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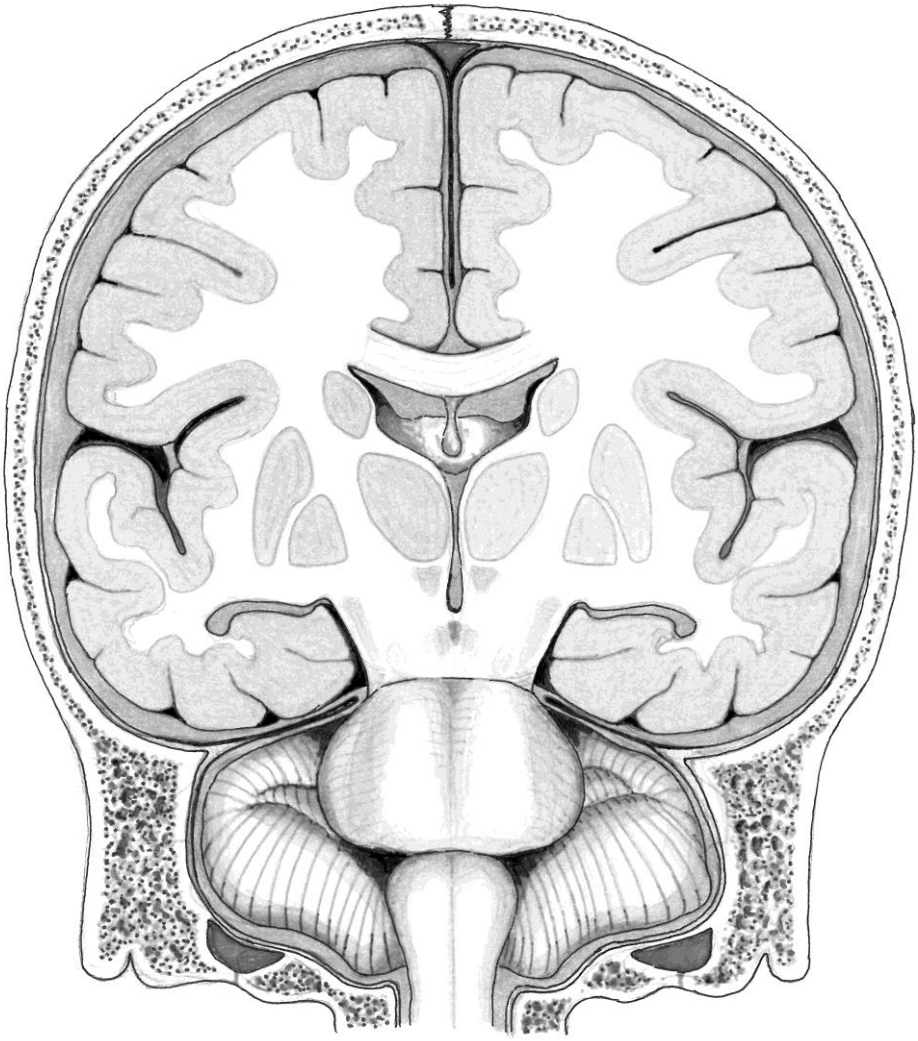

PhD Thesis

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Health behaviour in patients with minor stroke or transient ischemic attacks

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Lists of abbreviations and initials

CCI	Charlson Comorbidity Index
COVID-19	Corona Virus Disease 2019
IPAQ-SF	International Physical Activity Questionnaire - Short Form
IS	Ischemic Stroke
MET	Metabolic Equivalents
MRI	Magnetic resonance imaging
mRS	Modified Rankin Scale
NIHSS	National Institutes of Health Stroke Scale
OR	Odds ratio
PAR	Population attributional risk
RCT	Randomized controlled trial
RR	Risk ratio
SSS	Scandinavian Stroke Scale
TIA	Transient ischemic attacks
WHO	World Health Organization

Initials

DO	Dorthe Overgaard
JL	Jacob Liljehult
MML	Monique Mesot Liljehult
SM	Stig Mølsted
TC	Thomas Christensen
TM	Tom Møller

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Preface

This thesis is based on a research project that was initiated as part of the CIRE neuro/psych research program in collaboration between Nordsjællands Hospital, Hillerød; Copenhagen University College; and The University Hospitals Centre for Health Research UCSF, Copenhagen University Hospital (Rigshospitalet).

The instigators of the CIRE neuro/psych research program consist of researchers and managers from UCSF and Copenhagen University College, in collaboration with the UCSF steering committee consisting of representatives of the hospital managers in Region Hovedstaden.

The UCSF steering committee has initiated the program but has no direct involvement in the design or implementation of the individual studies.

The research project consists of three parts: a systematic review (Study I), a randomised controlled feasibility study (Study II), and a qualitative interview study (Study III).
The following four papers have been published or prepared based on the research project:

Study I

PAPER 1: Jacob Liljehult, Thomas Christensen, Stig Molsted, Dorthe Overgaard, Monique Mesot Liljehult, Tom Møller. Effect and efficacy of lifestyle interventions as secondary prevention. Acta Neurol Scand. 2020 Oct; 142(4): 299-313. Doi: 10.1111/ane.13308. PMID 32620044.

Study II

PAPER 2A: Jacob Liljehult, Stig Molsted, Tom Møller, Dorthe Overgaard, Mary Jarden, Lis Adamsen, Thomas Christensen. Lifestyle counselling as secondary prevention in patients with minor stroke and transient ischemic attack: study protocol for a randomized controlled pilot study. Pilot Feasibility Stud. 2020 Mar 25;6: 40. doi: 10.1186/s40814-020-00583-4. PMID 32226634.

PAPER 2B: Jacob Liljehult, Stig Molsted, Tom Møller, Dorthe Overgaard, Thomas Christensen. Lifestyle counselling as secondary prevention in patients with minor stroke or transient ischemic attack: a randomized controlled pilot study. (Manuscript prepared for submission)

Study III

PAPER 3: Jacob Liljehult, Tom Møller, Thomas Christensen, Stig Molsted, Dorthe Overgaard. Mastering health, safety, and worries after minor stroke: a qualitative study. (Manuscript prepared for submission)

English summary

Patients with minor stroke or transient ischemic attacks have a significant prevalence of cognitive deficits and a risk of recurrent stroke. They are, however, often discharged home with little specialized follow-up. Patients with stroke are encouraged to avoid smoking, be physically active, and to take preventive medication, though these suggestions are insufficient in making them change their behaviour. Comprehensive interventions are needed to support the patients in adapting healthy behaviour.

In Study I we made a systematic review and meta-analysis of previous randomised, controlled trials of behavioural interventions with stroke patients. There was considerable methodological heterogeneity, making it difficult to identify specific aspects that could potentially promote the patients' health behaviour. However, the interventions had a beneficial effect on blood pressure, hypertension, and low-density lipoprotein. Including physical training in the intervention increased the effect on blood pressure.

In Study II we tested the feasibility of an early initiated, patient-centred intervention to patients with minor stroke or transient ischemic attacks targeting smoking cessation, physical activity, and medication adherence, in a randomised controlled pilot trial. Patients were included during their hospital admission and were randomised to the intervention, which consisted of health behavioural counselling, telephone follow-up, and monitoring of physical activity, or usual care. Relevant patients were identified, recruited, and randomized early after admission. Most of them adhered to the study until follow-up, and we were able to assess the feasibility of the intervention and derive estimates that can serve to guide the design of large-scale randomised controlled trials.

In Study III we conducted qualitative interviews with selected participants from Study II and their relatives about their experience of returning to everyday life and how the stroke had affected their view on health and health behaviour. The participants experienced a new sense of vulnerability related to persisting symptoms and the awareness of risk of recurrence.

Overall, we can conclude that patients with minor stroke or transient ischemic attacks experience a new sense of vulnerability, beyond their functional limitations. This experience can motivate some patients to change behaviour, which might also help them control their worries. Early initiated, interdisciplinary interventions might therefore be necessary to support patients in restructuring their health and life prospects. Supportive behavioural interventions may help to optimise care outcomes in minor stroke, such as lowering blood pressure and optimising medication adherence. Structured health promotion counselling may help patients initiate health behaviour changes and promote increased physical activity levels.

Dansk resumé

Patienter med mild apopleksi eller transient cerebral iskæmi (TCI) udskrives ofte uden specialiseret opfølgning, trods høj forekomst af kognitive vanskeligheder og betydelig risiko for ny apopleksi. Patienterne opfordres til at undgå rygning, være fysisk aktive og tage forebyggende medicin, men opfordringer er utilstrækkelige til at ændre patienternes adfærd. Der er behov for mere omfattende interventioner, der kan støtte dem i at adaptere hensigtsmæssig sundhedsadfærd.

Studie I bestod af et systematisk review og meta-analyse af tidligere randomiserede, kontrollerede forsøg af adfærdsinterventioner til patienter med apopleksi. Interventionerne havde en gavnlig effekt på blodtryk, forekomsten af hypertension og *low density lipoprotein* i blodet. Inklusion af fysisk træning i interventionen forstærkede effekten på blodtrykket. På grund af betydelig metodisk heterogenitet var det svært at pege på elementer, der potentielt kunne fremme patienternes sundhedsadfærd.

I studie II forsøgte vi at udvikle en tidligt initieret, patient-centreret intervention til patienter med mild apopleksi og TCI med fokus på rygestop, fysisk aktivitet og medicinadhærens og testede anvendeligheden af interventionen i et randomiseret, kontrolleret pilot forsøg. Patienterne blev inkluderet under indlæggelsen og randomiseret til vanlig behandling eller intervention, bestående af rådgivning om sundhedsadfærd, telefonisk opfølgning, samt monitorering af fysisk aktivitet. Det var muligt at identificere relevante patienter, rekruttere, samt randomisere dem tidligt efter indlæggelsen, og fastholde dem i studiet indtil opfølgningen. Resultaterne var en anvendelig intervention og udledte estimater, der kan vejlede designet af et større studie.

I Studie III lavede vi kvalitative interviews med udvalgte deltagere fra Studie II om deres oplevelse af at vende tilbage til hverdagen og hvordan apopleksien havde påvirket deres syn på sundhed og sundhedsadfærd. Deltagerne oplevede at apopleksien havde medført en ny oplevelse af sårbarhed der hang sammen med vedvarende symptomer og bevidsthed om at det kunne ske igen.

