BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-084688
Article Type:	Protocol
Date Submitted by the Author:	25-Jan-2024
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Keywords:	Stroke < NEUROLOGY, REHABILITATION MEDICINE, Gait, Stroke medicine < INTERNAL MEDICINE

Study Protocol

Effectiveness of an adapted physical activity program applied at a dedicated structure versus a home-based self-management program on chronic post-stroke adults: a randomized control study protocol

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Abstract:

Introduction Physical activity (PA) protects the cardiovascular system and reduces the risk of stroke recurrence. However, most stroke survivors have significantly lower daily physical activity levels than those recommended. Adapted physical activity programs provide a useful means of increasing the daily physical activity levels of this population. PA programs designed to encourage people walking have been found to be more effective than no intervention: some have been applied at dedicated structures and others on an independent basis. The aim of this study will be to compare these two methods in terms of their effects on the daily walking rates of subjects with spastic hemiparesis after chronic stroke. Secondary outcomes will include effects on walking ability, endurance, balance, quality of life, and motivation for exercise. **Methods and analysis** This randomized, controlled, two-arm, parallel, single-blind study will include adults with chronic stroke spastic hemiparesis who are able to walk for 6 minutes. Our primary outcome will be the participants' daily activity measured via the number of steps performed per day using a Stepwatch™ device. We expect to establish that the program applied at a dedicated structure will be more effective than a self-managed program as a means of increasing the physical activity of chronic stroke subjects. **Ethics and dissemination** The protocol was approved by an independent National Ethics Committee under the number 2022-A01460-43. The results will be disseminated via publications in the scientific literature, oral and poster presentations by partners at international scientific meetings and associations of patients.

Registration The clinical trial, which is already in progress, was registered on the ClinicalTrials.gov website under the registration number NCT06061770.

Strengths and limitations of this study :

- Randomised controlled trial to compare adapted physical activity program applied at a dedicated structure versus a home-based self-management program on chronic post-stroke adults
- Adapted physical activity programs designed to meet the recommendations for physical activity after stroke
- Reliability and reproducibility of the Stepwatch assessments
- Evaluator blided from the intervention, but no double-blinding, impossible in this context
- No assesment of the longterm effects

Keywords: stroke, rehabilitation, Adapted Physical Activity, dedicated structure, step count

Word count (abstract/manuscript): 246 / 3967

Abbreviations:
PA: Physical activity
APA: Adapted Physical Activity
6MWT: 6 Meter Walk Test
W: Week

1. Introduction

Stroke is a major public health problem, not only because it results in a high annual mortality rate, estimated at 5.5 million individuals per year, but also because of its significant morbidity rate1. Since 50% of surviving stroke individuals are estimated to be permanently disabled[1], this is the leading cause of acquired motor disability in adults[2]. Consequences include medical complications, greater functional impairment, psychological disorders and musculoskeletal problems[3]-[4]-[5]-[6]. Loss of motor skills is one of the most common complaints of stroke survivors. Stroke is responsible for gait disorders in 75% of survivors[7]. Interestingly, the incidence rate of stroke includes a high recurrence rate approaching 25%, as reported in a recent study in the USA[8]. In the Interstroke study published in 2016, which was conducted in 32 countries, 10 modifiable risk factors were identified which need to be included in stroke prevention strategies. In particular, physical activity (PA) was found to be a protective factor against stroke, with an OR of 0.58 in men and 0.65 in women[9]-[10]. Identifying the modifiable risk factors can help improve prevention strategies, which is one of the main targets of the 2018-2030 European Stroke Prevention Plan[11]. In this population, the American Stroke and Heart Association recommends 20 to 60 minutes of aerobic activity three to five days a week and muscle-strengthening and stretching exercises two to three days a week in order to prevent cardiovascular disease and stroke recurrence[12]. However, daily PA in chronic stroke individuals seems to be far below these recommendations[13]. It is worth noting that the barriers most frequently cited to explain the low participation of post-stroke individuals in PA are not only physical difficulties such as musculoskeletal disorders, obesity or joint pain, but also environmental difficulties (access, transport, and cost), lack of motivation and fear of relapse[12]. Adapted Physical Activity (APA) programs could be drawn up to address some of these barriers.

Walking is an easy and affordable way of increasing PA and preventing chronic diseases[14]. One of the main parameters used in the literature to assess PA programs has been walking ability based on the 6-minute walk test (6MWT). Although the results of 6MWT and daily step counts are closely linked, the first test explains only about 50% of the variability observed in walking in real-life situations[15]-[16]. Other factors have been reported in the literature to influence the PA of individuals in the chronic stroke phase, including intrinsic factors such as age, PA before stroke onset, the presence of cognitive disorders[17], motivation and anxiety[18].On the

other hand, extrinsic factors such as the physical and social environment have been found to account for about 10% of the variability of stroke individuals' daily walking activity[19].The meta-analysis published by Lee et al.[20] has suggested that walking ability improves more in supervised programs than in autonomous programs, but no studies have been published so far to our knowledge in which the effects of a home-based APA program are compared with those of a supervised APA program applied at a dedicated structure.

The aim of this study was therefore to compare an APA program carried out at a dedicated structure versus subjects' homes in terms of its ability to increase the daily PA of chronic stroke individuals, based on measurements consisting of step counts recorded using a dedicated device. The most original contributions of this study are the comparison made between two types of PA programs (structured and autonomous), based on the ecological assessment criterion consisting of changes in the number of steps performed per day. On the other hand, it presents PA programs specially designed to improve the daily PA rates of post-stroke individuals, especially in terms of their walking performances. These programs, which have been drawn up in keeping with the latest international recommendations[20]-[21], include detailed descriptions in line with the guidelines published by Slade et al.[22].

2. Methods and analysis

This prospective, randomized, controlled, two parallel armed, single-blinded study was designed to compare the efficacy of an APA program carried out at a dedicated structure with that of autonomous practices, in terms of their ability to increase the daily PA of chronic stroke individuals. The main objective will be to assess the effects of a supervised PA program applied at a dedicated structure versus those of a home-based self-managed program on the daily walking rates of chronic post-stroke subjects with spastic hemiparesis. The secondary objectives will be to study the effects on walking ability, endurance, balance, quality of life and motivation for exercise. Primary and secondary endpoints will be assessed by an operator blinded to subject status. The single-blind design which is part of the APA protocol is not feasible in a blinded setting. For ethical reasons, participants will be allowed to pursue their usual medical follow-up and physiotherapy without any restrictions.

2.1. Eligibility criteria

Subjects over 18 years of age with left or right spastic hemiparesis as a result of the occurrence of their first unilateral hemorrhagic or ischemic stroke more than 6 months previously, who are able to walk for 6 minutes with or without technical assistance, will be eligible for inclusion. The exclusion criteria will include the inability to walk without human assistance (with or without an assistive device), cognitive impairments preventing/precluding informed consent, especially the inability to understand the aims of the study and the methods involved or the inability to communicate with the investigators. The presence of any other neurological disorder or pathology contraindicating PA (such as cardiovascular or respiratory disease, in particular) is another criterion for non-inclusion. Subjects must not be participating in any other clinical research project at the same time. Subjects' participation will be discontinued in the case of any adverse event making it necessary to interrupt the protocol (such as fracture, cardio-respiratory failure, etc.).

2.2. Design of the StrokAPA protocol

Two APA programs will be compared in this study. Subjects will be randomized into two groups as follows. Inclusion in one of the 2 groups will take place on D0, followed by the APA program at the rehabilitation center from W1 to W12 in the case of Group 1 and the home-based self-management program in that of Group 2. The end of the study will be reached by group 2 in W13, which will be followed by a compensatory APA program at the rehabilitation center. Group 1 will continue with the home-based self-management program from W14 to W25. These programs will be supervised (in person or remotely) by an APA teacher dedicated to each program.

A two-arm parallel design will be used with a view to comparing the 2 APA protocols. The primary endpoint adopted in order to meet our primary objective will be assessed at W13 in the case of both groups. The addition of a self-directed APA program after the structured program for Group 1 will serve to answer a secondary question about the comparative efficacy of the home-based self-management program alone or after the structured program. For ethical reasons and to improve the recruitment, all post-stroke individuals enrolled in group 2 will benefit from both types of APA, since they will be able to participate in the structured program as

part of routine care, after completing the self-directed program. Detailed protocols are described in **Supplementary material 1.**

2.2.1. Structure of the APA program

The program will be applied as part of routine care at the rehabilitation center. It consists of 3 sessions of APA per week (Mondays, Wednesdays and Fridays) for 12 weeks. Each session will consist of 2 x 60-minute APA sessions. The entire program was designed to meet the recommendations for PA after stroke[21]. Each session will include 45 minutes of actual work and 15 minutes devoted to set-up measures. It will be supervised by an APA instructor providing participants with feedback and adapting the exercises to the limitations of each one. At the beginning of each week, a group meeting will be held to take an inventory of each participant's PA for the week.

2.2.2. APA home-based self-management program

The APA home-based self-management program will be based on detailed exercise cards presenting yoga, Pilates and walking activities. Subjects will be given a booklet of detailed cards with photographs. The main aim of the Adapted yoga exercises presented in the booklet is to stretch all four limbs and the trunk. The booklet presents the yoga session used in the structured program. The focus here is on the physical sensation of stretching and working without pain. The Adapted Pilates exercise booklet focuses on general motor strengthening. It presents the Pilates session used in the structured program.

Since our goal is to effectively promote PA in chronic stroke individuals, subjects are encouraged in all these programs to engage in PAs of their choice, even in activities other than those proposed, and to record them in the registry.

2.2.3. Time schedule

The study will run for 25 weeks with subjects enrolled in Group 1 and 13 weeks with those in Group 2, with an additional 12 weeks of participation in the compensatory structured APA program, as a routine care. The flow chart of the study is presented in **Figure 1**.

2.2.4. Enrolment and initial assessment

The inclusion medical visit will take place on D0 to check that the inclusion and non-inclusion criteria defined above have been met. This medical visit will also make it possible for the initial assessment to be carried out by an operator blinded to the subjects' status.

The enrolment visit is a medical consultation designed to ensure that there are no contraindications to participating in the program. It provides an opportunity for obtaining the subjects' informed consent and recording their stroke assessments, comorbidities, body mass index, stroke severity (NIHSS and injured area if available), the use of any assistive devices, pre-stroke sports activities, the presence of depressive syndrome (Individual Health Questionnaire 9, pain VAS and DN4 scale to assess any neuropathic component present) and the initial assessment. This visit will also be used to fit the Stepwatch® daily PA measurement monitor (to be worn at least during the subjects' waking hours for the entire duration of their participation in the study on the ankle of the healthy limb), to provide each subject with the notebook to be used for the written report and to record all the PAs performed during and outside the program.

A simple randomization procedure will then be used to assign the subject to one of the two groups, using a computer-generated table of random numbers.

2.2.5. Organization of subjects' follow-up

Follow-up will involve collecting Stepwatch® data every 3 weeks at the rehabilitation center without the person collecting the data being able to view or change the data. Since the program for Group 1 will take place at the rehabilitation center, data will be collected there during one session at W3, W6 and W9. The home-based self-management program will involve visits to the rehabilitation center every 3 weeks, during which Stepwatch® data will be collected at W3, W6 and W9 on group 2 and at W16, W19 and W22 on Group 1. A final evaluation will take place on W13, at the end of the first APA period, by an operator blinded to the subjects' status. Group 1 will continue the study on an exploratory basis, using the APA home-based self-management program up to W26, when the final assessment of the criteria will be carried out.

2.2.6. Evaluation criteria

In this protocol, the primary outcome will be the subjects' daily activity in terms of the number of steps measured per day, which will be recorded throughout the entire duration of the study using a Stepwatch™ device. This device has been tested and found to show the greatest accuracy at all the walking speeds and step lengths tested**[23]**. In our assessments, the device has to be worn on the ankle of the unaffected limb at least during the subjects' waking hours throughout their participation in the study.

The Stepwatch® device will be delivered to the subjects with an instruction manual on D0. It will then be calibrated by an investigator using the subject's anthropometric data and a 20-step calibration procedure. Data will be collected at W3, W6, W9 and W13 on both groups and at W16, W19, W22 and W26 on Group 1. These data will be collected by an investigator blinded to subjects' individual status. The comparison between the two groups as regards the primary endpoint will be performed at W13.

The secondary endpoints will be assessed based on the other tests performed to assess PA, endurance, balance and quality of life.

A written report on the PAs performed by each subject (types of PA and duration) will be recorded by the subjects themselves in a diary distributed at baseline.

The 6MWT will be used to assess subjects' walking ability. Heart rate and systolic blood pressure will be measured at rest and after the 6-minute walk test. Subjects will complete various assessments and questionnaires. The Borg Rating Scale of Exertion**[24]** will be used to rate the subjects' perception of their exertion after the 6MWT on a scale ranging from zero to maximum. The Stroke Specific Quality of Life**[25]** scale will be used to assess subjects' quality of life. This scale contains several sub-sections ranging from autonomy to social relationships and character. Subjects will asked to rate their difficulty in performing an activity or how far they agree with a statement, from 1 to 5. The Berg Balance Scale**[26]-[27]** will be used to assess subjects' balance by rating their ability to perform each of the 14 items from 0 to 4. The Activity-specific Balanced Confidence Scale[28] will be used to assess subjects' confidence in their balance. Subjects are asked to rate from their confidence in their balance from 0 to 100% in response to 16 situations. Lastly, the Behavioral Regulation in Exercise Questionnaire2[**29**] will be used to quantify participants' motivation to perform exercises of 24 kinds, which they will be asked to rate between 1 and 7.

2.3. Statistical aspects

2.3.1. Sample size calculations

Assuming the existence of a difference of 1000 between the endpoints, a standard deviation of 1500 **[31],** a 5% risk of the first type and a power of 80%, it would be appropriate to include 28 subjects per group, making a total number of 56 subjects. The present study will include 40 subjects, which will make it possible to specify the precision of the indicators with a power of 70%.

2.3.2. Statistical analysis

Data analysis will be performed by the statistician under the responsibility of the methodologist, using SPSS version 17.0 under Windows. The significance level will be set at 0.05. No interim analyses have been planned. The analysis will be blinded, i.e. the statistician will know nothing about the identity of the groups and will initially present the results anonymously to the coordinating investigator and the other investigators. Once the statistical analysis has been completed, the identity of the groups will be revealed.

The methodological and analytical plan will be based on the criteria presented in the Consolidated Standards of Reporting Trials Statement (CONSORT, http:// www.consort-statement.org/consort-statement/).

3. Ethics and dissemination

3.1. Informed consent and data management

This clinical trial will be conducted in keeping with the Helsinki Declaration. Subjects will be pre-selected among those attending our Physical Medicine and Rehabilitation Department, and eligible subjects will be contacted by the investigators. Participants will be asked to give their signed informed consent prior to the study.

The data obtained in this study will be processed by the Clinical Data Manager at the AP-HM Health Research Department, in line with the French legislation. Data will be recorded using an electronic case report form developed using open-source web-based software: the REDCap application.

3.3 Trial registration

The protocol used in this study was approved on May 2, 2023 by an independent National Ethics Committee (Comité de Protection des personnes Est IV) under the number 2022-A01460-43 and registered in the clinicaltrial.gov registry: NCT06061770. The manuscript meets the requirements of the SPIRIT guidelines for reporting protocols.

3.4 Dissemination

The results will be disseminated via publications in the scientific literature, oral and poster presentations by partners at international scientific meetings, wide-audience media and associations of patients and their families.

4. Discussion

PA is known to be a factor preventing stroke relapse. The daily PA rates of chronic stroke individuals are known to be significantly lower than those recommended by the international health authorities. Increasing PA in individuals after stroke is therefore still a real challenge.

