 and 24 months will be examined using random-effects regression modelling, with patients treated as random-effects to account for time.

b. The relationship between MVPA duration and systolic blood pressure at 12 months will be examined using random-effects regression modelling adjusted for baseline MVPA duration with individual patients treated as random-effects.

Specific aim 3

Once again, random-effects modelling will be used to explore the associations between participant characteristics (demographics, mood and fatigue), PA levels and mobility at 12 and 24 months relative to baseline.

Dissemination

The study results will be disseminated in a number of ways including journal publication and international conference presentations. This study is registered with the Australian New Zealand Clinical Trials Registry (ACTRN12613000196741).

DISCUSSION

This study will be the largest longitudinal PA dataset from stroke survivors to date. Through tracking PA levels and cardiovascular risk factors for 2 years, we will know more about how these factors interact post-stroke. This study will help to identify factors present at discharge from physiotherapy that are associated with low PA levels and increased cardiovascular risk long after formal care ends. By discovering this valuable information, we can target the stroke survivors most at risk and implement appropriate treatment, preventative strategies and education prior to discharge from therapy. The ultimate aim is for health professionals to employ behaviour change strategies to facilitate lifelong stroke survivor participation in PA. The findings of this study will be the first step towards building effective interventions to improve PA in stroke survivors, with the aim of improving long-term health and quality of life for this vulnerable group.

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