Samlet kan vi konkludere at patienterne med mild apopleksi og transitorisk cerebral iskæmi oplever en ny sårbarhed, der strækker sig ud over deres funktionelle begrænsninger. Oplevelsen af sårbarhed kan motivere til adfærdsændring, men kan også håndteres igennem ændring af adfærd. Der kan derfor være behov for tidligt initierede tværfaglige indsatser for at støtte patienterne i at genskabe deres sundhed og livssituation. Adfærdsintervention kan potentielt optimere udfaldet af behandlingen, såsom at sænke blodtrykket og forbedre medicinadhærens. Struktureret sundhedsfremmende rådgivning kan muligvis engagere patienterne i at ændre sundhedsadfærd og fremme fysisk aktivitet.

Part 1 – Background

Introduction

The idea of an association between our behaviour and our general health has been known since the ancient Greek and Roman times [1], though it was not until the modern era that we began to consider behavioural factors as risk factors for cerebrovascular diseases. For instance, it was not until 1989 that a scientific consensus was established on the association between cigarette smoking and the risk of stroke [2]. Since then a number of health-related behaviours have been found to affect the risk of stroke, including alcohol overuse, physical inactivity, and diet [3, 4]. Yet, we still lack evidence on how to facilitate behavioural change in patients. Simple encouragements to change behaviour have been found to be without effect and [5], although, research in more complex behavioural counselling has shown that it has some effect [6], we still do not have clear evidence on which approaches are most useful.

My personal interest in the subject started with a discussion with a close relative who, due to his job, undergoes regular physicals. He noted that the doctors offered plenty of advice on *what* to change in relation to his health, but none of them gave him any guidance in terms of *how* to change it. From his point of view their advice was not actually useful because it only addressed the endpoint without giving him any directions on how to get there. This made me reflect on our own clinical practice. How can we, as health professionals, communicate health advice to patients in a meaningful way, while taking potential barriers into consideration?

For any individual behavioural intervention to be rational we must further hold the hypotheses that: (1) the association between the behaviour and the outcome of interest is causal, (2) both the behaviour and the outcome are modifiable, (3) the individual must have a degree of agency and control over the behaviour.

The overall purpose of this research project was to give patients with minor stroke or transient ischemic attacks the necessary knowledge, skills, and confidence to independently take care of their own health in interaction with their current environment to prevent long-term functional decline through a rehabilitative, patient-centred approach to health counselling. Patients with minor cerebrovascular disease are most often discharged home after a few days in the hospital. Before discharge they are informed of test results, new medication, diagnoses, prognosis, and recommended lifestyle. On top of this they might be emotionally overwhelmed by the sudden illness and have cognitive deficits – a combination that might not provide the best of conditions for facilitating healthy living.

Background

Introduction to stroke

The term *apoplexy* dates back to ancient Greece and literally means *stricken to the ground*. Originally broadly used to describe all conditions with a sudden onset of unconsciousness or paralysis, it was not until the Renaissance, when dissections became common in medical science, that the phenomenon was associated with findings of vascular lesions in the brain and limited to cerebrovascular diseases [7].

The modern definition of a stroke is "*neurological deficit of cerebrovascular cause that persists beyond 24 hours or is interrupted by death within 24 hours*" [8]. Incidences with a duration of less than 24 hours and remission of the focal neurological deficits are referred to as a *transient ischemic attacks* (TIA) [8]. In 30–50% of patients with TIA, tissue damage can be demonstrated on magnetic resonance imaging (MRI) and a more recent definition, based on the absence of tissue damage in neuroimaging, has therefore been proposed [9], although this definition has not yet been fully adopted.

Strokes are mainly divided into two types: *ischemic strokes* and *intracerebral haemorrhages*. In some countries, mainly in the USA, subarachnoid haemorrhages are also included under the term stroke [8].

Ischemic strokes are caused by a sudden blockage of an artery in the brain causing hypoperfusion of the nervous tissue in a delimited area of the brain, depriving the tissue of the oxygen and glucose necessary for it to function. If the perfusion declines below 20% of normal all basic functions of the nerve cells will come to a halt, and the cells will die within minutes – creating an infarct. In the surrounding tissue, i.e. the penumbra, the cell metabolism will be sufficient to keep the cells alive as long as the perfusion remains between 20–50% of normal, although cell function might be affected. But the survival of the cells in the penumbra is a race against time, and if tissue perfusion is not restored, the infarction will expand into the penumbra [10].

The blockage of an artery can be caused by either a blood clot (thrombus) created in the affected blood vessel or by a blood clot originating from somewhere else in the arterial system (thrombo-embolism). Thrombus develops due to damage to the inner layer of the artery, which activates the haemostatic system, creating a blood clot. The most prevalent cause of thrombosis is atherosclerosis. Thromboembolism in the brain can originate from anywhere in the arterial system from the left atrium of the heart to the point of the blockage. But most embolisms of the brain develop in the heart due to arrythmias that disrupt the normal flow of blood through the heart [11].

Intracerebral haemorrhages are caused by leakage of blood from arteries into the tissue of the brain. The leaked blood coagulates when it comes into contact with the tissue, preventing the exchange of oxygen and nutrients between the blood and the cells, causing the cells within the haemorrhage to die. The primary cause of spontaneous intracerebral haemorrhages of the brain is pathological changes in the wall of small arteries and arterioles – encompassing atherosclerosis, lipohyalinosis, and Charcot-Bouchard aneurisms secondary to hypertension. In recent years cerebral amyloid angiopathy has also been identified as a frequent cause of intracerebral haemorrhage in elderly people [12].

The clinical presentation of the stroke depends on a combination of the size and placement of the lesion. Because of the topographic organisation of the nervous system a lesion in a certain area of the brain will cause corresponding neurological deficits. Most strokes affect only one of the hemispheres of the brain and deficits will therefore most often have a hemiform distribution. The most common deficits include contra-lateral weakness of the muscles or loss of tactile sense; speech impairments (aphasia or dysarthria); partial loss of vision (anopsia); loss of consciousness; and cognitive deficits, such as difficulties with planning, carrying out everyday activities (apraxia), inattention towards the surroundings (neglect), and unawareness of symptoms (anosognosia).

The clinical severity of the stroke can be quantified using an aggregated score from a multi-item assessment tool, assigning points based on the severity of each deficit. Commonly used assessment tools are National Institutes of Health Stroke Scale (NIHSS), (11 items; 0 = no deficits/42 = maximal severity) and the Scandinavian Stroke Scale (SSS), (9 items; 58 = no deficits/0 = maximal severity). Scores from the two tools are highly correlated (although negatively) and therefore considered to be equivalent [13]. Clinical severity has been found to be a significant predictor of prognosis in patients with stroke [14, 15].

The concept ‘minor stroke’ is often used in research to designate patients with mild and non-disabling deficits, although the term lacks a formal consensus definition [16]. Several potential definitions based on the overall burden of deficits, the presence of specific deficits, or combinations of these, have been tested against short- and long-term prognosis (mortality and modified Rankin Scale), showing that definitions based on aggregate scores (SSS or NIHSS) are applicable [16, 17].

Stroke epidemiology

The stroke incidence in Denmark is 12–13,000 cases per year, equivalent to an incidence rate of 300 cases per 100,000 people per year. Strokes mainly occur among people who are elderly (mean

age 72 years) and rarely in people under 50 years of age. They occur equally in men and women, although women are, on average, older at the time of their first stroke [18].

Cerebrovascular diseases are not limited to high income countries. Globally an estimated 17 million people suffer a stroke each year, making it one of the leading causes of early death and disability worldwide [19].

There are several risk factors for stroke, of which hypertension is the most dominant with a population attributional risk (PAR) of 34.6% [99% confidence interval (CI) 30.4–39.1]. Other important risk factors are atrial fibrillation and diabetes, as well as a number of health behavioural factors, such as smoking, diet, alcohol overuse, and physical inactivity [20].

Strokes are associated with a range of short- and long-term health-related consequences. In the first week after the index stroke, neurological deterioration is common, either due to progression of the lesion or a new stroke [21]. Complications due to immobilisation and dysphagia are common in the first weeks in patients with severe stroke. Long-term consequences include persistent physical and cognitive deficits, depression, and epilepsy [21, 22].

The mortality rate for patients with stroke is 10% within 30 days of stroke onset, and 15–20% within the first year [18]. The most important risk factors for dying after a stroke include old age, severe stroke, accumulation of comorbidities, and deviances in vital signs at admission [14]. The mortality rate does not appear to be increased in patients with minor stroke compared to the age-sex standardised background population (*unpublished data from* [14]).

The risk of a recurrent stroke is markedly increased after the first stroke. Approximately one in four patients admitted with a stroke in Denmark has previously had a stroke or TIA. Within the first year the recurrence rate is 12%, after which it is 5–6% per year [21]. Patients who suffer a recurrent stroke have a high risk of disability, institutionalisation, and death [23].

Associations between non-medical health behaviour and stroke risk

It is well established in the scientific literature that health behaviours, such as diet, smoking, physical inactivity, and excessive alcohol use contribute to the risk of both index and recurrent strokes.

Tobacco use

Both active tobacco use and passive exposure to tobacco smoke increase the risk of stroke [20, 24, 25]. The prevalence of daily smokers among adults in Denmark is 17%, although it has been decreasing steadily in the past decades. Smoking is more prevalent in men, in people 55–64 years of age, among people with no or low level of education, among the unemployed, and in people

who live alone. Among daily smokers 73% indicate an intention to quit smoking, 35% of whom would like help [26].

The proportion of current smokers in the Danish Stroke Registry [27] was 23% among patients with stroke and 18% among patients with TIA, while the proportion of former smokers was 28% in patients with stroke and 30% in patients with TIA.

Previous studies have found that current smokers have twice the risk of a stroke compared to non-smokers and previous smokers (odds ratio (OR) 2.09 [99%CI 1.75–2.51]) [20] and daily exposure to passive smoking increases the risk of stroke by 25% (risk ratio (RR) 1.25 [95%CI 1.12–1.38]) [25]. Hankey [24] also found that the risk increased with greater use among daily smokers, which indicates a dose-response.

To date, no studies have been published on a potential association between electronic nicotine delivery systems (e-cigarettes) and cardiovascular disease.

Alcohol use

In a meta-analysis of cohort and case-control studies Reynolds *et al.* [28] found that a daily alcohol intake of five units or more increased the risk of both ischemic and haemorrhagic strokes compared to non-drinkers (RR 1.64 [95CI 1.39–1.93]). An increased risk was also found with a daily intake of 2–4 units of alcohol, although this was not consistently significant in all models.