Initial rehabilitation management includes early mobilization and upright positioning in physiotherapy programs. Moore et al. have reported that an intensive walking PA program significantly improved the daily walking rates of the post-stroke subject's studied**[31].** APA can be used in the rehabilitation process for individuals after stroke**[32].** It helps maintain their independence, reduces the risk of recurrence and favors their social reintegration when applied in a group setting**[33]**. APA programs, which are often carried out as an adjunct to rehabilitation care for a period of 3 to 12 months, constitute a whole stage in the post-stroke recovery process**[33].** The duration of these programs seems to contribute importantly to enabling subjects to increase their activity levels. In fact, as shown by Lee et al. in a meta-analysis conducted in 2020, programs lasting at least 12 weeks had significantly greater effects on muscle strength and walking ability than those lasting for shorter periods**[20]**. The latter authors suggested that the duration of these exercise programs contributes importantly to inducing physiological adaptations that improve individuals' walking ability.

The StrokAPA protocol may provide a useful approach to encouraging post-stroke individuals to increase their PA. It is worth noting that most of the studies establishing the effectiveness of APA programs as means of increasing daily walking are based on direct gait training or at least on incentives to walk**[30]-[31].** Moore et al., who applied a structure-based APA program after reaching a recovery plateau in a conventional rehabilitation setting, observed an increase of approximately 24% in participants' daily step count. The Danks study[30] was a home-based self-management program that included motivational interviews encouraging subjects to walk with daily step count goals and the use of a pedometer as a feedback. The step rates increased significantly from an average number of 5205 to 6372 steps per day. Moore's study was based on the use of a structured supervised PA program, and Danks' study on a home-based self-management program with motivational interviewing and testing the use of pedometer as a feedback. Both types of programs were found to have beneficial effects on PA in ecological settings, since they increased the number of daily steps taken by individuals with stroke sequelae. The meta-analysis published by Lee et al.[20] has suggested that walking ability improves more in supervised programs than in self-directed programs, but no studies have been published so far to our knowledge in which the effects of a home-based unsupervised APA program are compared with those of a supervised APA program applied at a dedicated structure.

In the present APA study, it is proposed to compare the effects of the program applied at a dedicated structure versus those of a home-based self-management program with a view to optimizing their use on chronic post-stroke individuals. This project fits the spirit of the European Stroke Action Plan 2018-2030, which stresses the lack of PA programs catering for stroke survivors. The aim of the latter Action Plan is to make PA programs accessible to all stroke survivors**[11]**. A recent meta-analysis has shown that participation in a supervised program combining motor strengthening and aerobic exercise promotes individuals' participation in PA and improves their cardiorespiratory fitness, muscle strength and walking ability**[20]**.

Ultimately, we have several aims. First, to establish the value of a structured APA program for chronic post-stroke individuals. The main advantages of our program include the fact that it requires only a straightforward medical examination to check for contraindications and that it can be carried out in conjunction with APA instructors. The results obtained here could be of great importance on several levels. For individuals and their families, it would reinforce the feasibility and the interest in of programs of this kind by improving individuals' walking performances in their everyday lives. At present, the daily PA rates of individuals in the chronic stroke

phase are known to be well below the international recommendations**[13]**, and a program of this kind could greatly improve this situation. From the point of view of the health care system, the results of this study could constitute a further step towards optimizing the management of individuals with chronic post-stroke sequelae. The implementation of an APA program at dedicated structures would also enable individuals who have suffered from a stroke to interact with people in similar situation. PA helps to maintain independence, reduce the risk of recurrence and encourage social reintegration if practiced in a group**[33]**. This promotes interactions and inter-group emulation, which is conducive to motivation for PA and promotes the pursuit of PA at the end of the program. Adapted group physical activity can also have disadvantages, such as the risk of exercising at the intensity of the least active participant, thus minimizing the benefits for most participants. Conversely, the intensity of the exercise may be too high, increasing dropout rates. To avoid these issues, our group program is supervised by an APA professional who ensures that the exercise proposed is appropriate for each participant and can adjust it if necessary.

On the other hand, the implementation of a program at a dedicated structure prior to a self-managed program seems likely to result in sustained PA rates in chronic stroke individuals, thus increasing the effectiveness of the self-managed program. This would increase the value of generalizing programs of this kind so as to lead post-stroke individuals to increase their PA rates, which could then be maintained independently, requiring only periodic follow-up visits. It would therefore be worth conducting a medico-economic study on the benefits of programs of this kind as means of reducing disability and secondary complications in a population of chronic post-stroke individuals. In fact, the aim of programs of this kind would be to enable individuals to change their lifestyles by including regular PA, thus reducing the risk of recurrence, which would naturally also reduce public health costs.

Walking seems to be an easy beneficial form of PA preventing chronic diseases**[14]**. One of the most original aspects of this study is that it involves assessments which are as similar as possible to what individuals often do in real life, namely measuring the number of daily steps they take, in this case, using the Stepwatch. The authors of some recent studies have used this method**[30]-[31]-[34]** to measure the number of steps taken per day. The results obtained with this device have been found to show particularly good reliability and reproducibility, regardless of the wearers' stride speed and stride length**[23]**. The Stepwatch can therefore be said to be a reproducible ecological means of assessing the effectiveness of PA programs**[13]**.

One of the main limitations of the present study is the lack of double-blinding, although this is impossible to achieve in studies of this kind. We have attempted to prevent bias by blinding the assessor to the status of the subjects.

Another limitation is that there was no provision for long-term assessments of the impact of the program. It would certainly be of interest to conduct a study on the long-term effects, as well as on the medico-economic benefits of programs of this kind.

4. Conclusion

In conclusion, this is an original study because of the comparisons it presents between the efficacy of APA programs conducted at a dedicated structure versus home-based self-management programs, in terms of the resulting improvements in the PA rates of chronic post- stroke individuals in their daily lives, based on ecological assessments. The results of this study will confirm the value of PA programs suggested in the 2018-2030 European Stroke Action Plan.

Funding: This project was funded by a grant from Assistance Publique des Hôpitaux de Marseille (AAP Jeune Chercheurs 2021).

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved an independent National Ethics Committee (Comité de Protection des personnes Est IV) under the number 23.00588.000168 and registered in the clinicaltrial.gov registry: NCT06061770.

Informed Consent Statement: Informed consent will be obtained from all subjects involved in the study

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Author Contributions: Conceptualization: MC, LB; methodology: MC, LB, PA; writing—original draft preparation: ES, MC; writing—review and editing: MC, LC, JMV, NPB supervision: MC, LB, JMV; project administration: ES, MC, LB, JMV, NPB; funding acquisition: MC, LB. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: This study is sponsored by Assistance Publique – Hôpitaux de Marseille (DRCI).

The authors thanks the rehabilitation teams for their invaluable assistance and Mrs. Jessica Blanc for her English writing correction.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Figures

Figure 1. Study schedule.

Supplementary material

Supplementary material 1. Detailed APA protocol

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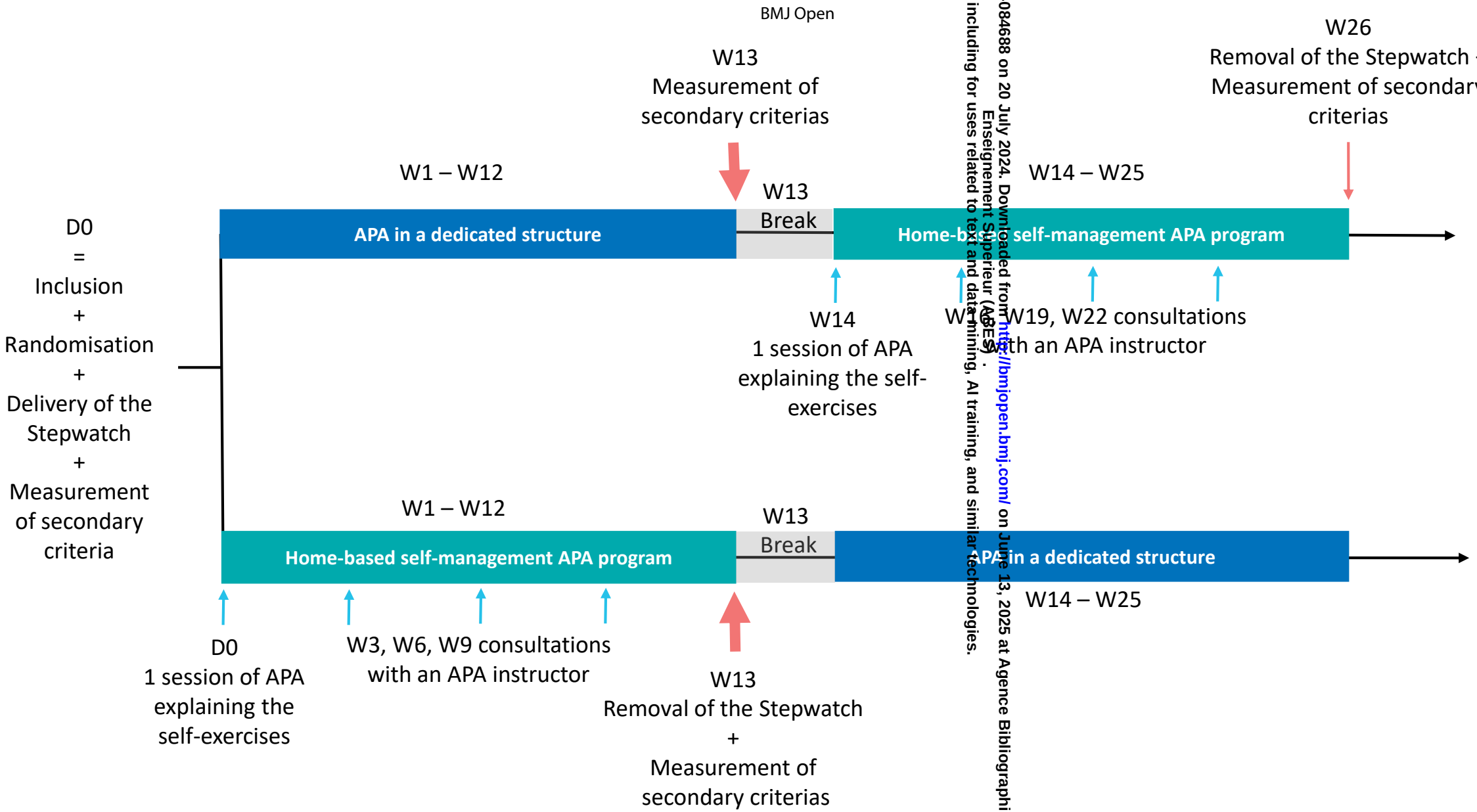

Supplementary material 1. Detailed APA protocol

A. Structure of the APA program

The program will be applied as part of routine care at the rehabilitation center. It consists of 3 sessions of APA per week (Mondays, Wednesdays and Fridays) for 12 weeks. Each session will consist of 2 x 60-minute APA sessions. The entire program was designed to meet the recommendations for PA after stroke**[21]**. Each session will include 45 minutes of actual work and 15 minutes devoted to set-up measures. It will be supervised by an APA instructor providing participants with feedback and adapting the exercises to the limitations of each one. At the beginning of each week, a group meeting will be held to take an inventory of each participant's PA for the week. The goal is to encourage the group to increase their walking time outside of the program. Participants will be encouraged to increase their walking time by approximately 25% per week. If the participant's weekly goal was met, the participant will be encouraged to increase activity by 25% of the weekly average time until 1 hour of walking per day is achieved, and then the goal will be to consistently achieve 1 hour of walking per day. If participants did not meet their weekly goal, the goal remained the same.

The activities practiced in this program will be yoga, Pilates, outdoor walking, zumba, Molkky® and aquagym. The plan for each session was designed in advance based on the Consensus on Exercise Reporting Template**[22]** criteria. The same plan was used throughout the sessions with a view to helping the individuals to learn the gestures:

- The main aim of the Adapted yoga session is to stretch all four limbs and the trunk. It consists of 8 poses, each of which targets a specific muscle or muscle group and is held for 3 minutes. The focus is on the body's sense of stretch and working without pain.

- The main aim of the Adapted Pilates session is to improve muscle strength. It consists of 12 movements performed in series of 10 repetitions, the last 3 of which depend on how tired the muscles feel.

- The main aim of the outdoor walking session is to improve walking ability. The course alternates between flat ground (asphalt), uneven ground (potholes, puddles, gravel, grass) and a 20% incline/slope. The session includes 5 minutes of acceleration to maximum walking speed on level ground, subdivided into 10 x 30 seconds with a 5-minute interval between each acceleration. During the 5-minute intervals between each acceleration, a spontaneous speed walk is performed. The APA instructor can change the walking speed, pause times and acceleration times.

- The main aim of the Adapted Zumba session is to work on endurance in a fun way with a series of choreographed, rhythmic movements set to music.

- A session devoted to a throwing game, Molkky®, is intended to improve balance, coordination and cognition via a fun throwing activity. The activity is carried out outdoors on sandy ground in teams of 2. This activity promotes sociability and creates cohesion within the group of subjects.

- The Aquagym session is designed to improve muscle strength, balance and walking under reduced gravity conditions. The session consists of abdominal exercises (3 sets of 10 repetitions), quadriceps exercises (3 sets of 10 repetitions), balancing exercises on one foot (5 minutes per leg) and walking exercises (15 minutes).

B. APA home-based self-management program

The main aim of the outdoor walking exercise booklet is to optimize walking skills. The session includes 5 minutes of acceleration to maximum walking speed on level ground, subdivided into 10 x 30 seconds with a 5-minute interval between each acceleration. A face-to-

face consultation with an APA instructor is scheduled on the first day of the program, and during weeks 3, 6 and 9 of the self-management program. These visits provide subjects with motivational follow-up, as well as meeting the technical memory constraints of the Stepwatch™ device, which can be used to make continuous recordings during approximately 3 weeks. On the first day, an APA session is scheduled to teach yoga exercises tailored to the state of the participants. The 6-week visit also includes an APA session, with additional materials included to enrich the program with the adapted Pilates booklet. Visits at weeks 3 and 9 will include a motivational interview with an APA instructor based on the subject's written report on the exercises performed.

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

Section/item	Item No	Description	Reported on page No
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	01
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry.	01,05
	2b	All items from the World Health Organization Trial Registration Data Set All WHO Trial Registration Data requirements are met with the trial's registration in the ClinicalTrials.gov. Trial registration information	01,05
Protocol version	3	Spirit 2013 Guidance Last update: February 28, 2020	
Funding	4	Sources and types of financial, material, and other support	07
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	01
	5b	Name and contact information for the trial sponsor AP-HM, Département de la Recherche Clinique et de l'Innovation (DRCI) 80 Rue Brochier, 13005 Marseille drci@ap-hm.fr	01,07

	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	03
	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)	03
Introduction			
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	02
	6b	Explanation for choice of comparators	02
Objectives	7	Specific objectives or hypotheses	03
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)	03
Methods: Participants, interventions, and outcomes			
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	03-04
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)	03
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	03-04

	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)
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial
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
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)
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
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size
Methods: Assignment of interventions (for controlled trials)		
Allocation:		
Sequence generation	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
Allocation concealment mechanism	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

Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	05
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	04
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	NA
Methods: Data collection, management, and analysis			
Data collection methods	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	04-05
	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 protocol	NA
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	07
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	05
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	NA

	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)	NA
Methods: Monitoring			
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	NA
	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	NA
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	04-05
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	NA
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	07
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)	NA

Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	04
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	NA
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	04,07
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	Title page / 07
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	05
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	NA
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	06
	31b	Authorship eligibility guidelines and any intended use of professional writers	07
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	07
Appendices			
Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	CRF en annexe

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	NA

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.