The general intake of alcohol is declining in the Danish population. From 2010 to 2017 the proportion of adults in Denmark with an intake above the recommended level (7 units of alcohol weekly for women and 14 for men) decreased from 24% to 18%. The proportion of adults with a weekly intake above 30 units of alcohol was 4.7% for men and 0.9% for women. Alcohol overuse is most prevalent in men, people living alone, people older than 55 years of age, and the unemployed [26].

In the Danish Stroke Registry [27] 10% of the patients were registered as having an intake above the recommended (7/14 units/w). We have no data on the proportion of patients with a daily intake above five units.

Physical inactivity

Physical inactivity is associated with increased risk of hypertension, atherosclerosis, and type 2 diabetes, while regular physical activity has a protective effect against ischemic stroke. O'Donnell *et al.* [20] found that 8% of patients with ischemic stroke were regularly physically active prior to admission (at least four hours of moderate or strenuous exercise per week), compared to 12% of matched, non-stroke controls, implying that regular physical activity has a protective effect (OR 0.69 [99%CI 0.53–0.90]; PAR 28.5% [99%CI 14.5–48.5]).

In a systematic review Billinger *et al.* [29] found that physical activity in stroke survivors could improve patients' quality of life and functional ability and reduce the level of cognitive impairment and the risk of current cardiovascular events. They were unable to provide a clear conclusion on the type and dosage of exercises needed.

A total of 28.8% of the general Danish population did not fulfil the World Health Organisation (WHO) minimum recommendation for physical activity in 2017 (150 minutes of moderate intensity or 75 minutes of vigorous intensity activity per week). The proportion of people who fulfilled the recommendation was the same among men and women, but the proportion of non-fulfilment was increasing with age and higher among people with short educations and people who lived alone [26].

Unhealthy diet

Regular consumption of fruit, vegetables, and fish is associated with a decreased risk of stroke, while regular consumption of red meat, organ meats, eggs, high-salt foods, and cooking with lard is associated with an increased risk of stroke [4].

Although most of these findings are based on observational studies a few randomised controlled trials (RCT) have tested the effect of more comprehensive dietary concepts, such as Mediterranean diets, which have been found to decrease systolic blood pressure and the risk of cardiovascular disease in people with high risk [30, 31].

Association between medical health behaviour and stroke

Preventive medication is an important part of the secondary prevention of stroke. Commonly used medications are antiplatelets, anticoagulants, antihypertensives, and cholesterol lowering drugs.
Antiplatelets (mainly clopidogrel or acetylsalicylic acid/aspirin) are recommended for most patients with ischemic stroke to prevent recurrent strokes. Treatment is started early with a bolus dose and will normally continue with daily doses onwards. In patients with atrial fibrillation, antiplatelet treatment is insufficient to prevent recurrent stroke, and in these cases, anticoagulants, such as vitamin-k antagonists (warfarin) or novel oral anticoagulants are recommended as the preventive treatment [32].

The main risk factor for stroke and other cardiovascular diseases is hypertension [20]. Treatment to regulate the arterial blood pressure under 140/90 mmHg using antihypertensive medication and non-pharmacological measures, such as physical activity and low-sodium diet, is therefore often appropriate [32].

Hyperlipidemia is another common and significant risk factor for stroke and cardiovascular disease. Cholesterol lowering treatment, mainly with statins, is therefore recommended for patients with stroke or TIA if they have hyperlipidemia or other cardiovascular risk factors [32].

Although the effect of pharmacological treatment as part of secondary prevention of stroke is well-documented deviation from the recommendations is common. According to the WHO 75% of patients diagnosed with hypertension are not optimally regulated and the primary cause is poor adherence to antihypertensive medication [33]. Adherence to medication is affected by multiple factors deriving from patients, health professionals, and the organisation of health services [ibid]. In an American cohort study of 2588 patients with ischemic stroke or TIA Bushnell *et al.* [34] found that 24.5% of the patients had ceased to use one or several prescribed medications after three months. Persistence in medication use was associated with prescription of fewer drugs, higher age, less disability, health insurance, working status, and an understanding of why the medication had been prescribed.

Glader *et al.* [35] found, in a Swedish registry study of stroke survivors (n = 21077) who were followed via the central prescription registry, that persistence in taking preventive medication decreased steadily during the follow-up period. After two years 74% continued to take antihypertensive drugs, 56% with statins, 64% with antiplatelets, and 45% with warfarin, implying substantial differences between the types of medications. Persistence was associated with higher age, comorbidities, good self-perceived health, absence of low mood, and initial treatment in a specialised stroke unit.

Qualitative studies [36–38] of stroke patients, caregivers, and health professionals have highlighted barriers for adherence to medication as difficulties in taking the medication, side effects, lack of knowledge about the medication and the disease, absence of symptoms, concerns about overmedication, negative stories in the media (especially about statins), the patients not taking the disease seriously, frequent changes to the medication, and the complexity of the treatment. Facilitators for adherence were support from caregivers and health professionals, fear of a new stroke, management of side effects, good routines, and belief in the benefits of the medication [36–38]. Studies on other patient groups have further highlighted socioeconomic factors and cost as causes of non-adherence [39].

In a 2017 systematic review of 18 interventional studies (n = 10292) designed to increase adherence to preventive medication in patients with stroke Wessol *et al.* [40] found no clear effect of any of the interventions on the rate of adherence.

The experience of everyday life after minor stroke or TIA

Even though the neurological deficits that patients with minor stroke and TIA experience are minor or transient, a large part of them afterward report a variation of physical, psychological, and cognitive difficulties, that are extensive enough to affect their everyday life.

Fens *et al*. [41] found in a cross-sectional study that 48% of patients with minor stroke or TIA experience cognitive difficulties, such as impaired memory, concentrating, and ability to multi-task, while 40% experienced problems with reading, writing, and communicating, three months after the event.

Several qualitative studies of the everyday experiences of patients with minor stroke or TIA have found that the participants experience remnant symptoms that entail limitations to their lives on multiple levels, from their concrete functional abilities to their sense of independence, body image, safety, social roles, and engagement with other people [42–49]. The participants found that even small limitations in their abilities could affect a lot of different aspects of their lives, and that they therefore did not return to 'normality' [43].

Changes on the bodily level affected the participants' ability to perform usual everyday activities and engage in social activities [49]. This made them experience their bodies as limited, unreliable, and unknown to them, which they found to be a treat to their health, safety, and independence [43, 47]. Some expressed this as a split between the body and the will in which they wanted to do the things they had done before the stroke, but were unable to [48].

Often the remnant symptoms were not realised until the patients returned home and find that they were unable to perform the same activities as they could before [45, 49]. Especially the non-physical symptoms, such as fatigue and mood changes, were easily overlooked by patients and health professionals, though they could impose substantial limitations to the patients' everyday life [45].

Participation in social activities was mainly affected by communicative difficulties, restrictions in mobility or use of transportation, or limited ability to navigate in complex social settings with many sensory input [47, 50]. Some patients felt frustrated that non-physical symptoms were 'invisible' to other people and were thus not acknowledged [46, 47].

These difficulties meant that a lot of patients had to limit their social activities and focus their energy on their closest family and the activities of most importance to them. To some this resulted in a feeling of isolation, loneliness, and sadness over the loss of praised activities [51].

An important driving force for improvement in many patients who experienced remnant symptoms, was the hope and prospect of regaining the abilities and independence they had had before the stroke. Especially important was returning to activities that had been meaningful, such

as hobbies and traveling, or had supported their social role, such as returning to work or social activities [42]. Advances in ability were achieved by keeping active and continuously exploring and challenging their limitations, though some had to adjust their level of ambition gradually to avoid disappointments [42, 48, 50, 52].

Lifestyle and health behaviour

When discussing associations between behaviour and health the concepts *lifestyle* and *health behaviour* are central.

The term '*lifestyle*' [German: *Lebensstil*] was introduced to the field of psychoanalysis by the Austrian psychologist Alfred Adler to describe the way individuals live their lives to obtain a set of life goals defined early in life [53]. In Adler's view of the term an individual's lifestyle was established in childhood and was largely fixed from then on and could only be changed through an active process, such as psychotherapy.

The way the term lifestyle is used in the context of health originates from sociological theory, mainly the English sociologist Anthony Giddens, who defined it as "*a set of practices which the individual embraces, not only because such practices fulfil utilitarian needs, but because they give material form to a particular narrative of self-identity*" [54]. A person's lifestyle is, in this sense, not only the collection of actions and behaviours that the person performs; it also consists of an overarching narrative that binds the actions together and internalises them as part of the person's identity.

The related term *lifestyle disease* is often applied to a range of non-communicable diseases to indicate the contribution of lifestyle to their aetiology. It is has been noted that this term might be inexpedient, as it may give an exaggerated impression of the actual impact of lifestyle, while ignoring the contributions of other factors, e.g. living conditions and socioeconomic factors [55].

Health behaviour (or less often health-related behaviour) is a second term used in relation to the association between behaviour and health. The term was originally defined by Kasl and Cobb in 1966 [56] to describe sets of actions or behaviours performed in relation to health and illness that could either be actions taken by healthy individuals to prevent disease (*health behaviour*), actions taken by ill individuals to "define the state" and "discover a suitable remedy" (*illness behaviour*), or behaviours related to the social role of being sick (*sick-role behaviour*). Various shortcomings in Kasl and Cobb's definitions have later been emphasised, including the quite sharp distinction between healthy and ill individuals, which might not recognise efforts to prevent progression of illness in patients with chronic conditions or actions taken to prevent illness in other people, such as serving healthy foods to one's family. Also, in this definition, behaviours are only

considered to be health behaviours if they are explicitly motivated by an intention to improve health [57]. Due and Holstein have proposed this definition: "*Health behaviour is the actions people perform for themselves or for other, which in the long term, will improve health*" [57](own translation).

Previous research on behavioural change in patients with stroke

RCTs have previously tested various interventions to modify behaviour in patients with stroke and TIA, most of them (see Study I) aimed directly at changing behaviour, while others examined the effect on health behaviour of changing the organisation of treatment and care.

Bridgwood *et al.*'s [6] systematic review of stroke service-based prevention strategies on modifiable risk factors examined 42 RCT (n = 33,840) and found no significant effects on any outcome measures. They found a tendency of an effect in favour of organisational changes compared to educational/behavioural interventions, though this distinction might not be applicable in terms of multimodal interventions featuring both categories. Lawrence *et al.*'s [58] meta-analysis of 20 RCTs (n = 6,373) with multimodal behavioural interventions to prevent recurrent stroke or TIA found a significant effect on systolic and diastolic blood pressure and waist circumference, but not on blood lipids, blood glucose, body composition, smoking or fruit/vegetable consumption. They proposed both lack of theoretical underpinning and failure to sufficiently activate the families of the participants as potential explanations for the weak effectiveness. Deijle *et al.*'s [59] meta-analysis of 22 RCTs (n = 2574) with lifestyle interventions in patients with stroke or TIA observed a significant effect on systolic blood pressure, but not on diastolic blood pressure, cardiovascular events, or blood lipids. The effect on systolic blood pressure was greatest in interventions including aerobic exercise training or a duration > 4 months.

Patient perspective on health behaviour after stroke

Despite extensive evidence of the importance of health behaviour in relation to the primary and secondary prevention of stroke it appears that patients with stroke are reluctant in modifying their health behaviour. Research on the patient perspective on health behaviour after stroke suggests that the patients' behaviour results from a complex interaction between themselves and their perception of the situation, their surroundings, and the social context they act within.

Awareness of the severity of the disease and of the risk of future strokes has been reported as a considerable motivating factor for modifying behaviour and adhering to preventive medication [60]. However, other studies have found that patient with strokes lack knowledge about the risk of recurrent stroke and about stroke risk factors. Croquelois et al. [61] found that 49 percent of

patients with neurological diseases were unaware of the cause of their disease, with only 16 percent of patients with stroke attributing their stroke to poor lifestyle. Around half of patients in all patient groups answered that chance had played a major role. Lack of knowledge and unawareness of the risk of future strokes have considerable impact in low adherence to preventive medication and behavioural change [62]. Believes about the effects of changing behaviour on reducing the risk of recurrence are, together with believes about behavioural control, important for the engagement in behavioural change [60].

A range of barriers and facilitators for engaging in health behaviour after a stroke, including affected bodily functions, personal factors, and environmental factors, have been reported in qualitative studies. Persistence of neurological symptoms, such as cognitive impairments, motor deficits, problems with balance, and fatigue, as well as comorbidities, were highlighted as barriers for engaging in health behaviour, including physical activity and use of medication [44, 45, 63, 64]. Personal factors included knowledge, attitudes and believes towards the behaviour, prior habits, cognitive abilities, and psychological factors such as fear (especially fear of falling), motivation, and self-efficacy [44, 45, 60, 63–65]. Environmental factors included safe surroundings, transportation, access to facilities and services, and the availability of both professional and social support [44, 60, 63, 64]. The patients use of health resources was influenced by their knowledge and the availability, although a reported barrier among patients with minor stroke and TIA was the believe that they were not ill enough to occupy resources [45, 49].

Although results of interventional studies have been varying [6, 58, 59], qualitative interview studies have found that participants and relatives considered education and counselling to be meaningful [66]. The interventions gave the participants a feeling of being supported, as well as knowledge about the disease and risk factors, which further increased their confidence. Support was provided from both health care professionals, who were perceived to be competent and reliable sources of information, and from relatives and other patients, which allowed them to share knowledge and personal experiences. The patients' experience of confidence allowed them to translate their knowledge into action, which again enhanced their motivation and feeling of being competent and capable [51, 65–67]. Auton *et al.* [68] found that most patients did not have specific intentions to change behaviour right after the stroke, but developed these with time when they began to settle in their new situation – while their main concern in the early phase was regaining functional abilities.

Qualitative studies on patients' perspective of long-term follow-up have reported that patients considered the follow-up to be varying in focus and content depending on whether it was stroke specific or provided by the general practitioner. The general practitioners were perceived to be

concerned with medication and treatment but had little focus on persistent symptoms and stroke related problems which had an impact on the patients' quality of life [45, 49].

Patients with stroke experience a broad range of difficulties, and even neurological deficits that at first glance seem minor, might have extensive effects on the patient's life situation. All of these effects can potentially become barriers and facilitators for the patients' health behavior, dependent on the overall situation. The patients' perspective on their own situation should therefore be part of the health professionals' assessment when they talk to patients about their health behaviour.

Part 2 – Individual studies

Objectives

The overall purpose of the research project was to develop a clinically feasible approach to improve patient-clinician communication and to develop a practical intervention in patients with minor stroke and TIA, with a focus on the health behaviour of the patients to reduce associated risks and ultimately prevention of recurrent strokes.

1) As part of the development process, we conducted a systematic review of the scientific literature describing interventions to modify health behaviour in patients with stroke or TIA and reviewed the theoretical literature on modifying individual behaviour.

2) We carried out a pilot study to test the utility of the intervention developed and the feasibility of an RCT.

3) We performed a qualitative interview study with selected participants from the pilot study to explore the experience of daily life in patients discharged home after minor stroke or transient ischemic attack, with a focus on perceived health and reflection on their health behaviour, and how this is associated with their overall experience of returning to everyday life in relation to potential sequelae of stroke.

Methodological considerations

Target population

The focus of this project was on patients with minor stroke and TIA who were discharged home, as this group of patients receives little follow-up post-discharge and are largely expected to manage their health by themselves [69], although there might be limitations to their ability to do so. Minor stroke was defined as a Scandinavian Stroke Scale of 45-58 [70] at admission with persistent neurological deficits beyond 24 hours of stroke onset.

Both patients with manifest minor stroke and TIA were included because they can be difficult to differentiate in clinical practice. The theoretical distinction of persistence or remission of symptoms within 24 hours would be difficult to verify because some symptoms, especially cognitive deficits, can be very subtle and hard to ascertain in a hospital setting in the acute phase. Further, MRI scans to verity the presence of persistent ischemia would not always be available within the narrow time frame we had for recruitment. In addition, the care and treatment of the two patient groups is organised within the same patient pathway and they are therefore largely offered the same treatment and follow-up.

The proposed intervention

We proposed an evidence-based, early initiated, nurse-led health behavioural counselling intervention focusing on smoking cessation, physical activity, and adherence to preventive medication. We hypothesised based on existing literature that smoking, physical inactivity, and non-adherence to preventive medication would be the risk factors which were both most readily modifiable and have the greatest impact on the risk of recurrent stroke, mainly through the reduction of arterial blood pressure [3, 4, 20, 24, 25, 29, 71–75].

Social-cognitive theory

Three theories dominate the literature on health behaviour and behavioural change: social-cognitive theory (the reasoned action model/self-efficacy), cognitive theory (the health belief model), and the transtheoretical model (stages of change) [76]. We used social-cognitive theory as the fundamental framework for our intervention. Additional theories have been proposed to explain other types of behaviour than health-related, but they will not be covered here as they are not commonly used in this context.

The main assumption of social-cognitive theory is that behaviour is learned, most often through modelling the behaviour of other people and can therefore be unlearned. Second, our behaviour is always intentional, and it is therefore dependent on an intention to act to obtain something; we never act outside of a context. Further, our behaviour is dependent on the fact that we actually have control over our actions, which means we need to have both the ability to act and that nothing prevents us from acting, and on our perception of behavioural control, i.e. that we believe that we have behavioural control. The intention to act is concurrently regulated by our attitudes towards the behaviour, our perception of social norms, and, again, our belief in behavioural control. All of these are again affected by an array of individual, social, and structural background factors.

For behaviour to change, there must be (1) a sufficiently strong positive intention (or commitment), (2) no major obstacles, and (3) sufficient skills in the individual to perform the behaviour. The positive intention is based on a conviction and perception that: the advantages of changing behaviour outweigh the disadvantages; normative pressure exists for the behaviour; behavioural control is perceived as possible; the behaviour is perceived to be consistent with the individual's self-image; and that the emotional reaction towards the behaviour is more positive than negative [77].

The person-centred and rehabilitative approach

The patient-centred approach emphasises counselling focused on the needs of the patient and the patient's life situation. Changing and maintaining behaviour is conditioned on the patient having an intention to execute that behaviour. As a result, the counselling should involve collaboration between patients and health professionals in which patients make the decisions and find the solutions that fit with their own life situation.

Miller and Rollnick [78] underline acceptance as a key concept in the patient-centred approach, which entails that the health professional recognises the patients absolute worth as a human being and sees the person as essentially seeking self-actualisation; that the health professional shows appropriate empathy for the patient, meaning that the health professional is capable of understanding the patients frame of reference and convictions; that the patients right to autonomy and self-determination is acknowledged and respected; and that the patients strengths and attempts to take action are affirmed.

The rehabilitative approach means that the intervention: (1) has a focus on the patient's everyday life and attempts to integrate the health behaviour into the patient's existing activities and participation in the environment, (2) is founded in the patient's conditions, abilities, and understanding of the situation, (3) takes the totality of the patient's physical, psychological, and social situation into consideration while including the patient's social support network when relevant [79].

The aim of the counselling was to engage the participants to partake in health-promoting behaviour and to adhere to the preventive medication, but also to support them in setting concrete goals and to assist them in finding suitable strategies to achieve their goals.

Early initiation

The rational for early initiation of the intervention was based on the assumption that a window of opportunity exist, providing a limited timespan immediately after the debut of the illness in which the patient is particularly receptive to information and possesses a high level of readiness for changing behaviour [80]. In contrast, the sudden event of a stroke can conceivably overwhelm the patients [68], which is why one of the aims of the feasibility study was to assess whether patients were willing and able to participate in this type of intervention at this early stage.

The 5As model

Our purpose was to develop a counselling intervention that nurses and other health professionals can easily manage in a clinical setting with a minimum of training. Consequently we chose the 5As model to structure he counselling [81, 82].

The 5As model, which consists of six consecutive elements, aims to support patients in reflecting on their own behaviour, setting concrete goals, and finding strategies to achieve those goals. One of the advantages of this model is that it provides a structure for counselling sessions and that there is a well-defined assignment of roles between the patient and the health professional in each element (Figure 1).

The first element involves assessing patients' current health behaviour and potential health consequences, either by asking them or through objective assessments. Patients are subsequently asked about their readiness or intention to change behaviour. In addition, the health professional provides clear, specific, and relevant advice on what to change, including information on the potential advantages and disadvantages of changing or not changing a behaviour.

If patients have a concrete intention to change a current behaviour, or adhere to a new one, a realistic and specific goal is defined in collaboration with the health professional in accordance with the patients' preferences and abilities.

If patients are dismissive towards the advice, this is acknowledged, but the health professional might ask permission to bring the issue up again later, to give the patient time to reconsider.