BMJ Open

Effectiveness of an adapted physical activity programme applied at a structure versus a home-based self-management pro-gramme on chronic post-stroke adults: a randomized control study protocol

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-084688.R1
Article Type:	Protocol
Date Submitted by the Author:	11-Jun-2024
Complete List of Authors:	Satger, Etienne; AP-HM Prieur-blanc, Nicolas; Aix-Marseille University; AP-HM Viton, jean-michel; Aix-Marseille University; AP-HM AUQUIER, Pascal; Aix-Marseille University, EA 3279 (Santé Publique : Qualité de Vie et Maladies Chroniques); FranceCoag Network bensoussan, laurent; Aix-Marseille University; UGECAM Provence-Alpes-Cote d'Azur COTINAT, Maëva; Aix-Marseille University,
Primary Subject Heading:	Rehabilitation medicine
Secondary Subject Heading:	Sports and exercise medicine
Keywords:	Stroke < NEUROLOGY, REHABILITATION MEDICINE, Gait, Stroke medicine < INTERNAL MEDICINE

Study Protocol

Effectiveness of an adapted physical activity programme applied at a structure versus a home-based self-management programme on chronic post-stroke adults: a randomized control study protocol

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Abstract:

Introduction Physical activity (PA) protects the cardiovascular system and reduces the risk of stroke recurrence. However, most stroke survivors have significantly lower daily physical activity levels than those recommended. Adapted PA programmes provide a useful means of increasing the daily physical activity levels of this population. PA programmes designed to encourage people walking have been found to be more effective than no intervention. Some have been applied at structures while others on an independent basis. The aim of this study will be to compare the two methods in terms of their impact on the daily walking rates of subjects with spastic hemiparesis following a chronic stroke. Secondary outcomes will include effects on walking ability, endurance, balance, quality of life, and motivation for exercise. **Methods and analysis** This French single-centre randomized (1:1), controlled, two-arm, parallel, single-blind study will include 40 adults with chronic stroke spastic hemiparesis who are able to walk for 6 minutes. The primary outcome will be the participants' daily activity measured via the number of steps performed per day using a Stepwatch™ device. We expect to establish that the programme applied at a structure will be more effective than a self-managed programme as a means of increasing the physical activity of chronic stroke subjects. **Ethics and dissemination** The protocol was approved by an independent National Ethics Committee (Comité de Protection des personnes Est IV). Participants will be asked to provide their signed informed consent prior to the study. The results will be disseminated via publications in the scientific literature, oral and poster presentations by partners at international scientific meetings and associations of patients.

Trial registration: ClinicalTrials.gov, NCT06061770.

Strengths and limitations of this study :

- Randomised controlled trial to compare adapted physical activity programme applied at a structure versus a home-based self-management programme on chronic post-stroke adults
- Adapted physical activity programmes designed to meet the recommendations for physical activity after stroke
- Reliability and reproducibility of the Stepwatch assessments
- Evaluator blided from the intervention, but no double-blinding, impossible in this context
- No assesment of the longterm effects

Keywords: stroke, rehabilitation, Adapted Physical Activity, structure, step count

Word count (abstract/manuscript): 265 / 4324

Abbreviations:
PA: Physical activity
APA: Adapted Physical Activity
6MWT: 6 Meter Walk Test
W: Week

1. Introduction

Stroke is a major public health concern, not only due to its high annual mortality rate (estimated at 5.5 million individuals per year), but also because of its significant morbidity rate. It is estimated that 50% of surviving stroke individuals are permanently disabled[1], making it the leading cause of acquired motor disability in adults[2]. The consequences of stroke include medical complications, greater functional impairment, psychological disorders and musculoskeletal problems[3]-[4]-[5]-[6]. Loss of motor skills is one of the most common complaints of stroke survivors. Stroke is responsible for gait disorders in 75% of survivors[7]. Interestingly, the incidence rate of stroke includes a high recurrence rate approaching 25%, as reported in a recent study in the USA[8]. The Interstroke study published in 2016, conducted in 32 countries, identified 10 modifiable risk factors which need to be included in stroke prevention strategies. Physical activity (PA) was found to be a protective factor against stroke, with an OR of 0.58 in men and 0.65 in women[9]-[10]. ¨The identification of modifiable risk factors can facilitate the improvement of prevention strategies, which represent one of the main objectives of the 2018-2030 European Stroke Prevention Plan[11]. In this population, the American Stroke and Heart Association recommends that individuals engages in 20 to 60 minutes of aerobic activity three to five days a week and muscle-strengthening and stretching exercises two to three days a week in order to prevent cardiovascular disease and stroke recurrence[12]. However, the level of daily PA in chronic stroke individuals appears to be significantly below the recommended guidelines[13]. It is worth noting that the most frequently cited barriers to participation in PA among post-stroke individuals are not solely physical such as musculoskeletal disorders, obesity or joint pain. Rather, environmental difficulties including access, transport, and cost, as well as lack of motivation and fear of relapse, also play an important role[12]. Adapted Physical Activity (APA) programmes could be developed to address some of these barriers.

Walking is an accessible and cost-effective method of increasing PA and preventing chronic diseases[14]. One of the main parameters used in the literature to assess PA programmes has been walking ability based on the 6-minute walk test (6MWT). Although the results of 6MWT and daily step counts are closely linked, the former test explains only about 50% of the variability observed in walking in real-life situations[15]-[16]. Other factors have been reported in the literature to influence the PA of individuals in the chronic stroke phase, including intrinsic factors such as age, PA before stroke onset, the presence of cognitive disorders[17], motivation and anxiety[18]. On the other hand, extrinsic factors such as the physical and social environment have been found to account for about 10% of the variability observed in walking in real-life situations[19]. The meta-analysis published by Lee et al.**[20]** has suggested that walking ability improves more in supervised

programmes than in autonomous programs. However, no studies have been published so far to our knowledge in which the effects of a home-based APA programme are compared with those of a supervised APA programme applied at a structure.

The objective of this study was therefore to compare the effectiveness of an APA programme conducted at a structure versus with that of a home-based programme in increasing the daily PA of chronic stroke individuals, by measuring step counts using a dedicated device. The most original contributions of this study is the comparison made between two types of PA programmes (structured and autonomous), based on the ecological assessment criterion consisting of changes in the number of steps performed per day. On the other hand, it presents PA programmes that have been specially designed to enhance the daily PA rates of post-stroke individuals, particularly in relation to their walking abilities. These programs, which have been developed in accordance with the latest international recommendations[20]-[21], include detailed descriptions that align with the guidelines published by Slade et al.[22].

2. Methods and analysis

This prospective, randomised, controlled, two-parallel-armed, single-blinded study was designed to compare the efficacy of an APA programme carried out at a structure with that of autonomous practices, in terms of their ability to increase the daily PA of chronic stroke individuals. This is a single-centre study which will take place in Marseille, France. The primary objective of this study will be to assess the effects of a supervised PA programme applied at a structure versus those of a home-based self-managed programme on the daily walking rates of chronic post-stroke subjects with spastic hemiparesis. The secondary objectives will be to study the effects on walking ability, endurance, balance, quality of life and motivation for exercise. Primary and secondary endpoints will be assessed by an operator blinded to subject status. The single-blind design which is part of the APA protocol is not feasible in a blinded setting. For ethical reasons, participants will be permitted to pursue their usual medical follow-up and physiotherapy without any restrictions.

2.1. Eligibility criteria

Subjects aged 18 years or above with left or right spastic hemiparesis resulting from their first unilateral haemorrhagic or ischemic stroke which occurred more than 6 months previously, and who are able to walk for 6 minutes with or without technical assistance, will be eligible for inclusion. The exclusion criteria will include the inability to walk without human assistance (with or without an assistive device), cognitive impairments preventing informed consent, especially the inability to understand the aims of the study and the methods involved or the inability to communicate with the investigators. The presence of any other neurological disorder or pathology contraindicating PA (such as cardiovascular or respiratory disease, in particular) is another criterion for non-inclusion. Subjects must not be participating in any other clinical research project concurrently. In the event of any adverse event necessitating protocol interruption (e.g., fracture, cardio-respiratory failure, etc.), subject participation will be discontinued.

2.2. Design of the StrokAPA protocol

The present study will compare two APA programs. Subjects will be randomly assigned to one of two groups. Subjects will be randomly assigned to one of two groups on Day 0. Group 1 will participate in the APA programme at the rehabilitation centre from Week 1 to Week 12, while Group 2 will engage in a home-based self-management programme. Group 2 will conclude the study at Week 13, after which they will participate in a compensatory APA programme at the rehabilitation centre. Group 1 will continue with the home-based self-management programme from W14 to W25. These programmes will be supervised (in person or remotely) by an APA teacher dedicated to each programme.

A two-arm parallel design will be used with a view to comparing the two APA protocols. The primary endpoint, which has been selected in order to meet the primary objective, will be assessed at W13 in the case of both groups. The addition of a home-based self-management APA programme after the in-structure programme for Group 1 will serve to address a secondary question regarding the comparative efficacy of the home-based self-management programme in isolation or subsequent to the in-structure programme. For ethical reasons and to enhance recruitment, all post-stroke individuals enrolled in group 2 will benefit from both types of APA, as

they will be able to participate in the structured programme as part of routine care, after completing the self-directed program. The detailed protocols are described in the **Supplementary material 1.**

2.2.1. Structure of the APA programme

The programme will be implemented as part of routine care at the rehabilitation centre. It consists of 3 sessions of APA per week (Mondays, Wednesdays and Fridays) for 12 weeks. Each session will consist of 2 x 60-minute APA sessions. The entire programme was designed to meet the recommendations for PA after stroke[21]. Each session will include 45 minutes of actual work and 15 minutes devoted to set-up measures. The programme will be supervised by an APA instructor, who will provide participants with feedback and adapt the exercises to each individual's limitations. At the beginning of each week, a group meeting will be held to take an inventory of each participant's PA for the week.

2.2.2. APA home-based self-management program

The APA home-based self-management programme will be based on detailed exercise cards presenting yoga, Pilates and walking activities. Subjects will be given a booklet of detailed cards with photographs. The main aim of the adapted yoga exercises presented in the booklet is to stretch all four limbs and the trunk. The booklet presents the yoga session used in the structured programme. The focus here is on the physical sensation of stretching and working without pain. The Adapted Pilates exercise booklet focuses on general motor strengthening. It presents the Pilates session used in the structured programme.

Since the objective is to effectively promote PA in chronic stroke individuals, subjects are encouraged in all these programmes to engage in PAs of their choice, even in activities other than those proposed, and to record them in the registry.

2.2.3. Time schedule

The study will run for 25 weeks with subjects enrolled in Group 1 and 13 weeks with those in Group 2, with an additional 12 weeks of participation in the compensatory structured APA program, as a routine care. The flow chart of the study is presented in **Figure 1**. The study has not yet commenced, but enrolment is scheduled to begin in September 2024. The study is expected to last for a period of two years.

2.2.4. Enrolment and initial assessment

The inclusion medical visit will take place on D0 with the objective of verifying that the inclusion and non-inclusion criteria defined above have been met. This medical visit will also permit the initial assessment to be carried out by an operator blinded to the subjects' group.

The enrolment visit is a medical consultation designed to ensure that there are no contraindications to participating in the programme. The visit provides an opportunity for the subject to provide informed consent and for the relevant data to be recorded recording. This includes the subjects' stroke characteristics (cortical or subcortical, ischemic or haemorrhagic), comorbidities, body mass index, stroke severity (NIHSS and injured area if available), the use of any assistive devices, spasticity (modified Ashworth score), pre-stroke sports activities, the presence of depressive syndrome (Individual Health Questionnaire 9), pain VAS and DN4 scale to assess any neuropathic component present and the initial assessment. This visit will also be used to fit the Stepwatch® daily PA measurement monitor (to be worn at least during the subjects' waking hours for the entire duration of their participation in the study on the ankle of the healthy limb), to provide each subject with the notebook to be used for the written report and to record all the PAs performed during and outside the programme.

A simple randomisation procedure will then be employed to assign the subject to one of the two groups, using a computer-generated table of random numbers.

2.2.5. Organization of subjects' follow-up

Follow-up will involve collecting Stepwatch® data every 3 weeks at the rehabilitation centre, with the individual responsible for data collection being unable to view or alter the data in any way. Given that the programme for Group 1 will be conducted at the rehabilitation centre, data will be collected there during one session at W3, W6 and W9. The home-based self-management programme will involve visits to the

rehabilitation centre every 3 weeks, during which Stepwatch® data will be collected at W3, W6 and W9 on group 2 and at W16, W19 and W22 on Group 1. A final evaluation will take place on W13, at the end of the first APA period, by an operator who is blinded to the subjects' status. Group 1 will continue the study on an exploratory basis, using the APA home-based self-management programme until W26, at which point the final assessment of the criteria will be conducted.

2.2.6. Evaluation criteria

In this protocol, the primary outcome will be the subjects' daily activity in terms of the number of steps measured per day, average per week, which will be recorded throughout the entire duration of the study using a Stepwatch™ device. This device has been tested and found to show the greatest accuracy at all the walking speeds and step lengths tested[23]. In order to ensure the accuracy of the data collected, the device has to be worn on the ankle of the unaffected limb at least during the subjects' waking hours throughout their participation in the study.

The Stepwatch® device will be delivered to the subjects with an instruction manual on D0. It will then be calibrated by an investigator using the subject's anthropometric data and a 20-step calibration procedure. Data will be collected at W3, W6, W9 and W13 on both groups and at W16, W19, W22 and W26 on Group 1. These data will be collected by an investigator blinded to subjects' individual status. The comparison between the two groups with regards to the primary endpoint will be performed at W13.

The secondary endpoints will be assessed based on the other tests performed to assess walking ability, endurance (walking test 6 minutes and Borg Rating Scale of Exertion), balance (Berg Balance Scale and Activity-specific Balanced Confidence scale), quality of life (Stroke Specific Quality of Life) and motivation for exercise (Behavioural regulation in exercise questionnaire 2).

A written report on the PAs performed by each subject (types of PA and duration) will be recorded by the subjects themselves in a diary distributed at baseline.

The 6MWT will be used to assess subjects' walking ability. Heart rate and systolic blood pressure will be measured at rest and after the 6-minute walk test. Subjects will complete various assessments and questionnaires. The Borg Rating Scale of Exertion[24] will be employed to assess the subjects' perception of their exertion following the 6MWT on a scale ranging from zero to maximum. The Stroke Specific Quality of Life[25] scale will be used to evaluate subjects' quality of life. This scale contains several sub-sections including autonomy, social relationships and character. Subjects will be asked to rate their difficulty in performing an activity or how far they agree with a statement on a scale of 1 to 5. The Berg Balance Scale[26]-[27] will be used to assess subjects' balance by rating their ability to perform each of the 14 items from 0 to 4. The Activity-specific Balanced Confidence Scale[28] will be used to assess subjects' confidence in their balance. Subjects are asked to rate from their confidence in their balance from 0 to 100% in response to 16 situations. Finally, the Behavioural Regulation in Exercise Questionnaire2[29] will be used to quantify participants' motivation to perform exercises of 24 kinds, which they will be asked to rate between 1 and 7.

2.3. Statistical aspects

2.3.1. Sample size calculations

Assuming the existence of a difference of 1000 steps between the endpoints, a standard deviation of 1500 [30], a 5% risk of the first type and a power of 80%, it would be appropriate to include 28 subjects per group, making a total number of 56 subjects. The present study will include 40 subjects, which will make it possible to specify the precision of the indicators with a power of 70%. The randomisation ratio will be 1:1 in this study.

2.3.2. Statistical analysis

Data analysis will be performed by the statistician under the responsibility of the methodologist, using SPSS version 17.0 under Windows. The significance level will be set at 0.05. No interim analyses have been planned. The analysis will be blinded, i.e. the statistician will know nothing about the identity of the groups and will initially present the results anonymously to the coordinating investigator and the other investigators. Once the statistical analysis has been completed, the identity of the groups will be revealed.

The methodological and analytical plan will be based on the criteria presented in the Consolidated Standards of Reporting Trials Statement (CONSORT, http:// www.consort-statement.org/consort-statement/).

2.4. *Patient and Public involvement in research*:

The implementation of the APA protocol in structures, as part of routine care, has been adapted on the basis of feedback from patients participating in this program.

3. Ethics and dissemination

3.1. Informed consent and data management

This clinical trial will be conducted in accordance with the Helsinki Declaration. Subjects will be pre-selected from among those attending our Physical Medicine and Rehabilitation Department, and eligible subjects will be contacted by the investigators. Participants will be asked to give their signed informed consent prior to the study (**Supplementary material 2).**

The data obtained in this study will be processed by the Clinical Data Manager at the AP-HM Health Research Department, in line with the French legislation. Data will be recorded using an electronic case report form developed using open-source web-based software, namely the REDCap application.