When an appropriate goal has been agreed upon, patients need to find strategies to obtain it, which requires them having the knowledge and skills necessary to figure out how to do this. As a result, the health professional needs to assist patients in acquiring the skills, confidence, and social support needed to achieve the goal. This includes helping them to identify potential barriers and resources.

Often, a single counselling session is insufficient to establish sustainable change, which is why arranging how further support should be provided is advisable at the end of the session. In some instances, a new appointment with the same health professional can be scheduled, while in others referring the patient to follow-up in other sectors will be necessary.

Baseline and follow-up assessments

Before randomisation all participants underwent a thorough, standardised baseline assessment that included questions on demographics, health behaviour, previous conditions, current neurologic deficits, and measurement of vital signs, body weight, waist circumference, and spirometry.

Research on hospital-based tobacco cessation interventions found that the effect of a single counselling session before discharge is insufficient and that follow-up sessions at least one month after discharge are necessary. For this reason, we incorporated regular telephone follow-up sessions after four and eight weeks in the intervention to help patients reassess and maintain motivation. The telephone sessions followed a standardised interview guide with questions addressing overall well-being, remaining symptoms, problems related to everyday activities,

relevant behavioural goals and motivation, adherence to medication, experience of side effects, and use of health resources or contact with other health professionals (e.g. general practitioner).

Final follow-up was conducted after 12 weeks in the hospital-based outpatient clinic for participants in both treatment arms.

Ethical considerations

The study was conducted in accordance with the Helsinki Declaration [83], including respect for the participants' autonomy and right to informed consent. Participants were informed that participation was voluntary and that further participation could be declined at any time without explanation.

Our *a priori* assumption was that the inconvenience of participating would be minor and that the benefits would outweigh potential drawbacks. Expected inconveniences included withdrawal symptoms in relation to smoking cessation and the muscles soreness associated with increased physical activity, both of which would be transient and safe. Participants were asked about side effects from the medication at all follow-up contacts and encouraged to report these to their general practitioner [69].

The use of a usual care control group as a comparison was necessary to test the feasibility and acceptability of the randomisation process prior to the design of a full-scale RCT.

The study was evaluated by the Scientific Committee of the Capital Region of Denmark (H-17040484), which determined that it was not subject to Danish legislation on scientific committees. The Danish Data Protection Agency approved the data management plan (file no. VD-2018-306, I-6552). Prior to participant recruitment the study protocol was registered at ClinicalTrials.gov: NCT03648957.

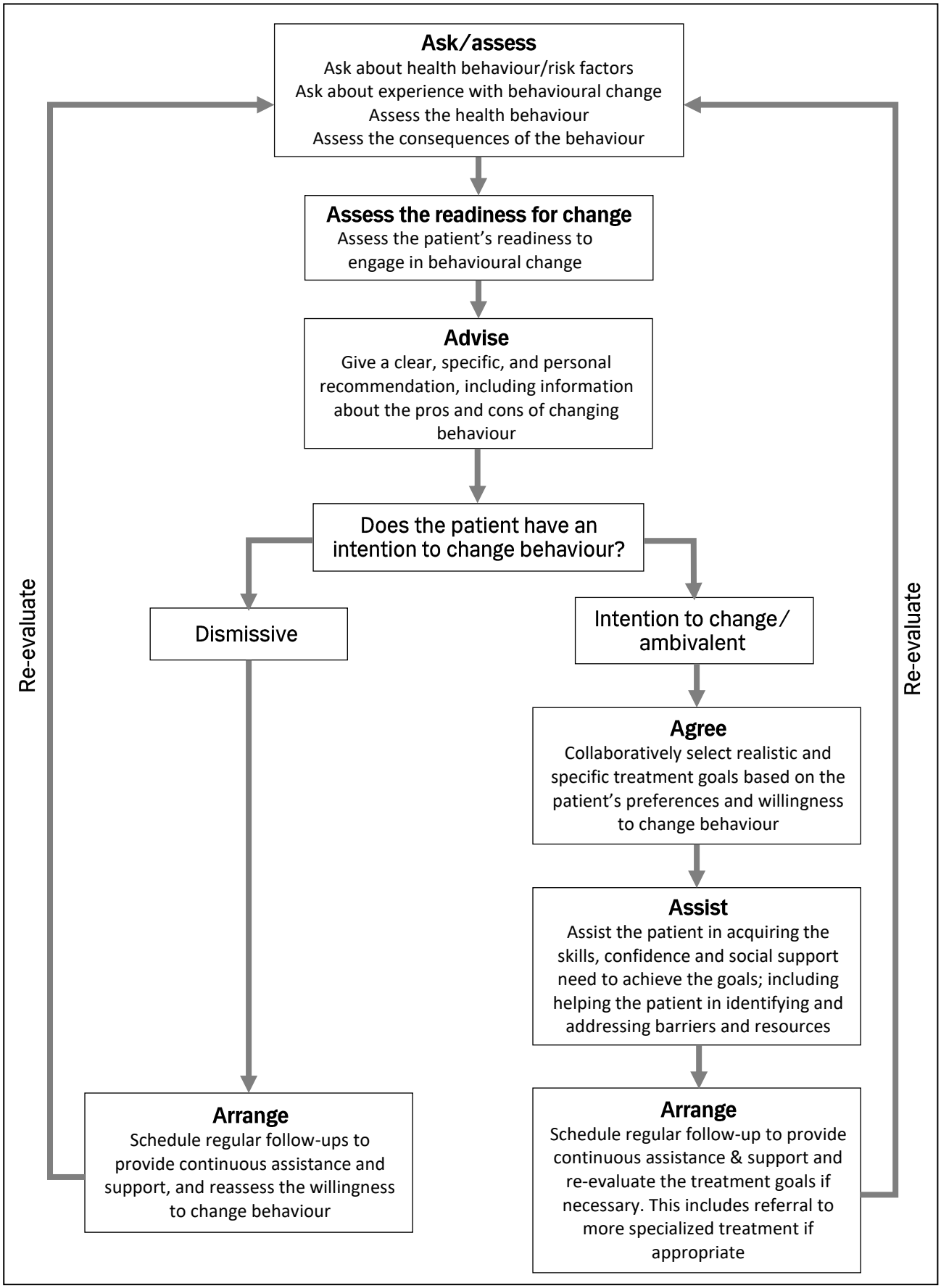

Figure 1 The 5As approach modified from Vallis *et al*. 2013 [52] and Sherson *et al*. 2014 [53], as proposed in Liljehult *et al*. 2020 [48]
Figure reproduced from Figure 2 in Paper 2A

Study I

Objectives

The aim of this study was to gain an overview of the existing research literature on health behavioural interventions involving patients with stroke and TIA. The purpose was to examine the effect of single- or multimodal counselling and educational interventions directed at individual or multiple lifestyle risk factors on primarily blood pressure and hypertension and secondarily on other available outcomes, and to examine the content and methodology of previous interventional studies.

Method

Relevant studies were identified through systematic searches in scientific databases (PubMed, Embase, PsycInfo, CINAHL, Scopus, and Web of Science) and through reference searches in similar publications. Reports were included if they were RCTs of counselling or patient education interventions of either individuals or groups, targeting single or multiple behavioural factors provided in a hospital, outpatient, or community setting to adult patients with stroke or TIA. The primary outcome of interest was systolic blood pressure, while other relevant outcomes included stroke recurrence, vascular events, mortality, biometrical measures, behavioural measures, or patient-reported outcomes. We excluded reports if they were not randomised or the intervention primarily consisted of training/rehabilitation or pharmaceuticals (e.g. nicotine substitute).

All titles and abstracts were screened for relevance, and reports were excluded if: they were duplicates, if they were not original publications, or if they clearly did not meet the inclusion criteria. Research protocols and conference abstracts were excluded from the review if we were unable to find full-text publications of the same study. Full-text reports of potentially relevant studies were read and evaluated by three authors independently and relevant reports were selected after a joint discussion.

Data extraction and evaluation of methodological quality and risk of bias were independently conducted by two researchers. Discrepancies were discussed until consensus was achieved. The data extracted were analysed using both quantitative meta-analyses and a qualitative evaluation of the content of the reported interventions. Due to the complex nature of the interventions random effects models were used for all meta-analyses. Subgroup-analyses were made to test potential interactions between the intervention effects and common methodological features, such the timing and length of the intervention, inclusion of theory in the design, and the content of the intervention.

A protocol for the systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) before the review was commenced (record ID. 64681)[84].

Results

We identified 10094 reports in total. Of these 5101 were excluded because they were either duplicates, reviews, or non-original publications, and a further 4864 records were excluded after evaluation of the abstract. Three researchers (JL, TM, MML) independently read the remaining 129 records in full and discussed their eligibility, leading to the inclusion of 29 studies [73].

These 29 studies showed considerable diversity in the content and delivery of the interventions. Most of them aimed to provide the knowledge and skills necessary for participants to independently regulate their health behaviour. Yet, the approaches included, for example: patient education, counselling, physical training, formal and informal support, or changes in the organisation of health care and in most cases a combination of several elements.

The timing of participant recruitment varied from during the initial hospitalisation to up to one year after the index stroke. Four studies did not state the time of recruitment. Time of recruitment had some association with the attrition rate, indicating that very early recruitment caused more participants to drop out. Although we found a trend towards a greater effect on systolic blood pressure in the studies with early recruitment, this trend was not statistically significant ($p = 0.19$). All included studies had multiple intervention points over time, with intervention periods ranging from three weeks to two years. We found no evidence of an association between the length of the intervention and the effect.

We found an overall significant effect of the included interventions on systolic and diastolic blood pressure and on the proportion of participants who achieved their target blood pressure, and serum low-density lipoprotein (Table 1). The treatment effect was greatest in the studies that included physical exercise as part of the intervention. For all outcome measures the quality of the evidence was graded as low to very low due to methodological limitations.

Conclusion

Although we currently are unable to give a clear recommendation on the optimal approach to changing health behaviour in patients with stroke, behavioural interventions appear to have some beneficial effects. The effect seems to be greatest in interventions that include increasing the participants level of physical activity.