3.3 Ethics approval and trial registration

The protocol used in this study was approved on May 2, 2023 by an independent National Ethics Committee (Comité de Protection des personnes Est IV) under the number 23.00588.000168 and registered in the clinicaltrial.gov registry: NCT06061770. The manuscript meets the requirements of the SPIRIT guidelines for reporting protocols.

3.4 Dissemination

The results will be disseminated via publications in the scientific literature, oral and poster presentations by partners at international scientific meetings, wide-audience media outlet and associations of patients and their families.

4. Discussion

It is well established that PA is a factor preventing stroke relapse. The daily PA rates of chronic stroke individuals are known to be significantly lower than those recommended by the international health authorities. Consequently, increasing PA in individuals after stroke remains a significant challenge.

The initial rehabilitation management includes early mobilisation and upright positioning in physiotherapy programmes. Moore et al. have reported that an intensive walking PA programme significantly improved the daily walking rates of the post-stroke subject's studied[30]. APA can be employed in the rehabilitation process for individuals after stroke[31]. It helps to maintain their independence, reduces the risk of recurrence and favours their social reintegration when applied in a group setting[32]. APA programmes, which are often carried out as an adjunct to rehabilitation care for a period of 3 to 12 months, constitute a whole stage in the post-stroke recovery process[32]. The duration of these programmes appears to be a significant factor in enabling subjects to increase their activity levels. A meta-analysis conducted by Lee et al. in 2020 demonstrated that programmes lasting at least 12 weeks had significantly greater effects on muscle strength and walking ability than those lasting for shorter periods[20]. The latter authors proposed that the duration of these exercise programmes contributes importantly to inducing physiological adaptations that improve individuals' walking ability.

The StrokAPA protocol may provide an effective approach to encouraging post-stroke individuals to increase their PA. It is noteworthy that the majority of the studies establishing the effectiveness of APA programmes as means of increasing daily walking are based on direct gait training or at least on incentives to walk**[30]-[33].** Moore et al. observed an increase of approximately 24% in participants' daily step count after applying a structure-based APA programme in a conventional rehabilitation setting, where they had reached a recovery plateau**[30]**. The Danks study**[33]** was a home-based self-management programme that included motivational interviews encouraging subjects to walk with daily step count goals and the use of a pedometer as a feedback. The step rates increased significantly from an average number of 5205 to 6372 steps per day. Moore's study was based on the use of a structured supervised PA programme, while Danks' study was based on a home-based self-management programme with motivational interviewing and the testing of the use of a pedometer as a feedback tool. Both types of programmes were found to have beneficial effects on PA in ecological settings, since they increased the number of daily steps taken by individuals with stroke sequelae. The

meta-analysis published by Lee et al.[20] has indicated that supervised programmes tend to result in greater improvements in walking ability than self-directed programmes. However, to the best of our knowledge, no studies have yet been published that directly compare the effects of a home-based unsupervised APA programme with those of a supervised APA programme delivered at a structure.

The present APA study proposes a comparison of the effects of the programme applied at a structure versus those of a home-based self-management programme with a view to optimising their use on chronic post-stroke individuals. This project aligns with the spirit of the European Stroke Action Plan 2018-2030, which stresses the lack of PA programmes catering for stroke survivors. The objective of the latter Action Plan is to make PA programmes accessible to all stroke survivors[11]. A recent meta-analysis has demonstrated that participation in a supervised programme combining motor strengthening and aerobic exercise is an effective strategy for promoting individuals' participation in physical activity and improving their cardiorespiratory fitness, muscle strength and walking ability[20].

Ultimately, we have several aims. First, to establish the value of a structured APA programme for chronic post-stroke individuals. The main advantages of our programme include the fact that it requires only a straightforward medical examination to ascertain for contraindications and that it can be carried out in conjunction with APA instructors. The results obtained here could be of great importance on several levels. For individuals and their families, it would reinforce the feasibility and the interest in programmes of this kind thereby improving individuals' walking performances in their everyday lives. At present, the daily PA rates of individuals in the chronic stroke phase are known to be well below the international recommendations[13], and a programme of this kind could greatly improve this situation. From the perspective of the healthcare system, the results of this study could constitute a further step towards optimising the management of individuals with chronic post-stroke sequelae. Furthermore, the implementation of an APA programme in structures would also enable individuals who have suffered from a stroke to interact with people in similar situations. PA helps to maintain independence, reduce the risk of recurrence and encourage social reintegration if practiced in a group[33]. This promotes interactions and inter-group emulation, which is conducive to motivation for PA and promotes the pursuit of PA at the end of the programme. Adapted group physical activity can also have disadvantages, such as the risk of exercising at the intensity of the least active participant, thus minimising the benefits for most participants. Conversely, the intensity of the exercise may be too high, increasing dropout rates. To avoid these issues, our group programme is supervised by an APA professional who ensures that the exercise proposed is appropriate for each participant and can adjust it if necessary.

Conversely, the implementation of a programme at a structure prior to a self-managed programme seems likely to result in sustained PA rates in chronic stroke individuals, thus increasing the effectiveness of the self-managed programme. This would increase the value of generalising programmes of this kind so as to lead post-stroke individuals to increase their PA rates, which could then be maintained independently, requiring only periodic follow-up visits. Consequently, it would be worth conducting a medico-economic study on the benefits of such programmes in reducing disability and secondary complications in a population of chronic post-stroke individuals. In fact, the aim of such programmes of this kind would be to enable individuals to modify their lifestyles by including regular PA, thus reducing the risk of recurrence, which would naturally also reduce public health costs.

Walking appears to be an accessible and beneficial form of PA that prevent chronic diseases[14]. One of the most innovative aspects of this study is that it involves assessments that are as similar as possible to what individuals often do in real life, namely measuring the number of daily steps they take, in this case, using the Stepwatch. The authors of some recent studies have used this method[30]-[33]-[34] to measure the number of steps taken per day. The results obtained with this device have been found to show particularly good reliability and reproducibility, regardless of the wearers' stride speed and stride length[23]. Therefore, the Stepwatch can be considered a reliable and reproducible ecological means of assessing the effectiveness of PA programs[13]. Nevertheless, the selection of primary outcome measures obtained via technology and not through standardised clinical scales may be open to question, given that it could be susceptible to issues of poor reliability and replicability across studies. To address this, standard clinical tests were incorporated as secondary objectives.

One of the principal limitations of the present study is the absence of double-blinding, despite the inherent difficulties in achieving this in studies of this kind. We have attempted to mitigate bias by ensuring that the assessor was unaware of the subjects' status.

The potential for underuse or misuse of the Stepwatch device represents a risk inherent to this study. Any issues with the device would be addressed during the scheduled visits for the group undergoing rehabilitation

at the centre, as well as during the interviews scheduled every three weeks for the group undergoing rehabilitation at home. Additionally, participants can contact the provided telephone number if they encounter any problems.

All participants are authorised to continue physiotherapy rehabilitation. The intention is that APA should be carried out in addition to the usual rehabilitation for stabilised patients. The objective is to study stabilised patients in their ecological conditions, without modifying them. The two groups will be comparable on this point.

Another limitation is that there was no provision for long-term assessments of the impact of the programme. It would certainly be of interest to conduct a study on the long-term effects, as well as on the medico-economic benefits of programmes of this kind.

This study represents a significant contribution to the field of physical activity (PA) research, as it presents a novel comparison between the efficacy of two distinct types of PA programs: those conducted in a structure versus those conducted in a home-based self-management format. The study's findings will provide valuable insights into the impact of these programmes on the daily lives of individuals with chronic post-stroke conditions. The findings of this study will corroborate the efficacy of the physical activity programs recommended in the 2018-2030 European Stroke Action Plan.

Funding: This project was funded by a grant from Assistance Publique des Hôpitaux de Marseille (AAP Jeune Chercheurs 2021). Grant number: Not Applicable.

Informed Consent Statement: Informed consent will be obtained from all subjects involved in the study

Author Contributions: Conceptualization: MC, LB; methodology: MC, LB, PA; writing—original draft preparation: ES, MC; writing—review and editing: MC, LC, JMV, NPB supervision: MC, LB, JMV; project administration: ES, MC, LB, JMV, NPB; funding acquisition: MC, LB. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: This study is sponsored by Assistance Publique – Hôpitaux de Marseille (DRCI).

The authors thanks the rehabilitation teams for their invaluable assistance and Mrs. Jessica Blanc for her English writing correction.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Supplementary material

Supplementary material 1. Detailed APA protocol

Supplementary material 2. Participant consent form

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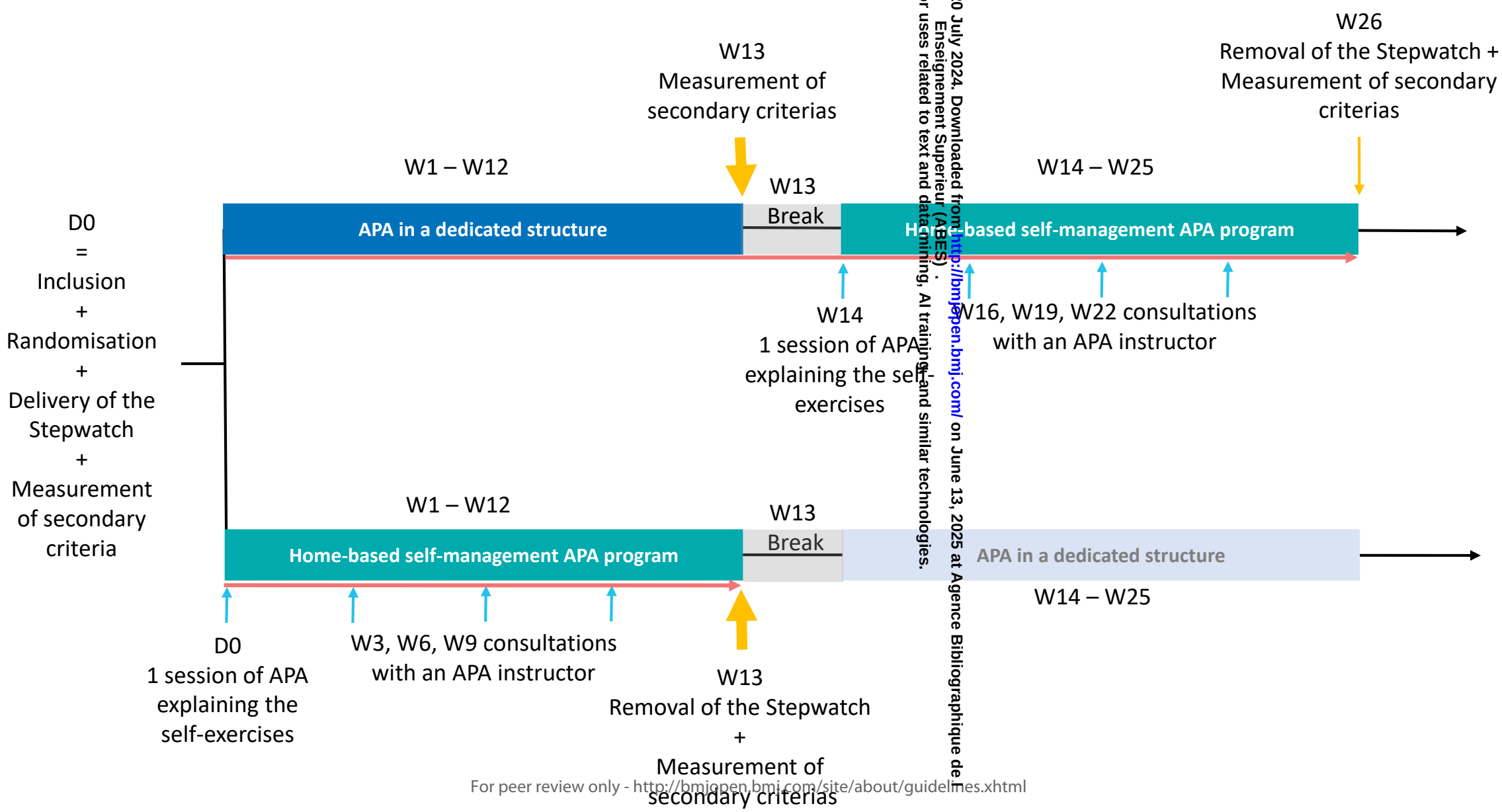
Figures

Figure 1. Study schedule. The red arrows indicate the measurement of the primary endpoint, while the yellow arrows represent the measurement of the secondary endpoints.



Supplementary material 1. Detailed APA protocol

A. Structure of the APA program

The program will be applied as part of routine care at the rehabilitation center. It consists of 3 sessions of APA per week for 12 weeks. Each session will consist of 2 x 60-minute APA sessions. The entire program was designed to meet the recommendations for PA after stroke**[21]**. Each session will include 45 minutes of actual work and 15 minutes devoted to set-up measures. It will be supervised by an APA instructor providing participants with feedback and adapting the exercises to the limitations of each one. At the beginning of each week, a group meeting will be held to take an inventory of each participant's PA for the week. The goal is to encourage the group to increase their walking time outside of the program. Participants will be encouraged to increase their walking time by approximately 25% per week. If the participant's weekly goal was met, the participant will be encouraged to increase activity by 25% of the weekly average time until 1 hour of walking per day is achieved, and then the goal will be to consistently achieve 1 hour of walking per day. If participants did not meet their weekly goal, the goal remained the same.

The activities practiced in this program will be yoga, Pilates, outdoor walking, zumba, Molkky® and aquagym. The plan for each session was designed in advance based on the Consensus on Exercise Reporting Template**[22]** criteria. The same plan was used throughout the sessions with a view to helping the individuals to learn the gestures:

- The main aim of the Adapted yoga session is to stretch all four limbs and the trunk. It consists of 8 poses, each of which targets a specific muscle or muscle group and is held for 3 minutes. The focus is on the body's sense of stretch and working without pain.

- The main aim of the Adapted Pilates session is to improve muscle strength. It consists of 12 movements performed in series of 10 repetitions, the last 3 of which depend on how tired the muscles feel.

- The main aim of the outdoor walking session is to improve walking ability. The course alternates between flat ground (asphalt), uneven ground (potholes, puddles, gravel, grass) and a 20% incline/slope. The session includes 5 minutes of acceleration to maximum walking speed on level ground, subdivided into 10 x 30 seconds with a 5-minute interval between each acceleration. During the 5-minute intervals between each acceleration, a spontaneous speed walk is performed. The APA instructor can change the walking speed, pause times and acceleration times.

- The main aim of the Adapted Zumba session is to work on endurance in a fun way with a series of choreographed, rhythmic movements set to music.

- A session devoted to a throwing game, Molkky®, is intended to improve balance, coordination and cognition via a fun throwing activity. The activity is carried out outdoors on sandy ground in teams of 2. This activity promotes sociability and creates cohesion within the group of subjects.

- The Aquagym session is designed to improve muscle strength, balance and walking under reduced gravity conditions. The session consists of abdominal exercises (3 sets of 10 repetitions), quadriceps exercises (3 sets of 10 repetitions), balancing exercises on one foot (5 minutes per leg) and walking exercises (15 minutes).

B. APA home-based self-management program

The main aim of the outdoor walking exercise booklet is to optimize walking skills. The session includes 5 minutes of acceleration to maximum walking speed on level ground,

subdivided into 10 x 30 seconds with a 5-minute interval between each acceleration. A face-to-face consultation with an APA instructor is scheduled on the first day of the program, and during weeks 3, 6 and 9 of the self-management program. These visits provide subjects with motivational follow-up, as well as meeting the technical memory constraints of the Stepwatch™ device, which can be used to make continuous recordings during approximately 3 weeks. On the first day, an APA session is scheduled to teach yoga exercises tailored to the state of the participants. The 6-week visit also includes an APA session, with additional materials included to enrich the program with the adapted Pilates booklet. Visits at weeks 3 and 9 will include a motivational interview with an APA instructor based on the subject's written report on the exercises performed.

Patient information guide

Comparison of the effectiveness of an adapted physical activity programme in a structure with a self-programme in patients in the chronic phase of a stroke : StrokAPA

Sponsor: AP-HM (Assistance Publique Hôpitaux de Marseille)
Direction de la Recherche Santé et Maladies Rares - 80 rue Brochier - 13 354 Marseille Cedex 5 - France

Coordinating investigator: Dr COTINAT - Pr VITON's PRM Department - Address: Hôpital Sainte Marguerite, 270 Boulevard Sainte Marguerite, MARSEILLE, 13009 Tel: 04 91 74 42 48

Dear Sir/Madam

Dr / P r _____ has asked you to take part in a study entitled "**Comparison of the effectiveness of an adapted physical activity programme in a dedicated structure with a self-programme in patients in the chronic phase of a stroke".**
Assistance Publique des Hôpitaux de Marseille is the promoter of this research and will ensure that it runs smoothly.

In accordance with Law 2012-300 of 5 March 2012 on research involving the human person (known as the Jardé Law) / Public Health Code; Title II of Book 1 on research involving the human person, we ask you to read this information leaflet carefully, which is intended to answer any questions you may have, before deciding whether or not to take part in this research.
Don't hesitate to ask questions if anything is unclear or if you would like further information.

Context

Stroke is the leading cause of acquired motor disability in adults. Physical activity is a cardiovascular protective factor and reduces the risk of stroke recurrence. However, daily physical activity levels in patients with stroke sequelae are well below international recommendations. The creation of adapted physical activity programmes is an interesting option for these patients, with the aim of increasing their daily physical activity. Some programmes are carried out in a facility, others independently. We propose to compare the effectiveness of these two methods.

Aims of the study

The aim of this study is to compare the practice of an adapted physical activity programme in a dedicated facility with a self-programme carried out at home. The secondary objectives will be to study patients' walking ability, endurance, balance, quality of life and motivation to engage in physical activity.

This could increase the interest in adapted physical activity, which is still underdeveloped in France. One of the main advantages of our programme is that it requires only a medical examination to ensure that there are no contraindications, and can be carried out in association with adapted physical activity teachers. This study could have several effects: for you and your family, it would reinforce the practical feasibility and interest of this type of programme, by enabling you to make gains in walking in everyday life. From the point of view of the healthcare system, the results of our pilot study could constitute a further step towards optimising the care of people suffering the after-effects of a stroke.

Conduct of the study

Your participation in the study consists of :
Participation in an adapted physical activity programme in a dedicated facility and in an independent programme, as well as wearing a pedometer (Stepwatch) on the ankle of the non-affected limb for the duration of your participation in the study. The order of these programmes will depend on the group to which you belong. The group will be allocated to you by chance.

Your participation will begin with an inclusion medical visit to ensure that there are no contraindications to your taking part in the adapted physical activity programmes.
After this visit, you will be assigned to a group according to a random allocation.
Group 1 will take part in the study for 26 weeks. They will start with the structured programme for 12 weeks, then after a 1-week break, they will begin the independent physical activity programme for 12 weeks.
Group 2 will take part in the study for 13 weeks. It will start with the programme of physical activity in autonomy for 12 weeks, then after a 1-week break, it will start the programme in a dedicated structure, outside the study, in a compensatory manner. This programme in a dedicated structure, taking place outside the study, will not be covered by the research insurance but by the institution's insurance.

The supervised programme is carried out at the Institut Universitaire de Réadaptation de Valmante Sud, with 3 sessions a week of adapted physical activity.
The self-programme includes consultations with an adapted physical activity teacher every 3 weeks at Hôpital Sainte Marguerite to keep you motivated and answer any questions you may have.

The pedometer ™ data is collected every 3 weeks, during the consultations scheduled in the 2 programmes.
Walking ability, endurance, balance, perceived quality of life and motivation to engage in physical activity were assessed at the inclusion visit and at a visit at 13 weeks in both groups. ème A final consultation is scheduled in group 1 at 26 weeks for a final assessment.

Benefits, risks and constraints associated with taking part in this research

Expected benefits

- For you: The aim of your participation is to enable you to increase your daily physical activity and improve your walking, endurance and balance, as well as increasing your motivation to engage in physical activity. The long-term aim is to improve your quality of life.
  Regular physical activity also reduces the risk of a stroke recurring.
- For the company: The results of our pilot study could be a further step towards optimising care for people suffering after-effects of an accident.
  the feasibility and effectiveness of a programme of physical activity for the treatment of stroke.
  The only requirements are a medical consultation to ensure that there are no contraindications and follow-up by an adapted physical activity teacher.

Foreseeable risks and constraints

The risks associated with this study are not significant:

- Your participation will require your personal time to take part in adapted physical activity programmes,
- During tests and adapted physical activity, the risks of falls and injuries remain,
- As the aim of this study is to increase your physical activity, it is possible that participation in this study may result in fatigue after the adapted physical activity sessions.
- Your participation means that you will have to wear the Stepwatch pedometer every day, around the ankle of your non-affected lower limb, without any additional risk.

Compensation - payment of study costs

- At the end of your participation in the study, you will receive an allowance of *€100.* to compensate for the constraints suffered.

- In accordance with current regulations, you are hereby informed that the maximum amount of compensation received over a 12-month period by a person participating in biomedical research is set at €4,500.

Reflection period

You have between 1 and 7 days to decide whether or not to take part.

Legal and ethical aspects

You may refuse to give your authorisation. This refusal will have no impact on the quality of care you receive.

This project falls within the scope of research involving the human person involving minimal risks and constraints (category 2), within the meaning of article L.1121-1 paragraph 1, of the Public Health Code.

It is subject to the regulations that apply to research "involving the human person".
"These include Law no. 2012-300 of 5 March 2012 on research involving the human person (known as the Jardé Law), as amended by Order no. 2016-800 of 16 June 2016, and its implementing decrees.

This study received a favourable opinion from the Est IV Committee for the Protection of Individuals on 02/05/2023.

This research is conducted in accordance with the reference methodology MR 001 approved by the Commission Nationale de l'Informatique et des Libertés (CNIL) on 13 July 2018 and with which Assistance Publique - Hôpitaux de Marseille has undertaken to comply (Récépissé n°2205999 v 0 of 30 August 2018).

In accordance with the law, the APHM, the promoter of this research, has taken out insurance with SHAM (18 rue Edouard Rochet 69372 LYON Cedex 08 - +33 (0)4 72 75 50 25) under the number policy number 166 005.

As part of this study, your personal data will be processed to enable the results of the research to be analysed in the light of the objective presented to you.

This data processing is based on the performance of a task in the public interest entrusted to the data controller (article 6.1.e of the RGPD) and the exemption to process health data for scientific research purposes (art.9 RGPD).

All personal information collected throughout the study will be treated as confidential. All study data concerning you will be pseudonymised. You will be given a code number. This will be used to identify you and any personal information without having to use your name, medical record number or other common identifiers. Your data will remain strictly confidential and may only be consulted by the medical team, persons duly authorised by the sponsor and, if necessary, by representatives of the Competent Authorities.

The demographic data (sex and age) and clinical data (weight, height and previous and current treatments) concerning you, required for this research, will be processed electronically by the research organisers.

This computerised processing is under the responsibility of the data controller: Assistance Publique Hôpitaux de Marseille (80 rue Brochier, 13354 Marseille Cedex 5 - Tel: 04 91 38 00 00), represented by its legal representative in office.

It will be carried out in accordance with the provisions of law no. 78-17 of 6 January 1978 on data processing, data files and individual liberties.

Data collected as part of this research will not be transferred to countries outside the European Economic Area (EEA).

Further studies :

The data collected during this research will be used for research purposes. At the end of the study, unless you object, we would like to keep the data so that it can be re-used for other studies on adapted physical activity programmes for patients in the chronic phase of a stroke, for a period of 15 years.

You will be informed of these new studies via the APHM website: http://fr.ap-hm.fr. Your

personal data will be kept for 15 years after the end of the research.

Pursuant to Act no. 78-17 of 6 January 1978, amended on 12 December 2018, on Data Processing, Data Files and Individual Liberties (Title II "Processing covered by the personal data protection regime provided for by Regulation (EU) 2016/679 of 27 April 2016"; Chapter II "Rights of the data subject") you have :

- a right of access, rectification and deletion of your data collected in the context of this study and likely to be processed, and a right to limit their processing,
- the right to object to the collection, processing and transmission of your data covered by professional secrecy,
- a right to portability: you can ask for your personal data to be returned to you or transferred to a third party where possible.

You may withdraw your consent to the collection and processing of your personal data at any time.

You can exercise these rights by contacting the investigating doctor treating you or the study coordinator, Dr Maeva COTINAT.

If you have any questions or complaints about the processing of your data during this study, you should first contact the doctor treating you in the study, who will be able to direct your request.

In the event of any difficulties in connection with the management of the data collected, you may submit a complaint to the Data Protection Officer at Assistance Publique Hôpitaux de Marseille, by e-mail to dpo@ap-hm.fr.

You may also submit a complaint concerning the way in which your data is processed to the supervisory authority responsible for applying data protection law in France, the Commission Nationale de l'Informatique et des Libertés (CNIL), online via the link: https://www.cnil.fr/fr/webform/adresser-une-plainte or by post to the following address: Commission Nationale de l'Informatique et des Libertés, 3 Place de Fontenoy, TSA 80715, 75334 PARIS CEDEX 07.

The presentation of this data will not allow you to be identified, either directly or indirectly.

These data may be used for scientific publications, but your name or any other element that might identify your participation will not appear.

In accordance with the law (art L1122-1 of the Public Health Code), you may, if you wish, be informed orally of the overall results of this research by contacting the investigating doctor in charge of the study.

The study data and the results of the treatment will be kept for a period of 15 years after the end of the study, on paper or electronically.

Your doctor will keep you informed of any new information or changes concerning the study that may affect your health or your willingness to continue the study.

If you wish, on request, the study doctor will be able to inform you of the overall results of the study, approximately one year after the last patient has completed participation in the study.

Your authorisation does not relieve the sponsor and the investigator of their respective responsibilities.

For further information, to request access to your data, or to obtain the overall results of the study, please contact Dr COTINAT on 04 91 74 42 48 or by e-mail: maeva.cotinat@ap-hm.fr

Thank you for taking the time to read this information letter. If you agree to take part in this research, please date and sign the attached consent form.

To take part in this study, you will need to sign the form below entitled "Consent form".

INFORMED CONSENT FOR PATIENT PARTICIPATION

Comparison of the effectiveness of an adapted physical activity programme in a dedicated structure with a self-programme in patients in the chronic phase of a stroke : StrokAPA

Sponsor: AP-HM (Assistance Publique Hôpitaux de Marseille)
Direction de la Recherche Santé et Maladies Rares - 80 rue Brochier - 13 354 Marseille Cedex 5 - France

Coordinating investigator: Dr COTINAT - Pr VITON's PRM Department - Address: Hôpital Sainte Marguerite, 270 Boulevard Sainte Marguerite, MARSEILLE, 13009 Tel: 04 91 74 42 48

I, the undersigned, ...*(name, first name)*, who is due to receive treatment for my illness, declares :

1. Having freely agreed to take part in the study entitled **"Comparison of the effectiveness of an adapted physical activity programme in a dedicated structure with a self-programme in patients in the chronic phase of a cerebrovascular accident: StrokAPA",** without this releasing the organisers of the research from their responsibilities,
2. Have understood that if I agree to take part in this research, I must sign this document,
3. Have understood that signing the consent form does not relieve the sponsor and the investigator of their respective responsibilities.
4. I certify that I am over 18 and that I am not under any legal protection (guardianship, curatorship, safeguard of justice),
5. I understand that I have a period of reflection between the time I receive the information and the time I sign this document,
6. I have been informed that I may withdraw my agreement to participate at any time, without justification and without any prejudice to me,
7. I have been informed that I retain all my rights guaranteed by Law 2012-300 of 5 March 2012 on research involving the human person (known as the Jardé Law) / Public Health Code, Title II of Book 1 on research involving the human person,
8. Have been informed that this research has received a favourable opinion from the Comité de Protection des Personnes Est IV dated 02/05/2023.
9. Have been informed of the purpose, progress, advantages and disadvantages of this research, and that it will be carried out in accordance with Good Clinical Practice as defined in the Official Bulletin published by the Ministry of Social Affairs and Employment,
10. To have been able to ask all the questions I wanted and to have received appropriate answers that I clearly understood, and to have noted that I could add to this information throughout the study by contacting Dr COTINAT, coordinating investigator (**04 91 74 42 48**),

11. Have been informed that the Promoter of this study is the APHM and that, in accordance with the law, the APHM has taken out insurance with SHAM under number 166.005,
12. I have been informed of the use of pseudonymised data concerning me, collected as part of this research by computer processing. The presentation of the results of the study will not enable me to be identified, either directly or indirectly (Act no. 78-17 of 6 January 1978, as amended, relating to information technology, files and civil liberties),
13. Have been informed that this data may only be consulted by the study investigators and the sponsor or by persons authorised by the sponsor and bound by professional secrecy, or by persons authorised by the administrative, health and legal authorities,
14. I have been informed that I may, if I wish, access this data, check it and request changes if necessary, in accordance with the law in force (Law no. 78-17 of 6 January 1978, as amended, relating to information technology, files and civil liberties),
15. Have noted that any new information arising during the course of the study, which could affect my participation, will be communicated to me as soon as possible,
16. Have understood that the sponsor, or the coordinating investigator, may decide to stop the study at any time,
17. I have been informed that the overall results of the study may be communicated to me in accordance with Article L1122-1 of the French Public Health Code,
18. Be affiliated to a social security scheme, or be a beneficiary of such a scheme,

I agree to take part in this study under the conditions specified above.

☐ YES N O ☐

I agree that the data collected in the course of this research may be re-used for other studies on adapted physical activity programmes for patients in the chronic phase of a stroke for a period of 15 years.

☐ YES N O ☐

Done at ..... Le .....

Name and signature of subject Name and signature of investigating doctor

If required :

If the patient cannot read or write independently, a third person, completely independent of the investigator and the sponsor, must certify that he/she has read this document to the patient and has obtained his/her agreement to sign on his/her behalf:

Last name : _____ *First name :*

_____

Relationship with the

*patient :*_____

Signature :

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

Section/item	Item No	Description	Reported on page No
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	01
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry.	01,05
	2b	All items from the World Health Organization Trial Registration Data Set All WHO Trial Registration Data requirements are met with the trial's registration in the ClinicalTrials.gov. Trial registration information	01,05
Protocol version	3	Spirit 2013 Guidance Last update: February 28, 2020	
Funding	4	Sources and types of financial, material, and other support	07
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	01
	5b	Name and contact information for the trial sponsor AP-HM, Département de la Recherche Clinique et de l'Innovation (DRCI) 80 Rue Brochier, 13005 Marseille drci@ap-hm.fr	01,07

	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	03
	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)	03
Introduction			
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	02
	6b	Explanation for choice of comparators	02
Objectives	7	Specific objectives or hypotheses	03
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)	03
Methods: Participants, interventions, and outcomes			
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	03-04
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)	03
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	03-04

	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)	04
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)	02
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	03-04
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	04-05
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)	04 / fig 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	05 2.3.1
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	04
Methods: Assignment of interventions (for controlled trials)			
Allocation:			
Sequence generation	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	05
Allocation concealment mechanism	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	05

Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	05
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	04
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	NA
Methods: Data collection, management, and analysis			
Data collection methods	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	04-05
	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 protocol	NA
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	07
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	05
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	NA

	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)	NA
Methods: Monitoring			
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	NA
	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	NA
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	04-05
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	NA
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	07
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)	NA

Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	04
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	NA
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	04,07
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	Title page / 07
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	05
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	NA
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	06
	31b	Authorship eligibility guidelines and any intended use of professional writers	07
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	07
Appendices			
Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	Supplementary material 2

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	NA

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.