Table 1 Results of the meta-analyses

All meta-analyses are based on random-effects models. Mean difference was used for parametrical outcomes when all studies reported the same unit; Standardized Mean Difference was used for parametrical outcomes when different units were reported; Risk Ratio was used for binominal outcome measures

Vital signs	Studies	Partici-pants	Effect Estimate	p-value	I^2	Quality of evidence (GRADE)
Outcome						
Systolic blood pressure (mmHg) [85–98]	14	2222	MD -3.85 [-6.43, -1.28]	0.003**	53%	⨁⨁◯◯ Low[A, B]
Diastolic blood pressure (mmHg) [85–92, 94–97]	12	1711	MD -1.60 [-3.09, -0.11]	0.04*	40%	⨁⨁◯◯ Low[A, B]
SBP <140 mmHg [87, 91, 93, 97–99]	6	1546	RR 1.14 [1.03, 1.25]	0.01**	23%	⨁⨁◯◯ Low[A, B]
Heart rate (beats pr minute) [92, 94]	2	113	MD -2.87 [-6.34, 0.61]	0.11	0%	⨁◯◯◯ Very low[A, B, C]
Biochemistry						
Total cholesterol [85–88, 90, 92, 94, 95, 98, 100]	10	925	MD -4.25 [-9.27, 1.22]	0.13	9%	⨁⨁◯◯ Low[A, B]
HDL [86, 88, 89, 92, 94, 95]	6	552	MD 1.64 [-1.12, 4.40]	0.24	0%	⨁⨁◯◯ Low[A, B]
LDL [89, 91, 93, 95, 97]	5	1003	SMD -0.23 [-0.41, -0.05]	0.01**	36%	⨁⨁◯◯ Low[A, B]
Triglycerides [95, 100]	2	63	MD -14.71 [-43.07, 13.56]	0.31	0%	⨁◯◯◯ Very low[A, B, C]
Fasting blood glucose [88, 94]	2	75	MD -0.19 [-0.47, 0.10]	0.20	0%	⨁◯◯◯ Very low[A, B, C]
HbA1c [89, 90]	2	170	MD 0.12 [-0.46, 0.70]	0.69	63%	⨁◯◯◯ Very low[A, B, C]
TC/HDL-ratio [88, 94]	2	75	MD 0.0 [-0.49, 0.49]	0.99	0%	⨁◯◯◯ Very low[A, B, C]
Body composition						
Body mass index [87–89, 94]	4	329	MD -0.44 [-1.38, 0.51]	0.37	0%	⨁◯◯◯ Very low[A, B, C]
Body weight [85, 89, 94, 101]	4	175	MD -0.53 [-4.09, 3.03]	0.77	0%	⨁◯◯◯ Very low[A, B, C]
Waist-hip ratio [88, 94]	2	75	MD 0.0 [-0.04, 0.03]	0.83	0%	⨁◯◯◯ Very low[A, B, C]
Adverse events						
Death (all causes) [5, 94, 99, 102, 103]	5	4668	RR 0.97 [0.58, 1.61]	0.37	0%	⨁⨁◯◯ Low[A, B]
Recurrent stroke/TIA [5, 90, 102, 103]	4	4330	RR 1.08 [0.78, 1.50]	0.77	0%	⨁⨁◯◯ Low[A, B]
Adverse events (all) [5, 89, 90, 99, 102–104]	7	4813	RR 0.77 [0.56, 1.08]	0.83	0%	⨁⨁◯◯ Low[A, B]
Functional level						
Modified Rankin Scale [5, 85, 87, 105]	4	606	SMD -0.26 [-0.58, 0.05]	0.11	69%	⨁◯◯◯ Very low[A, B, C]
Patient reported outcomes						
Quality of life [86–88, 90, 106]	6	1546	SMD -0.09 [-0.53, 0.34]	0.67	85%	⨁◯◯◯ Very low[A, B, D]

Sub-analyses	Studies	Partici-pants	Effect Estimate	p-value†	I^2	References
Time of recruitment	**11**	**1777**	**SBP (mmHg)**	0.19	40%	⨁⨁◯◯ Low[A, B]
Early recruitment [87, 89, 91, 95]	4	303	MD -0.54 [-0.98, -0.10]			
1-4 weeks [85, 86, 88, 94, 97]	5	968	MD -0.16 [-0.31, -0.00]			
Late recruitment [90, 93]	2	506	MD -0.03 [-0.40, 0.33]			
Length of the intervention	**13**	**2142**	**SBP (mmHg)**	0.99	0%	⨁⨁◯◯ Low[A, B]
3-12 weeks [88, 91, 92, 94, 95]	5	193	MD -0.21 [-0.55, 0.13]			
13-51 weeks [85, 86, 89, 90, 96]	5	875	MD -0.19 [-0.51, 0.12]			
≥52 weeks [87, 93, 97]	3	1074	MD -0.21 [-0.33, -0.09]			
Training interventions	**13**	**2142**	**SBP (mmHg)**	0.04*	76%	⨁⨁◯◯ Low[A, B]
Training [88, 89, 91, 94]	4	174	MD -9.83 [-16.56, -3.09]			
No training [85–87, 90, 92, 93, 95–97]	9	1968	MD -2.61 [-4.26, -0.96]			
Theory-based intervention	**13**	**2142**	**SBP (mmHg)**	0.71	0%	⨁⨁◯◯ Low[A, B]
Theory based [85, 86, 91–95]	7	973	MD -3.99 [-6.36, -1.61]			
Non-theory based [87–90, 96, 97]	6	1169	MD -3.35 [-5.67, -1.03]			
Family support	**13**	**2142**	**SBP (mmHg)**	0.74	0%	⨁⨁◯◯ Low[A, B]
Family/relative support [87, 92]	2	248	MD -2.44 [-11.26, 6.38]			
No family support [85, 86, 88–91, 93–97]	11	1894	MD -4.00 [-6.91, -1.10]			

SBP systolic blood pressure, **MD** mean difference, **RR** risk ratio, **SMD** standardized mean difference, **HDL** high-density lipoprotein, **LDL** low-density lipoprotein, **TC/HDL ratio** total cholesterol/HDL ratio, *P<0.05, **P<0.01, † p-value for the overall effect of the model

GRADE: A down-graded due to insufficient blinding, B down-graded due to indirectness caused by substantial different intervention, C down-graded because the analysis is based on limited data (few studies or few participants), D down-graded due to use of indirect outcome measures

Table is reproduced from Table 5 in Paper 1. References are modified.

Study II

Objectives

The objectives were to evaluate the feasibility of a client-centred patient counselling intervention focused on smoking cessation, physical activity, and adherence to preventive medication in patients with minor stroke or TIA, and to test the potential effects of the intervention on blood pressure and other cardiovascular risk factors in patients with minor stroke and TIA.

Method

We conducted a two-arm parallel group, randomised controlled feasibility and pilot study in which participants were randomly allocated to usual care or the counselling intervention.

Patients were screened for eligibility during hospitalisation at the acute stroke ward, Department of Neurology, Nordsjællands Hospital, Denmark. They were eligible for inclusion if they were adults, had acute minor stroke (SSS > 45) or TIA, were discharged home, could provide valid consent, had no communicative barriers, were independently mobile and independent in self-care, and did not have a severe psychiatric illness or exhibit substance abuse [69].

Participants were allocated into the two treatment arms immediately after baseline testing using simple non-stratified 1:1 randomisation. The randomisation sequence was generated electronically and implemented into RedCap, ensuring concealment of subsequent allocations and that allocation could not be changed. Participants stayed in the same treatment arm for the entire study period.

Participants in the intervention group received nurse-led, targeted behavioural counselling. Initial counselling was provided face to face at the hospital while subsequent counselling was done via telephone after four and eight weeks. Apart from the baseline assessment the control group only received usual care. Participants from both treatment arms were followed up after 12 weeks, which included reassessment of arterial blood pressure, smoking status, body composition, and adherence to prescribed medication. Long-term outcomes included readmission with recurrent stroke/TIA or ischemic heart disease, and fatality within one year of inclusion.

Bowen *et al*.'s [107] model for designing feasibility studies in preventive medicine was used to evaluate the feasibility study, including the domains eligibility, acceptance, demand & practicality, adherence, and attrition.

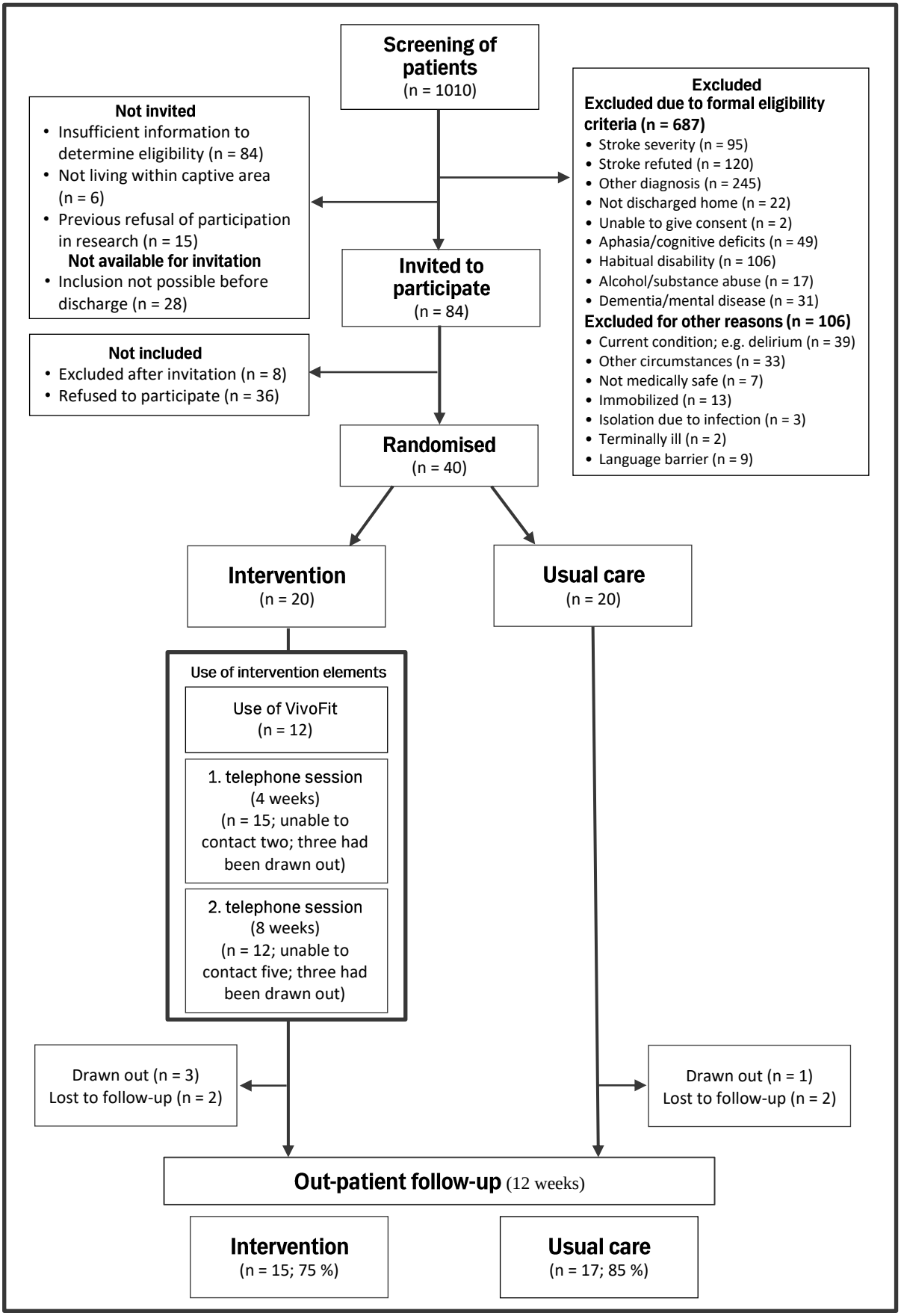

Figure 2 Patient flow from screening to follow-up

Figure is reproduced from Figure 2 in Paper 2B

Results

Forty patients accepted participation and were randomly assigned to the two treatments arms (20 intervention and 20 usual care, Table 2 presents the study population characteristics). The median follow-up time was 85 days (range 82–104 days). Though the study was not powered to formally test the significance of the changes of outcomes, all included outcome measures proved to be manageable according to the study protocol. Estimates for the allocation groups at baseline and follow-up are presented in Table 3.

A significant reduction in systolic blood pressure was observed in both allocation groups from baseline to 12 weeks follow-up (overall reduction 7.3 mmHg [95%CI 2.93–11.72]), although the difference between groups was non-significant. A reduction was also observed for diastolic blood pressure, but this was not significant.

No changes were observed in any of the body composition measures (weight, body mass index, and waist to hip ratio). A 3-point increase was observed in the fatigue score overall, signifying a significant increase in the burden of fatigue. Although the increased burden of fatigue was greatest in the control group, the between group difference was not significant. On the single-item level the most distinct difference was in the item *"Mentally, I feel exhausted",* in which a greater increase was observed among the control group. There was a slight, but non-significant, tendency towards a decrease in time spent on physical activity, but no clear change in the level of intensity. Of the 32 participants who completed follow-up 17 had remained as physically active as before the stroke, 9 were more active, and 6 less active, with no between group difference. One participant from each group suffered a recurrent stroke within one year after enrolment.

Demand and acceptability

A total of 1010 patients in the acute stroke ward were screened from October 2018 to January 2020, of whom 84 were invited to participate in the study. Most patients were excluded in the screening process because they did not have a stroke (n = 365) or because they were unable to participate due to the nature of their stroke (n = 146) or other health conditions (n = 251). Additionally patients were excluded due to non-health related reasons, such as not being discharged home (n = 22), language barriers (n = 9), not living in the captive area (n = 6), or previous refusal to participate in research (n = 15). Further 112 patients could not be invited because relevant information was lacking or because they were discharged before they could be invited. (Figure 2 provides a summary of the patient flow).

Forty patients agreed to participate and were randomly allocated to the two treatments arms: intervention (n = 20) and usual care (n = 20), while eight patients were excluded before inclusion and 36 patients declined to participate. The reasons for exclusion after invitation to participate

were either that the patient was discharged before consent was obtained (n = 4), the stroke diagnosis was refuted (n = 2), or changes in the patients' condition (one had a new stroke and one developed delirium). Various reasons for declining were reported: (1) did not find the intervention relevant, either because they already perceived their lifestyle as healthy or they did not find that their disease was connected to their behaviour, (2) already had regular contact with the health care system, (3) time constraints due to work or family responsibilities, (4) did not have the energy to participate in anything beyond standard treatment, and (5) no reason specified.

Table 2 presents the study population characteristics. All participants were discharged home without the intervention causing any delay in care. One participant was initially transferred to another hospital for a carotid endarterectomy and unfortunately suffered a new stroke during the procedure but was able to continue participation in the study.

Thirty-two (80%) completed the twelve-week follow-up period, while four were drawn out after randomisation (one participant was discharged before the intervention began and three were given a new diagnosis after undergoing a magnetic resonance imaging), and four were lost to follow-up. Since two follow-up sessions were conducted by telephone due to COVID-19 pandemic restrictions blood pressure measurements were performed by either the patient or the general practitioner. Median follow-up time was 85 days (range 82–104 days).

Of the participants in the intervention group, we were able to contact 15 after four weeks and 12 after eight weeks for the telephone follow-up (Figure 2). We received sufficient activity tracker data from 12 of the intervention group participants (60%), while two wanted to use their own devices, one was drawn out before the activity tracker was issued, and five never transferred any data. For the participants who transferred data the activity tracker was worn 90% of the days in the intervention period, with four participants wearing it every day (range 62–100%).

Implementation and practicality

Our aim was to recruit all participants before discharge and integrate the intervention pragmatically within the existing standard treatment. Largely, the protocol was manageable within the clinical setting, although we did identify some challenges.

A large number of patients had to be screened to identify relevant ones. In 84 cases the initial medical records lacked sufficient information to evaluate their eligibility and acquiring the information proved to be time-consuming.

Due to short hospital stays, 28 patients could not be invited before discharge and one had to be withdrawn because he was discharged before the intervention began. Due to time constraints and

negative participants feedback on the Astrand-Rhyming cycle test was omitted from the intervention.

Setting up the activity tracking devices proved to be more time-consuming than expected. All participants needed some degree of assistance in installing the smartphone application, setting up the user profile, and connecting the device. A few participants needed support in transferring data to the application after discharge.

Conclusion

The study showed that despite several implementation challenges, it is possible to identify, recruit and randomise relevant patients early within a narrow timeframe in initial care after admission and to retain most participants in the study until follow-up. Some adjustments had to be made to the study protocol during the pilot period, including generally omitting the Astrand-Rhyming cycle test. The activity tracker was accepted by the majority and provided new insights on longitudinal physical activity behaviour in a vulnerable population. The study was not designed to show an effect of the intervention, though findings may serve as basis for the design of large-scale RCTs.

Table 2 Baseline study population characteristics

	Intervention n = 20	**Usual care** n = 20
Age (years)	66.1 ± 9.3	68.0 ± 6.3
Sex (n/% female)	5 (25%)	6 (30%)
Diagnosis (IS/TIA)	12/6 (60%/30%)	11/8 (55%/40%)
Scandinavian Stroke Scale (SSS)		
58	15 (75%)	17 (85 %)
57	3 (15%)	0
56	1 (5%)	2 (10%)
55	1 (5%)	0
54	0	1 (5%)
Living arrangements		
Living alone	3 (15%)	5 (25%)
Living with a partner	17 (85%)	15 (75%)
Educational attainment		
Secondary school	7 (35%)	3 (15%)
Vocational education or training	2 (15%)	8 (40%)
Bachelor's degree or equivalent	6 (15%)	4 (20%)
Master's degree	3 (5%)	5 (25%)
Pre stroke performance status		
0 (asymptomatic)	18 (90%)	17 (85%)
1 (some symptoms, no disabilities)	2 (10%)	3 (15%)
Self-rated health		
Less good	3 (15%)	0
Good	12 (60%)	7 (35%)
Very good	4 (20%)	13 (65%)
Comorbidities		
Charlson Comorbidity Index		
0	10 (50%)	10 (50%)
1	5 (25%)	9 (45%)
2	3 (15%)	0
>2	2 (10%)	1 (5%)
Known diabetes	4 (20%)	0
Previous stroke	4 (20%)	4 (20%)
Previous myocardial infarction	2 (10%)	1 (5%)
Heart arrythmia (known or diagnosed)	2 (10%)	3 (15%)
Risk factors		
Smoking		
Current	3 (15%)	0
Former smoker	11 (55%)	9 (45%)
Never smoked	5 (25%)	11 (55%)
Package years	10 (IQR 3-15)	10 (IQR 3.9-10.5)
Alcohol intake (units/week)	6 (IQR 1.75-20.25)	5 (IQR 2.5-8.5)
Body composition		
Body weight (kg)	88.5 ± 15.5	82.6 ± 13.6
Body mass index (kg/m^2)	26.9 (IQR 25.5-30.9)	25.5 (IQR 23.5-28.1)
Waist/hip ratio	1.00 ± 0.09	0.98 ± 0.12
Biochemistry		
HbA1c, mmol/L	7.05 ± 2.15	6.51 ± 0.66
Total cholesterol, mmol/L	4.96 ± 1.16	5.16 ± 1.05
LDL, mmol/L	2.76 ± 0.97	3.09 ± 0.87
HDL, mmol/L	1.38 ± 0.50	1.34 ± 0.30
VLDL, mmol/L	0.71 ± 0.25	0.75 ± 0.35
Triglycerides, mmol/L	1.62 ± 0.63	1.90 ± 1.11

Measures are presented as *mean* ± *SD*, *n (%)*, or *median (IQR)*
SD standard deviation **IS** ischemic stroke **TIA** transient ischemic attack **SSS** Scandinavian Stroke Score **IQR** intra-quartile range **HbA1c** haemoglobin A1c **LDL** low density lipoprotein **HDL** high density lipoprotein **VLDL** very low density lipoprotein

Table reproduced from Table 1 in Paper 2B

Table 3 Measures of effect (Secondary and tertiary outcomes)