BMJ Open

Effectiveness of an institution-based adapted physical activity programme versus a home-based self-management programme for chronic post-stroke adults: protocol for a randomized controlled study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-084688.R2
Article Type:	Protocol
Date Submitted by the Author:	02-Jul-2024
Complete List of Authors:	Satger, Etienne; AP-HM Prieur-blanc, Nicolas; Aix-Marseille University; AP-HM Viton, jean-michel; Aix-Marseille University; AP-HM AUQUIER, Pascal; Aix-Marseille University, EA 3279 (Santé Publique : Qualité de Vie et Maladies Chroniques); FranceCoag Network bensoussan, laurent; Aix-Marseille University; UGECAM Provence-Alpes-Cote d'Azur COTINAT, Maëva; Aix-Marseille University,
Primary Subject Heading:	Rehabilitation medicine
Secondary Subject Heading:	Sports and exercise medicine
Keywords:	Stroke < NEUROLOGY, REHABILITATION MEDICINE, Gait, Stroke medicine < INTERNAL MEDICINE

Effectiveness of an institution-based adapted physical activity programme versus a home-based self-management programme for chronic post-stroke adults: protocol for a randomized controlled study

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Abstract

Introduction

Physical activity (PA) protects the cardiovascular system and reduces the risk of stroke recurrence. However, most stroke survivors have significantly lower daily physical activity levels than those recommended. Adapted PA programmes provide a useful means of increasing the daily physical activity levels of this population. PA programmes designed to encourage people walking have been found to be more effective than no intervention. Some programmes have been applied in institutional settings while others are done on an independent basis. The aim of this study will be to compare the two methods in terms of their impact on the daily walking rates of subjects with spastic hemiparesis following a chronic stroke. Secondary outcomes will include effects on walking ability, endurance, balance, quality of life, and motivation for exercise.

Methods and analysis

This French single-centre randomized (1:1), controlled, two-arm, parallel, single-blind study will include 40 adults with chronic stroke spastic hemiparesis who are able to walk for 6 minutes. The primary outcome will be the participants' daily activity measured via the number of steps performed per day using a Stepwatch™ device. We expect to establish that the institution-based programme will be more effective than a self-managed programme as a means of increasing the physical activity of chronic stroke subjects.

Ethics and dissemination

The protocol was approved by an independent National Ethics Committee (Comité de Protection des personnes Est IV). Participants will be asked to provide their signed informed consent prior to the study. The results will be disseminated via publications in the scientific literature, oral and poster presentations by partners at international scientific meetings and associations of patients.

Trial registration

ClinicalTrials.gov, NCT06061770.

Strengths and limitations of this study

- Randomised controlled trial to compare an institution-based adapted physical activity programme with a home-based self-management programme in chronic post-stroke adults.
- Adapted physical activity programmes designed to meet the recommendations for physical activity after stroke.
- Reliability and reproducibility of the Stepwatch assessments.
- Evaluator blided from the intervention, but no double-blinding, which is not possible in this context.
- No assesment of the long-term effects.

Keywords: stroke, rehabilitation, Adapted Physical Activity, institution-based, home-based, step count

Abbreviations:
PA: Physical activity
APA: Adapted Physical Activity
6MWT: 6 Meter Walk Test
W: Week

INTRODUCTION

Stroke is a major public health concern, not only due to its high annual mortality rate (estimated at 5.5 million individuals per year), but also because of its significant morbidity rate. It is estimated that 50% of surviving stroke individuals are permanently disabled[1], making it the leading cause of acquired motor disability in adults[2]. The consequences of stroke include medical complications, greater functional impairment, psychological disorders and musculoskeletal problems[3]-[4]-[5]-[6]. Loss of motor skills is one of the most common complaints of stroke survivors. Stroke is responsible for gait disorders in 75% of survivors[7]. Interestingly, the incidence rate of stroke includes a high recurrence rate approaching 25%, as reported in a recent study in the USA[8]. The Interstroke study published in 2016, conducted in 32 countries, identified 10 modifiable risk factors which need to be included in stroke prevention strategies. Physical activity (PA) was found to be a protective factor against stroke, with an OR of 0.58 in men and 0.65 in women[9]-[10]. ¨The identification of modifiable risk factors can facilitate the improvement of prevention strategies, which represent one of the main objectives of the 2018-2030 European Stroke Prevention Plan[11]. In this population, the American Stroke and Heart Association recommends that individuals engages in 20 to 60 minutes of aerobic activity three to five days a week and muscle-strengthening and stretching exercises two to three days a week in order to prevent cardiovascular disease and stroke recurrence[12]. However, the level of daily PA in chronic stroke individuals appears to be significantly below the recommended guidelines[13]. It is worth noting that the most frequently cited barriers to participation in PA among post-stroke individuals are not solely physical such as musculoskeletal disorders, obesity or joint pain. Rather, environmental difficulties including access, transport, and cost, as well as lack of motivation and fear of relapse, also play an important role[12]. Adapted Physical Activity (APA) programmes could be developed to address some of these barriers.

Walking is an accessible and cost-effective method of increasing PA and preventing chronic diseases[14]. One of the main parameters used in the literature to assess PA programmes has been walking ability based on the 6-minute walk test (6MWT). Although the results of 6MWT and daily step counts are closely linked, the former test explains only about 50% of the variability observed in walking in real-life situations[15]-[16]. Other factors have been reported in the literature to influence the PA of individuals in the chronic stroke phase, including intrinsic factors such as age, PA before stroke onset, the presence of cognitive disorders[17], motivation and anxiety[18]. On the other hand, extrinsic factors such as the physical and social environment have been found to account for about 10% of the variability observed in walking in real-life situations[19]. The meta-analysis published by Lee et al.[**20]** has suggested that walking ability improves more in supervised programmes than in

autonomous programs. However, no studies have been published so far to our knowledge in which the effects of a home-based APA programme are compared with those of a supervised institution-based APA.

The objective of this study was therefore to compare the effectiveness of an institution-based APA programme versus with that of a home-based programme in increasing the daily PA of chronic stroke individuals, by measuring step counts using a dedicated device. The most original contributions of this study is the comparison made between two types of PA programmes (institution and home-based), based on the ecological assessment criterion consisting of changes in the number of steps performed per day. On the other hand, it presents PA programmes that have been specially designed to enhance the daily PA rates of post-stroke individuals, particularly in relation to their walking abilities. These programs, which have been developed in accordance with the latest international recommendations[20]-[21], include detailed descriptions that align with the guidelines published by Slade et al.[22].

METHODS AND ANALYSIS

Study design and setting

This randomised, controlled, two-parallel-armed, single-blinded study was designed to compare the efficacy of an institution-based and a home-based APA programme, in terms of their ability to increase the daily PA of chronic stroke individuals. This is a single-centre study which will take place in Marseille, France. The primary objective of this study will be to assess the effects of a supervised institution-based PA programme versus those of a home-based self-managed programme on the daily walking rates of chronic post-stroke subjects with spastic hemiparesis. The secondary objectives will be to study the effects on walking ability, endurance, balance, quality of life and motivation for exercise. Primary and secondary endpoints will be assessed by an operator blinded to subject status. The single-blind design which is part of the APA protocol is not feasible in a blinded setting. For ethical reasons, participants will be permitted to pursue their usual medical follow-up and physiotherapy without any restrictions.

Eligibility criteria

Subjects aged 18 years or above with left or right spastic hemiparesis resulting from their first unilateral haemorrhagic or ischemic stroke which occurred more than 6 months previously, and who are able to walk for 6 minutes with or without technical assistance, will be eligible for inclusion. The exclusion criteria will include the inability to walk without human assistance (with or without an assistive device), cognitive impairments preventing informed consent, especially the inability to understand the aims of the study and the methods involved or the inability to communicate with the investigators. The presence of any other neurological disorder or pathology contraindicating PA (such as cardiovascular or respiratory disease, in particular) is another criterion for non-inclusion. Subjects must not be participating in any other clinical research project concurrently. In the event of any adverse event necessitating protocol interruption (e.g., fracture, cardio-respiratory failure, etc.), subject participation will be discontinued.

Design of the StrokAPA protocol

The present study will compare two APA programs. Subjects will be randomly assigned to one of two groups. Subjects will be randomly assigned to one of two groups on Day 0. Group 1 will participate in the APA programme at the rehabilitation centre from Week 1 to Week 12, while Group 2 will engage in a home-based self-management programme. Group 2 will conclude the study at Week 13, after which they will participate in a compensatory APA programme at the rehabilitation centre. Group 1 will continue with the home-based self-management programme from W14 to W25. These programmes will be supervised (in person or remotely) by an APA teacher dedicated to each programme.

A two-arm parallel design will be used with a view to comparing the two APA protocols. The primary endpoint, which has been selected in order to meet the primary objective, will be assessed at W13 in the case of both groups. The addition of a home-based self-management APA programme after the institution-based programme for Group 1 will serve to address a secondary question regarding the comparative efficacy of the home-based self-management programme in isolation or subsequent to the institution-based programme. For ethical reasons and to enhance recruitment, all post-stroke individuals enrolled in group 2 will benefit from both

types of APA, as they will be able to participate in the institution-based programme as part of routine care, after completing the self-directed program. The detailed protocols are described in the **Supplementary material 1.**

Institution-based APA programme

The programme will be implemented as part of routine care at the rehabilitation centre. It consists of 3 sessions of APA per week (Mondays, Wednesdays and Fridays) for 12 weeks. Each session will consist of 2 x 60-minute APA sessions. The entire programme was designed to meet the recommendations for PA after stroke[21]. Each session will include 45 minutes of actual work and 15 minutes devoted to set-up measures. The programme will be supervised by an APA instructor, who will provide participants with feedback and adapt the exercises to each individual's limitations. At the beginning of each week, a group meeting will be held to take an inventory of each participant's PA for the week.

Home-based self-management APA program

The APA home-based self-management programme will be based on detailed exercise cards presenting yoga, Pilates and walking activities. Subjects will be given a booklet of detailed cards with photographs. The main aim of the adapted yoga exercises presented in the booklet is to stretch all four limbs and the trunk. The booklet presents the yoga session used in the institution-based programme. The focus here is on the physical sensation of stretching and working without pain. The Adapted Pilates exercise booklet focuses on general motor strengthening. It presents the Pilates session used in the institution-based programme.

Since the objective is to effectively promote PA in chronic stroke individuals, subjects are encouraged in all these programmes to engage in PAs of their choice, even in activities other than those proposed, and to record them in the registry.

Time schedule

The study will run for 25 weeks with subjects enrolled in Group 1 and 13 weeks with those in Group 2, with an additional 12 weeks of participation in the compensatory institution-based APA program, as a routine care. The flow chart of the study is presented in **Figure 1**. The study has not yet commenced, but enrolment is scheduled to begin in September 2024. The study is expected to last for a period of two years.

Enrolment and initial assessment

The inclusion medical visit will take place on D0 with the objective of verifying that the inclusion and non-inclusion criteria defined above have been met. This medical visit will also permit the initial assessment to be carried out by an operator blinded to the subjects' group.

The enrolment visit is a medical consultation designed to ensure that there are no contraindications to participating in the programme. The visit provides an opportunity for the subject to provide informed consent and for the relevant data to be recorded recording. This includes the subjects' stroke characteristics (cortical or subcortical, ischemic or haemorrhagic), comorbidities, body mass index, stroke severity (NIHSS and injured area if available), the use of any assistive devices, spasticity (modified Ashworth score), pre-stroke sports activities, the presence of depressive syndrome (Individual Health Questionnaire 9), pain VAS and DN4 scale to assess any neuropathic component present and the initial assessment. This visit will also be used to fit the Stepwatch® daily PA measurement monitor (to be worn at least during the subjects' waking hours for the entire duration of their participation in the study on the ankle of the healthy limb), to provide each subject with the notebook to be used for the written report and to record all the PAs performed during and outside the programme.

A simple randomisation procedure will then be employed to assign the subject to one of the two groups, using a computer-generated table of random numbers.

Organization of participant follow-up

Follow-up will involve collecting Stepwatch® data every 3 weeks at the rehabilitation centre, with the individual responsible for data collection being unable to view or alter the data in any way. Given that the programme for Group 1 will be conducted at the rehabilitation centre, data will be collected there during one session at W3, W6 and W9. The home-based self-management programme will involve visits to the rehabilitation centre every 3

weeks, during which Stepwatch® data will be collected at W3, W6 and W9 on group 2 and at W16, W19 and W22 on Group 1. A final evaluation will take place on W13, at the end of the first APA period, by an operator who is blinded to the subjects' status. Group 1 will continue the study on an exploratory basis, using the APA home-based self-management programme until W26, at which point the final assessment of the criteria will be conducted.

Evaluation criteria

In this protocol, the primary outcome will be the subjects' daily activity in terms of the number of steps measured per day, average per week, which will be recorded throughout the entire duration of the study using a Stepwatch™ device. This device has been tested and found to show the greatest accuracy at all the walking speeds and step lengths tested[23]. In order to ensure the accuracy of the data collected, the device has to be worn on the ankle of the unaffected limb at least during the subjects' waking hours throughout their participation in the study.

The Stepwatch® device will be delivered to the subjects with an instruction manual on D0. It will then be calibrated by an investigator using the subject's anthropometric data and a 20-step calibration procedure. Data will be collected at W3, W6, W9 and W13 on both groups and at W16, W19, W22 and W26 on Group 1. These data will be collected by an investigator blinded to subjects' individual status. The comparison between the two groups with regards to the primary endpoint will be performed at W13.

The secondary endpoints will be assessed based on the other tests performed to assess walking ability, endurance (walking test 6 minutes and Borg Rating Scale of Exertion), balance (Berg Balance Scale and Activity-specific Balanced Confidence scale), quality of life (Stroke Specific Quality of Life) and motivation for exercise (Behavioural regulation in exercise questionnaire 2).

A written report on the PAs performed by each subject (types of PA and duration) will be recorded by the subjects themselves in a diary distributed at baseline.

The 6MWT will be used to assess subjects' walking ability. Heart rate and systolic blood pressure will be measured at rest and after the 6-minute walk test. Subjects will complete various assessments and questionnaires. The Borg Rating Scale of Exertion[24] will be employed to assess the subjects' perception of their exertion following the 6MWT on a scale ranging from zero to maximum. The Stroke Specific Quality of Life[25] scale will be used to evaluate subjects' quality of life. This scale contains several sub-sections including autonomy, social relationships and character. Subjects will be asked to rate their difficulty in performing an activity or how far they agree with a statement on a scale of 1 to 5. The Berg Balance Scale[26]-[27] will be used to assess subjects' balance by rating their ability to perform each of the 14 items from 0 to 4. The Activity-specific Balanced Confidence Scale[28] will be used to assess subjects' confidence in their balance. Subjects are asked to rate from their confidence in their balance from 0 to 100% in response to 16 situations. Finally, the Behavioural Regulation in Exercise Questionnaire2[29] will be used to quantify participants' motivation to perform exercises of 24 kinds, which they will be asked to rate between 1 and 7.

Statistical aspects

Sample size calculations

Assuming the existence of a difference of 1000 steps between the endpoints, a standard deviation of 1500 [30], a 5% risk of the first type and a power of 80%, it would be appropriate to include 28 subjects per group, making a total number of 56 subjects. The present study will include 40 subjects, which will make it possible to specify the precision of the indicators with a power of 70%. The randomisation ratio will be 1:1 in this study.

Statistical analysis

Data analysis will be performed by the statistician under the responsibility of the methodologist, using SPSS version 17.0 under Windows. The significance level will be set at 0.05. No interim analyses have been planned. The analysis will be blinded, i.e. the statistician will know nothing about the identity of the groups and will initially present the results anonymously to the coordinating investigator and the other investigators. Once the statistical analysis has been completed, the identity of the groups will be revealed.

The methodological and analytical plan will be based on the criteria presented in the Consolidated Standards of Reporting Trials Statement (CONSORT, http:// www.consort-statement.org/consort-statement/).

Patient and public involvement

The implementation of the institution-based APA protocol, as part of routine care, has been adapted on the basis of feedback from patients participating in this program.

ETHICS AND DISSEMINATION

Informed consent and data management

This clinical trial will be conducted in accordance with the Helsinki Declaration. Subjects will be pre-selected from among those attending our Physical Medicine and Rehabilitation Department, and eligible subjects will be contacted by the investigators. Participants will be asked to give their signed informed consent prior to the study (**Supplementary material 2).**

The data obtained in this study will be processed by the Clinical Data Manager at the AP-HM Health Research Department, in line with the French legislation. Data will be recorded using an electronic case report form developed using open-source web-based software, namely the REDCap application.

Ethics approval and trial registration

The protocol used in this study was approved on May 2, 2023 by an independent National Ethics Committee (Comité de Protection des personnes Est IV) under the number 23.00588.000168 and registered in the clinicaltrial.gov registry: NCT06061770. The manuscript meets the requirements of the SPIRIT guidelines for reporting protocols.

Dissemination

The results will be disseminated via publications in the scientific literature, oral and poster presentations by partners at international scientific meetings, wide-audience media outlet and associations of patients and their families.

DISCUSSION

It is well established that PA is a factor preventing stroke relapse. The daily PA rates of chronic stroke individuals are known to be significantly lower than those recommended by the international health authorities. Consequently, increasing PA in individuals after stroke remains a significant challenge.

The initial rehabilitation management includes early mobilisation and upright positioning in physiotherapy programmes. Moore et al. have reported that an intensive walking PA programme significantly improved the daily walking rates of the post-stroke subject's studied[30]. APA can be employed in the rehabilitation process for individuals after stroke[31]. It helps to maintain their independence, reduces the risk of recurrence and favours their social reintegration when applied in a group setting[32]. APA programmes, which are often carried out as an adjunct to rehabilitation care for a period of 3 to 12 months, constitute a whole stage in the post-stroke recovery process[32]. The duration of these programmes appears to be a significant factor in enabling subjects to increase their activity levels. A meta-analysis conducted by Lee et al. in 2020 demonstrated that programmes lasting at least 12 weeks had significantly greater effects on muscle strength and walking ability than those lasting for shorter periods[20]. The latter authors proposed that the duration of these exercise programmes contributes importantly to inducing physiological adaptations that improve individuals' walking ability.

The StrokAPA protocol may provide an effective approach to encouraging post-stroke individuals to increase their PA. It is noteworthy that the majority of the studies establishing the effectiveness of APA programmes as means of increasing daily walking are based on direct gait training or at least on incentives to walk**[30]-[33].** Moore et al. observed an increase of approximately 24% in participants' daily step count after applying an institution-based APA programme in a conventional rehabilitation setting, where they had reached a recovery plateau**[30]**. The Danks study**[33]** was a home-based self-management programme that included motivational interviews encouraging subjects to walk with daily step count goals and the use of a pedometer as a feedback. The step rates increased significantly from an average number of 5205 to 6372 steps per day. Moore's study was based on the use of an institution-based supervised PA programme, while Danks' study was based on a home-based self-management programme with motivational interviewing and the testing of the use of a pedometer as a feedback tool. Both types of programmes were found to have beneficial effects on PA in ecological settings, since they increased the number of daily steps taken by individuals with stroke sequelae. The meta-analysis published by Lee et al.[20] has indicated that supervised programmes tend to result in greater

improvements in walking ability than self-directed programmes. However, to the best of our knowledge, no studies have yet been published that directly compare the effects of a home-based unsupervised APA programme with those of a supervised institution-based APA programme.

The present APA study proposes a comparison of the effects of the institution-based programme versus those of a home-based self-management programme with a view to optimising their use in chronic post-stroke individuals. This project aligns with the spirit of the European Stroke Action Plan 2018-2030, which stresses the lack of PA programmes catering for stroke survivors. The objective of the latter Action Plan is to make PA programmes accessible to all stroke survivors[11]. A recent meta-analysis has demonstrated that participation in a supervised programme combining motor strengthening and aerobic exercise is an effective strategy for promoting individuals' participation in physical activity and improving their cardiorespiratory fitness, muscle strength and walking ability[20].

Ultimately, we have several aims. First, to establish the value of an institution-based APA programme for chronic post-stroke individuals. The main advantages of our programme include the fact that it requires only a straightforward medical examination to ascertain for contraindications and that it can be carried out in conjunction with APA instructors, as it could be done in a centre dedicated to physical activity. The results obtained here could be of great importance on several levels. For individuals and their families, it would reinforce the feasibility and the interest in programmes of this kind thereby improving individuals' walking performances in their everyday lives. At present, the daily PA rates of individuals in the chronic stroke phase are known to be well below the international recommendations[13], and a programme of this kind could greatly improve this situation. From the perspective of the healthcare system, the results of this study could constitute a further step towards optimising the management of individuals with chronic post-stroke sequelae. Furthermore, the implementation of an institution-based APA programme would also enable individuals who have suffered from a stroke to interact with people in similar situations. PA helps to maintain independence, reduce the risk of recurrence and encourage social reintegration if practiced in a group[32]. This promotes interactions and inter-group emulation, which is conducive to motivation for PA and promotes the pursuit of PA at the end of the programme. Adapted group physical activity can also have disadvantages, such as the risk of exercising at the intensity of the least active participant, thus minimising the benefits for most participants. Conversely, the intensity of the exercise may be too high, increasing dropout rates. To avoid these issues, our group programme is supervised by an APA professional who ensures that the exercise proposed is appropriate for each participant and can adjust it if necessary.

Conversely, the implementation of an institution-based programme prior to a self-managed programme seems likely to result in sustained PA rates in chronic stroke individuals, thus increasing the effectiveness of the self-managed programme. This would increase the value of generalising programmes of this kind so as to lead post-stroke individuals to increase their PA rates, which could then be maintained independently, requiring only periodic follow-up visits. Consequently, it would be worth conducting a medico-economic study on the benefits of such programmes in reducing disability and secondary complications in a population of chronic post-stroke individuals. In fact, the aim of such programmes of this kind would be to enable individuals to modify their lifestyles by including regular PA, thus reducing the risk of recurrence, which would naturally also reduce public health costs.

Walking appears to be an accessible and beneficial form of PA that prevent chronic diseases[14]. One of the most innovative aspects of this study is that it involves assessments that are as similar as possible to what individuals often do in real life, namely measuring the number of daily steps they take, in this case, using the Stepwatch. The authors of some recent studies have used this method[30]-[33]-[34] to measure the number of steps taken per day. The results obtained with this device have been found to show particularly good reliability and reproducibility, regardless of the wearers' stride speed and stride length[23]. Therefore, the Stepwatch can be considered a reliable and reproducible ecological means of assessing the effectiveness of PA programs[13]. Nevertheless, the selection of primary outcome measures obtained via technology and not through standardised clinical scales may be open to question, given that it could be susceptible to issues of poor reliability and replicability across studies. To address this, standard clinical tests were incorporated as secondary objectives.

One of the principal limitations of the present study is the absence of double-blinding, despite the inherent difficulties in achieving this in studies of this kind. We have attempted to mitigate bias by ensuring that the assessor was unaware of the subjects' status.

The potential for underuse or misuse of the Stepwatch device represents a risk inherent to this study. Any issues with the device would be addressed during the scheduled visits for the group undergoing rehabilitation

at the centre, as well as during the interviews scheduled every three weeks for the group undergoing rehabilitation at home. Additionally, participants can contact the provided telephone number if they encounter any problems.

All participants are authorised to continue physiotherapy rehabilitation. The intention is that APA should be carried out in addition to the usual rehabilitation for stabilised patients. The objective is to study stabilised patients in their ecological conditions, without modifying them. The two groups will be comparable on this point.

Another limitation is that there was no provision for long-term assessments of the impact of the programme. It would certainly be of interest to conduct a study on the long-term effects, as well as on the medico-economic benefits of programmes of this kind.

This study represents a significant contribution to the field of physical activity (PA) research, as it presents a novel comparison between the efficacy of two distinct types of PA programs: institution-based versus home-based self-management. The study's findings will provide valuable insights into the impact of these programmes on the daily lives of individuals with chronic post-stroke conditions. The findings of this study will corroborate the efficacy of the physical activity programs recommended in the 2018-2030 European Stroke Action Plan.

Funding: This project was funded by a grant from Assistance Publique des Hôpitaux de Marseille (AAP Jeune Chercheurs 2021). The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Contributors: Conceptualization: MC, LB; methodology: MC, LB, PA; writing—original draft preparation: ES, MC; writing—review and editing: MC, LC, JMV, NPB supervision: MC, LB, JMV; project administration: ES, MC, LB, JMV, NPB; funding acquisition: MC, LB. All authors have read and agreed to the published version of the manuscript. MC is responsible for the overall content of this article.

Acknowledgements: This study is sponsored by Assistance Publique – Hôpitaux de Marseille (DRCI). The authors thanks the rehabilitation teams for their invaluable assistance and Mrs. Jessica Blanc for her English writing correction.

Competing interests: The authors declare no competing interests.

Data availability statement: Individual participant data may be shared after completion and reporting of the study results and after data de-identification, for researchers who provide a methodologically sound proposal. Proposals should be sent to Maëva Cotinat (maeva.cotinat@ap-hm.fr).

Supplementary material

Supplementary material 1. Detailed APA protocol

Supplementary material 2. Participant consent form

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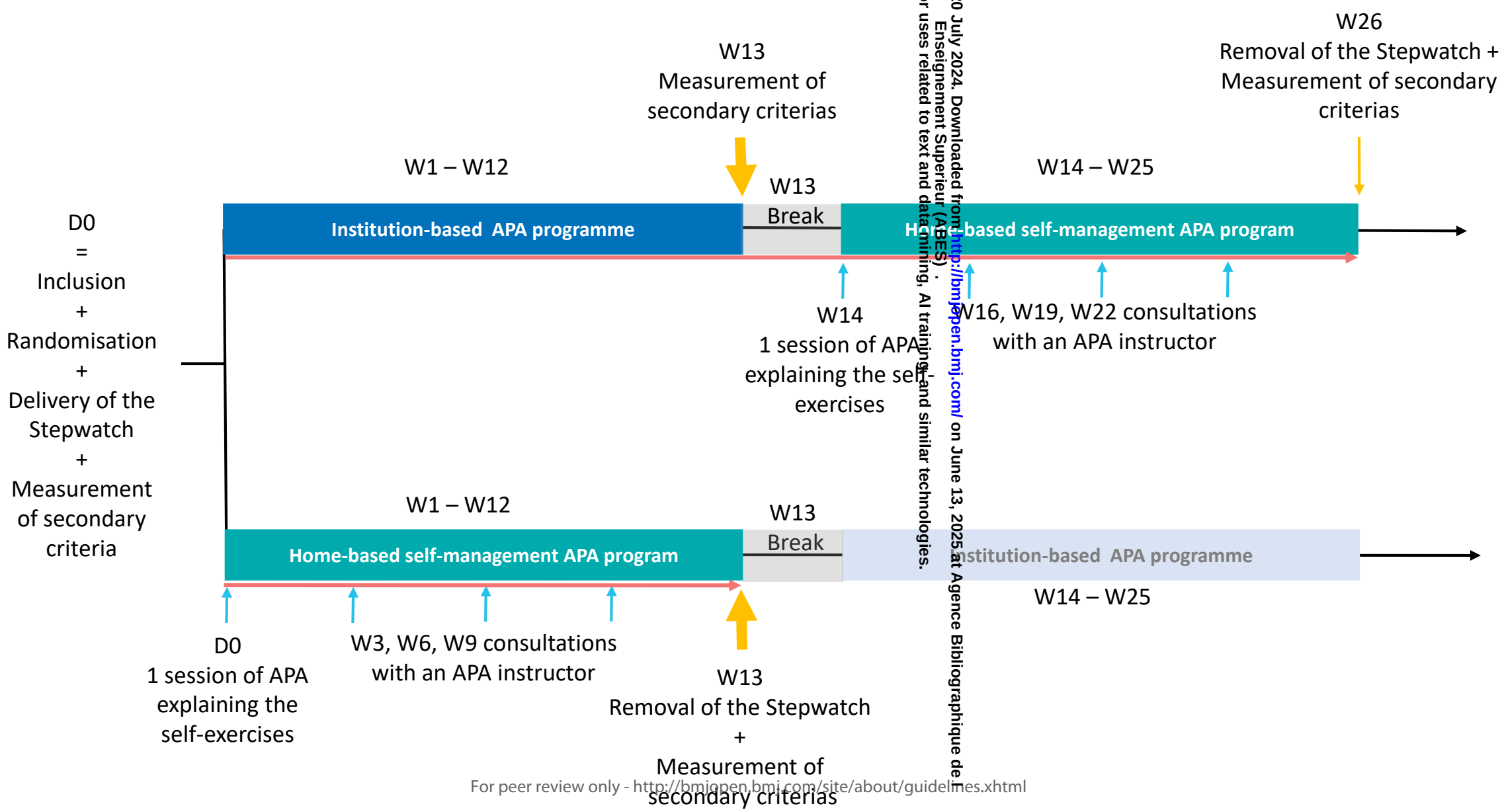
Figure title/legend

Figure 1. Study schedule. The red arrows indicate the measurement of the primary endpoint, while the yellow arrows represent the measurement of the secondary endpoints.



Supplementary material 1. Detailed APA protocol

A. Structure of the APA program

The program will be applied as part of routine care at the rehabilitation center. It consists of 3 sessions of APA per week for 12 weeks. Each session will consist of 2 x 60-minute APA sessions. The entire program was designed to meet the recommendations for PA after stroke**[21]**. Each session will include 45 minutes of actual work and 15 minutes devoted to set-up measures. It will be supervised by an APA instructor providing participants with feedback and adapting the exercises to the limitations of each one. At the beginning of each week, a group meeting will be held to take an inventory of each participant's PA for the week. The goal is to encourage the group to increase their walking time outside of the program. Participants will be encouraged to increase their walking time by approximately 25% per week. If the participant's weekly goal was met, the participant will be encouraged to increase activity by 25% of the weekly average time until 1 hour of walking per day is achieved, and then the goal will be to consistently achieve 1 hour of walking per day. If participants did not meet their weekly goal, the goal remained the same.

The activities practiced in this program will be yoga, Pilates, outdoor walking, zumba, Molkky® and aquagym. The plan for each session was designed in advance based on the Consensus on Exercise Reporting Template**[22]** criteria. The same plan was used throughout the sessions with a view to helping the individuals to learn the gestures:

- The main aim of the Adapted yoga session is to stretch all four limbs and the trunk. It consists of 8 poses, each of which targets a specific muscle or muscle group and is held for 3 minutes. The focus is on the body's sense of stretch and working without pain.

- The main aim of the Adapted Pilates session is to improve muscle strength. It consists of 12 movements performed in series of 10 repetitions, the last 3 of which depend on how tired the muscles feel.

- The main aim of the outdoor walking session is to improve walking ability. The course alternates between flat ground (asphalt), uneven ground (potholes, puddles, gravel, grass) and a 20% incline/slope. The session includes 5 minutes of acceleration to maximum walking speed on level ground, subdivided into 10 x 30 seconds with a 5-minute interval between each acceleration. During the 5-minute intervals between each acceleration, a spontaneous speed walk is performed. The APA instructor can change the walking speed, pause times and acceleration times.

- The main aim of the Adapted Zumba session is to work on endurance in a fun way with a series of choreographed, rhythmic movements set to music.

- A session devoted to a throwing game, Molkky®, is intended to improve balance, coordination and cognition via a fun throwing activity. The activity is carried out outdoors on sandy ground in teams of 2. This activity promotes sociability and creates cohesion within the group of subjects.

- The Aquagym session is designed to improve muscle strength, balance and walking under reduced gravity conditions. The session consists of abdominal exercises (3 sets of 10 repetitions), quadriceps exercises (3 sets of 10 repetitions), balancing exercises on one foot (5 minutes per leg) and walking exercises (15 minutes).

B. APA home-based self-management program

The main aim of the outdoor walking exercise booklet is to optimize walking skills. The session includes 5 minutes of acceleration to maximum walking speed on level ground,

subdivided into 10 x 30 seconds with a 5-minute interval between each acceleration. A face-to-face consultation with an APA instructor is scheduled on the first day of the program, and during weeks 3, 6 and 9 of the self-management program. These visits provide subjects with motivational follow-up, as well as meeting the technical memory constraints of the Stepwatch™ device, which can be used to make continuous recordings during approximately 3 weeks. On the first day, an APA session is scheduled to teach yoga exercises tailored to the state of the participants. The 6-week visit also includes an APA session, with additional materials included to enrich the program with the adapted Pilates booklet. Visits at weeks 3 and 9 will include a motivational interview with an APA instructor based on the subject's written report on the exercises performed.

Patient information guide

Comparison of the effectiveness of an adapted physical activity programme in a structure with a self-programme in patients in the chronic phase of a stroke : StrokAPA

Sponsor: AP-HM (Assistance Publique Hôpitaux de Marseille)
Direction de la Recherche Santé et Maladies Rares - 80 rue Brochier - 13 354 Marseille Cedex 5 - France

Coordinating investigator: Dr COTINAT - Pr VITON's PRM Department - Address: Hôpital Sainte Marguerite, 270 Boulevard Sainte Marguerite, MARSEILLE, 13009 Tel: 04 91 74 42 48

Dear Sir/Madam

Dr / P r _____ has asked you to take part in a study entitled "**Comparison of the effectiveness of an adapted physical activity programme in a dedicated structure with a self-programme in patients in the chronic phase of a stroke".**
Assistance Publique des Hôpitaux de Marseille is the promoter of this research and will ensure that it runs smoothly.

In accordance with Law 2012-300 of 5 March 2012 on research involving the human person (known as the Jardé Law) / Public Health Code; Title II of Book 1 on research involving the human person, we ask you to read this information leaflet carefully, which is intended to answer any questions you may have, before deciding whether or not to take part in this research.
Don't hesitate to ask questions if anything is unclear or if you would like further information.

Context

Stroke is the leading cause of acquired motor disability in adults. Physical activity is a cardiovascular protective factor and reduces the risk of stroke recurrence. However, daily physical activity levels in patients with stroke sequelae are well below international recommendations. The creation of adapted physical activity programmes is an interesting option for these patients, with the aim of increasing their daily physical activity. Some programmes are carried out in a facility, others independently. We propose to compare the effectiveness of these two methods.

Aims of the study

The aim of this study is to compare the practice of an adapted physical activity programme in a dedicated facility with a self-programme carried out at home. The secondary objectives will be to study patients' walking ability, endurance, balance, quality of life and motivation to engage in physical activity.

This could increase the interest in adapted physical activity, which is still underdeveloped in France. One of the main advantages of our programme is that it requires only a medical examination to ensure that there are no contraindications, and can be carried out in association with adapted physical activity teachers. This study could have several effects: for you and your family, it would reinforce the practical feasibility and interest of this type of programme, by enabling you to make gains in walking in everyday life. From the point of view of the healthcare system, the results of our pilot study could constitute a further step towards optimising the care of people suffering the after-effects of a stroke.

Conduct of the study

Your participation in the study consists of :
Participation in an adapted physical activity programme in a dedicated facility and in an independent programme, as well as wearing a pedometer (Stepwatch) on the ankle of the non-affected limb for the duration of your participation in the study. The order of these programmes will depend on the group to which you belong. The group will be allocated to you by chance.

Your participation will begin with an inclusion medical visit to ensure that there are no contraindications to your taking part in the adapted physical activity programmes.
After this visit, you will be assigned to a group according to a random allocation.
Group 1 will take part in the study for 26 weeks. They will start with the structured programme for 12 weeks, then after a 1-week break, they will begin the independent physical activity programme for 12 weeks.
Group 2 will take part in the study for 13 weeks. It will start with the programme of physical activity in autonomy for 12 weeks, then after a 1-week break, it will start the programme in a dedicated structure, outside the study, in a compensatory manner. This programme in a dedicated structure, taking place outside the study, will not be covered by the research insurance but by the institution's insurance.

The supervised programme is carried out at the Institut Universitaire de Réadaptation de Valmante Sud, with 3 sessions a week of adapted physical activity.
The self-programme includes consultations with an adapted physical activity teacher every 3 weeks at Hôpital Sainte Marguerite to keep you motivated and answer any questions you may have.

The pedometer ™ data is collected every 3 weeks, during the consultations scheduled in the 2 programmes.
Walking ability, endurance, balance, perceived quality of life and motivation to engage in physical activity were assessed at the inclusion visit and at a visit at 13 weeks in both groups. ème A final consultation is scheduled in group 1 at 26 weeks for a final assessment.

Benefits, risks and constraints associated with taking part in this research

Expected benefits

- For you: The aim of your participation is to enable you to increase your daily physical activity and improve your walking, endurance and balance, as well as increasing your motivation to engage in physical activity. The long-term aim is to improve your quality of life.
  Regular physical activity also reduces the risk of a stroke recurring.
- For the company: The results of our pilot study could be a further step towards optimising care for people suffering after-effects of an accident.
  the feasibility and effectiveness of a programme of physical activity for the treatment of stroke.
  The only requirements are a medical consultation to ensure that there are no contraindications and follow-up by an adapted physical activity teacher.

Foreseeable risks and constraints

The risks associated with this study are not significant:

- Your participation will require your personal time to take part in adapted physical activity programmes,
- During tests and adapted physical activity, the risks of falls and injuries remain,
- As the aim of this study is to increase your physical activity, it is possible that participation in this study may result in fatigue after the adapted physical activity sessions.
- Your participation means that you will have to wear the Stepwatch pedometer every day, around the ankle of your non-affected lower limb, without any additional risk.

Compensation - payment of study costs

- At the end of your participation in the study, you will receive an allowance of *€100.* to compensate for the constraints suffered.

- In accordance with current regulations, you are hereby informed that the maximum amount of compensation received over a 12-month period by a person participating in biomedical research is set at €4,500.

Reflection period

You have between 1 and 7 days to decide whether or not to take part.

Legal and ethical aspects

You may refuse to give your authorisation. This refusal will have no impact on the quality of care you receive.

This project falls within the scope of research involving the human person involving minimal risks and constraints (category 2), within the meaning of article L.1121-1 paragraph 1, of the Public Health Code.

It is subject to the regulations that apply to research "involving the human person".
"These include Law no. 2012-300 of 5 March 2012 on research involving the human person (known as the Jardé Law), as amended by Order no. 2016-800 of 16 June 2016, and its implementing decrees.

This study received a favourable opinion from the Est IV Committee for the Protection of Individuals on 02/05/2023.

This research is conducted in accordance with the reference methodology MR 001 approved by the Commission Nationale de l'Informatique et des Libertés (CNIL) on 13 July 2018 and with which Assistance Publique - Hôpitaux de Marseille has undertaken to comply (Récépissé n°2205999 v 0 of 30 August 2018).

In accordance with the law, the APHM, the promoter of this research, has taken out insurance with SHAM (18 rue Edouard Rochet 69372 LYON Cedex 08 - +33 (0)4 72 75 50 25) under the number policy number 166 005.

As part of this study, your personal data will be processed to enable the results of the research to be analysed in the light of the objective presented to you.

This data processing is based on the performance of a task in the public interest entrusted to the data controller (article 6.1.e of the RGPD) and the exemption to process health data for scientific research purposes (art.9 RGPD).

All personal information collected throughout the study will be treated as confidential. All study data concerning you will be pseudonymised. You will be given a code number. This will be used to identify you and any personal information without having to use your name, medical record number or other common identifiers. Your data will remain strictly confidential and may only be consulted by the medical team, persons duly authorised by the sponsor and, if necessary, by representatives of the Competent Authorities.

The demographic data (sex and age) and clinical data (weight, height and previous and current treatments) concerning you, required for this research, will be processed electronically by the research organisers.

This computerised processing is under the responsibility of the data controller: Assistance Publique Hôpitaux de Marseille (80 rue Brochier, 13354 Marseille Cedex 5 - Tel: 04 91 38 00 00), represented by its legal representative in office.

It will be carried out in accordance with the provisions of law no. 78-17 of 6 January 1978 on data processing, data files and individual liberties.

Data collected as part of this research will not be transferred to countries outside the European Economic Area (EEA).

Further studies :

The data collected during this research will be used for research purposes. At the end of the study, unless you object, we would like to keep the data so that it can be re-used for other studies on adapted physical activity programmes for patients in the chronic phase of a stroke, for a period of 15 years.

You will be informed of these new studies via the APHM website: http://fr.ap-hm.fr. Your

personal data will be kept for 15 years after the end of the research.

Pursuant to Act no. 78-17 of 6 January 1978, amended on 12 December 2018, on Data Processing, Data Files and Individual Liberties (Title II "Processing covered by the personal data protection regime provided for by Regulation (EU) 2016/679 of 27 April 2016"; Chapter II "Rights of the data subject") you have :

- a right of access, rectification and deletion of your data collected in the context of this study and likely to be processed, and a right to limit their processing,
- the right to object to the collection, processing and transmission of your data covered by professional secrecy,
- a right to portability: you can ask for your personal data to be returned to you or transferred to a third party where possible.

You may withdraw your consent to the collection and processing of your personal data at any time.

You can exercise these rights by contacting the investigating doctor treating you or the study coordinator, Dr Maeva COTINAT.

If you have any questions or complaints about the processing of your data during this study, you should first contact the doctor treating you in the study, who will be able to direct your request.

In the event of any difficulties in connection with the management of the data collected, you may submit a complaint to the Data Protection Officer at Assistance Publique Hôpitaux de Marseille, by e-mail to dpo@ap-hm.fr.

You may also submit a complaint concerning the way in which your data is processed to the supervisory authority responsible for applying data protection law in France, the Commission Nationale de l'Informatique et des Libertés (CNIL), online via the link: https://www.cnil.fr/fr/webform/adresser-une-plainte or by post to the following address: Commission Nationale de l'Informatique et des Libertés, 3 Place de Fontenoy, TSA 80715, 75334 PARIS CEDEX 07.

The presentation of this data will not allow you to be identified, either directly or indirectly.

These data may be used for scientific publications, but your name or any other element that might identify your participation will not appear.

In accordance with the law (art L1122-1 of the Public Health Code), you may, if you wish, be informed orally of the overall results of this research by contacting the investigating doctor in charge of the study.

The study data and the results of the treatment will be kept for a period of 15 years after the end of the study, on paper or electronically.

Your doctor will keep you informed of any new information or changes concerning the study that may affect your health or your willingness to continue the study.

If you wish, on request, the study doctor will be able to inform you of the overall results of the study, approximately one year after the last patient has completed participation in the study.

Your authorisation does not relieve the sponsor and the investigator of their respective responsibilities.

For further information, to request access to your data, or to obtain the overall results of the study, please contact Dr COTINAT on 04 91 74 42 48 or by e-mail: maeva.cotinat@ap-hm.fr

Thank you for taking the time to read this information letter. If you agree to take part in this research, please date and sign the attached consent form.

To take part in this study, you will need to sign the form below entitled "Consent form".

INFORMED CONSENT FOR PATIENT PARTICIPATION

Comparison of the effectiveness of an adapted physical activity programme in a dedicated structure with a self-programme in patients in the chronic phase of a stroke : StrokAPA

Sponsor: AP-HM (Assistance Publique Hôpitaux de Marseille)
Direction de la Recherche Santé et Maladies Rares - 80 rue Brochier - 13 354 Marseille Cedex 5 - France

Coordinating investigator: Dr COTINAT - Pr VITON's PRM Department - Address: Hôpital Sainte Marguerite, 270 Boulevard Sainte Marguerite, MARSEILLE, 13009 Tel: 04 91 74 42 48

I, the undersigned, ...*(name, first name)*, who is due to receive treatment for my illness, declares :

1. Having freely agreed to take part in the study entitled **"Comparison of the effectiveness of an adapted physical activity programme in a dedicated structure with a self-programme in patients in the chronic phase of a cerebrovascular accident: StrokAPA",** without this releasing the organisers of the research from their responsibilities,
2. Have understood that if I agree to take part in this research, I must sign this document,
3. Have understood that signing the consent form does not relieve the sponsor and the investigator of their respective responsibilities.
4. I certify that I am over 18 and that I am not under any legal protection (guardianship, curatorship, safeguard of justice),
5. I understand that I have a period of reflection between the time I receive the information and the time I sign this document,
6. I have been informed that I may withdraw my agreement to participate at any time, without justification and without any prejudice to me,
7. I have been informed that I retain all my rights guaranteed by Law 2012-300 of 5 March 2012 on research involving the human person (known as the Jardé Law) / Public Health Code, Title II of Book 1 on research involving the human person,
8. Have been informed that this research has received a favourable opinion from the Comité de Protection des Personnes Est IV dated 02/05/2023.
9. Have been informed of the purpose, progress, advantages and disadvantages of this research, and that it will be carried out in accordance with Good Clinical Practice as defined in the Official Bulletin published by the Ministry of Social Affairs and Employment,
10. To have been able to ask all the questions I wanted and to have received appropriate answers that I clearly understood, and to have noted that I could add to this information throughout the study by contacting Dr COTINAT, coordinating investigator (**04 91 74 42 48**),

11. Have been informed that the Promoter of this study is the APHM and that, in accordance with the law, the APHM has taken out insurance with SHAM under number 166.005,
12. I have been informed of the use of pseudonymised data concerning me, collected as part of this research by computer processing. The presentation of the results of the study will not enable me to be identified, either directly or indirectly (Act no. 78-17 of 6 January 1978, as amended, relating to information technology, files and civil liberties),
13. Have been informed that this data may only be consulted by the study investigators and the sponsor or by persons authorised by the sponsor and bound by professional secrecy, or by persons authorised by the administrative, health and legal authorities,
14. I have been informed that I may, if I wish, access this data, check it and request changes if necessary, in accordance with the law in force (Law no. 78-17 of 6 January 1978, as amended, relating to information technology, files and civil liberties),
15. Have noted that any new information arising during the course of the study, which could affect my participation, will be communicated to me as soon as possible,
16. Have understood that the sponsor, or the coordinating investigator, may decide to stop the study at any time,
17. I have been informed that the overall results of the study may be communicated to me in accordance with Article L1122-1 of the French Public Health Code,
18. Be affiliated to a social security scheme, or be a beneficiary of such a scheme,

I agree to take part in this study under the conditions specified above.

☐ YES N O ☐

I agree that the data collected in the course of this research may be re-used for other studies on adapted physical activity programmes for patients in the chronic phase of a stroke for a period of 15 years.

☐ YES N O ☐

Done at ..... Le .....

Name and signature of subject Name and signature of investigating doctor

If required :

If the patient cannot read or write independently, a third person, completely independent of the investigator and the sponsor, must certify that he/she has read this document to the patient and has obtained his/her agreement to sign on his/her behalf:

Last name : _____ *First name :*

_____

Relationship with the

*patient :*_____

Signature :

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

Section/item	Item No	Description	Reported on page No
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	01
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry.	01,05
	2b	All items from the World Health Organization Trial Registration Data Set All WHO Trial Registration Data requirements are met with the trial's registration in the ClinicalTrials.gov. Trial registration information	01,05
Protocol version	3	Spirit 2013 Guidance Last update: February 28, 2020	
Funding	4	Sources and types of financial, material, and other support	07
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	01
	5b	Name and contact information for the trial sponsor AP-HM, Département de la Recherche Clinique et de l'Innovation (DRCI) 80 Rue Brochier, 13005 Marseille drci@ap-hm.fr	01,07

	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	03
	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)	03
Introduction			
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	02
	6b	Explanation for choice of comparators	02
Objectives	7	Specific objectives or hypotheses	03
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)	03
Methods: Participants, interventions, and outcomes			
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	03-04
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)	03
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	03-04

	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)	04
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)	02
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	03-04
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	04-05
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)	04 / fig 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	05 2.3.1
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	04
Methods: Assignment of interventions (for controlled trials)			
Allocation:			
Sequence generation	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	05
Allocation concealment mechanism	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	05

Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	05
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	04
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	NA
Methods: Data collection, management, and analysis			
Data collection methods	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	04-05
	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 protocol	NA
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	07
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	05
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	NA

	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)	NA
Methods: Monitoring			
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	NA
	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	NA
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	04-05
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	NA
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	07
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)	NA

Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	04
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	NA
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	04,07
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	Title page / 07
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	05
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	NA
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	06
	31b	Authorship eligibility guidelines and any intended use of professional writers	07
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	07
Appendices			
Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	Supplementary material 2

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	NA

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.