	Intention to treat		Per protocol	
Arterial blood pressure	**Intervention**	**Control**	**Intervention**	**Control**
Systolic blood pressure *(mmHg)*	n = 20	n = 20	n = 14	n = 17
Baseline [A]	144.5 ± 14.71	140.5 ± 16.55	143.71 ± 12.98	141.58 ± 16.81
12-weeks follow-up [A]	137.1 ± 14.84	133.5 ± 14.41	134.57 ± 12.34	131.88 ± 13.62
Change [A]	-6.4 ± 9.32	-8.3 ± 17.29	-9.14 ± 10.00	-9.70 ± 18.44
Difference [B]		**1.85** [-7.13; 10.83]		**-0.56** [-10.16; 11.28]
Hypertension *(SBP >140 mmHg)*	n = 20	n = 20	n = 14	n = 17
Baseline	13 (65%)	11 (55%)	9 (73%)	10 (53%)
12-weeks follow-up	7 (35%)	6 (30%)	3 (66%)	5 (76%)
Difference [C]		**OR 1.0** [0.26; 3.87]		**OR 1.5** [0.33; 6.77]
Diastolic blood pressure	n = 20	n = 20	n = 14	n = 17
Baseline [A]	86.1 ± 11.49	83.0 ± 11.32	87.93 ± 11.01	84.06 ± 11.61
12-weeks follow-up [A]	81.35 ± 12.23	78.75 ± 8.74	81.14 ± 12.59	79.06 ± 8.98
Change [A]	-4.75 ± 10.52	-4.25 ± 10.84	-6.79 ± 12.12	-5.00 ± 11.65
Difference [B]		**0. 5** [7.34; -6.34]		**-1.78** [-10.6; 7.03]
Physical activity				
MET-minutes per week	n = 20	n = 20	n = 15	n = 17
Baseline [A]	2809 ± 3732	1538 ± 1180	3606 ± 4009	1596 ± 1263
12-weeks follow-up [A]	2048 ± 2242	1498 ± 801	2591 ± 2336	1594 ± 843
Change [A]	-761 ± 3868	-179 ± 1207	-1015 ± 4476	-211 ± 1312
Difference [B]		**-582** [-2458; 1294]		**-804** [-3344; 1736]
Time spent on physical activity *(min/week)*	n = 20	n = 20	n = 15	n = 17
Baseline [A]	765 ± 1071	344 ± 240	985 ± 1158	364 ± 255
12-weeks follow-up [A]	537 ± 583	343 ± 193	681 ± 604	363 ± 202
Change [A]	-228 ± 1130	- 31 ± 234	-304 ± 1306	-36 ± 255
Difference [B]		**-197** [-734; 340]		**-268** [-999; 463]
Moderate to vigorous physical activity	n = 20	n = 20	n = 15	n = 17
Baseline	13 (65%)	11 (55%)	11 (73%)	9 (53%)
12-weeks follow-up	12 (60%)	15 (75%)	10 (66%)	13 (76%)
Difference [C]		**OR 0.5** [0.10; 2.32] [B]		**OR 0.62** [0.10; 3.78] [B]
Body composition				
Body weight (kg)	n = 19	n = 19	n = 14	n = 17
Baseline [A]	88.5 ± 15.46	82.6 ± 13.58	89.2 ± 13.82	83.4 ± 13.22
12-weeks follow-up [A]	87.1 ± 13.18	80.6 ± 13.0	87.8 ± 10.20	81.2 ± 12.70
Change [A]	-1.3 ± 5.11	-1.9 ± 4.40	-1.9 ± 6.09	-2.2 ± 4.71
Difference [B]		**-0.59** [-3.65; 2.47] [B]		**-0.37** [-4-47; 3.74] [B]
Body Mass Index	n = 19	n = 19	n = 14	n = 17
Baseline [A]	28.6 ± 4.46	26.3 ± 3.48	28.5 ± 4.30	26.4 ± 3.59
12-weeks follow-up [A]	28.2 ± 3.71	25.6 ± 3.31	27.9 ± 3.13	25.7 ± 3.43
Change [A]	-0.41 ± 1.61	-0.61 ± 1.45	-0.59 ± 1.92	-0.72 ± 1.55
Difference [B]		**-0.2** [-1.18; 0.78] [B]		**-0.13** [-1.44; 1.18] [B]
Waist-hip ratio	n = 18	n = 19	n = 12	n = 10
Baseline [A]	1.0 ± 0.09	0.98 ± 0.11	1.01 ± 0.1	0.99 ± 0.1
12-weeks follow-up [A]	0.99 ± 0.07	0.97 ± 0.11	1.00 ± 0.07	0.97 ± 0.09
Change [A]	-0.01 ± 0.03	-0.01 ± 0.05	-0.01 ± 0.04	-0.03 ± 0.07
Difference [B]		**0.0** [-0.02; 0.03] [B]		**0.01** [-0.04; 0.06] [B]
Fatigue	n = 19	n = 20	n = 15	n = 17
Baseline [A]	18.9 ± 6.15	16.2 ± 4.58	18.4 ± 6.67	14.9 ± 1.96
12-weeks follow-up [A]	20.3 ± 8.27	19.9 ± 7.46	20.2 ± 9.23	19.2 ± 7.36
Change [A]	1.42 ± 4.21	3.7 ± 7.45	1.8 ± 4.69	4.35 ± 7.93
Difference [B]		**2.27** [-1.65; 6.21] [B]		**2.55** [-2.12; 7.22] [B]
Long-term follow-up *(1 year)*	n = 20	n = 20	n = 17	n = 19
Recurrent stroke	5% (n = 1)	5% (n = 1)	5.9% (n = 1)	5.3% (n = 1)
Other vascular events	0	0	0	0
Fatalities	0	0	0	0

MET Metabolic Equivalents, A mean ± standard deviation, B mean difference [95% confidence interval], C odds ratio [95% confidence interval]

Table reproduced from Table 2 in Paper 2B

Figure 3 Boxplots of steps per day for each participant sorted by median. Each measurement is represented by an opaque grey bar. Darker shading signifies a cluster of measurements. Dashed lines indicate the quartiles of all measurements.
Figure reproduced from Figure 4 in Paper 2B

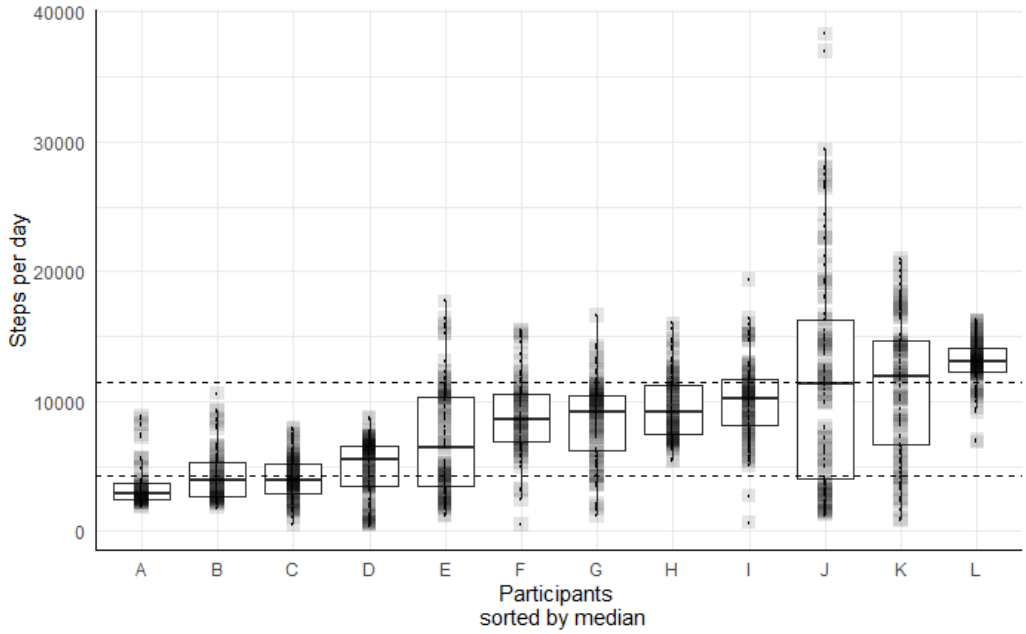

Table 4 Activity tracker data presented per participant (3A) and per time interval (3B)

	Steps per day mean ± SD	**Aerobic walking time** mean ± SD	**Adherence*** % [95%CI]
3A Participant (sorted from lowest to highest median)			
A	3606 ± 1861	4.72 ± 12.11	62.4% [51.2 - 72.6]
B	4358 ± 2077	3.32 ± 10.99	73.8% [63.1 - 82.8]
C	4096 ± 1652	0.16 ± 1.52	100% [95.8 - 100]
D	4833 ± 2218	34.77 ± 21.85	100% [96.0 - 100]
E	7066 ± 4225	23.67 ± 33.49	98.8% [93.6 - 100]
F	8884 ± 3079	8.45 ± 12.02	62.9% [52.9 - 72.1]
G	8585 ± 3118	30.90 ± 27.77	96.5% [90.1 - 99.3]
H	9572 ± 2455	1.76 ± 4.34	95.6% [89.0 - 98.8]
I	10068 ± 3124	13.02 ± 24.14	100% [95.7 - 100]
J	11897 ± 8597	61.40 ± 60.96	100% [95.7 - 100]
K	11168 ± 5322	10.37 ± 16.53	95.3% [88.4 - 98.7]
L	13024 ± 1781	53.06 ± 18.38	97.8% [92.3 - 99.7]
3B Time			
T1: weeks 1-3	7282 ± 3998	16.80 ± 24.23	91.7% [87.5 - 94.8]
T2: weeks 4-6	8809 ± 4641	24.70 ± 34.10	86.1% [81.2 - 90.1]
T3: weeks 7-9	8851 ± 4970	24.54 ± 35.56	86.9% [82.1 - 90.8]
T4: weeks 10-12	7941 ± 5089	20.60 ± 35.22	98.4% [96.0 - 99.6]

SD standard deviation, CI confidence interval, T time, *Percentage of days patients wore the VivoFit, CI calculated using the Exact method

Table reproduced from Table 3 in Paper 2B

Study III

Objectives

The objective of this study was to explore the experience of daily life in patients discharged home after minor stroke or TIA, with a focus on perceived health and reflection on their health behaviour, and how this was associated with their overall experience of returning to everyday life in relation to potential sequelae of stroke.

This may contribute to a better understanding of the patient perspective in how the stroke might affect their health behaviour and to identify more effective and supportive strategies to provide health behavioural counselling in the clinical setting and follow-up care.

Method

In extension of the pilot study (Study II) we conducted an exploratory qualitative study based on semi-structured interviews with selected participants at various times after discharge.

We developed an interview guide containing both broad and specific questions to guide the interviews (Table 5). The discussions stemmed from both the researcher's clinical experience and supporting literature, with the main assumptions being that health behaviour and behavioural change are highly affected by social support, perception of behavioural control, and self-perceived health. Interviews were conducted as face to face at the same hospital ward where the participant had been initially hospitalised. Interviews were conducted either individually or with a relative as co-participant at the stroke survivors' discretion.

The first three interviews, conducted jointly by JL and DO, were used to evaluate the usefulness of the interview guide and the setting. No changes were subsequently made to the interview guide.

Participants and procedures

All interviewees were selected among the participants in Study II, including participants from both treatment arms. Selection was mainly based on convenience sampling, but to ensure a maximum variation in age, sex, and time since discharge, as well as information-rich interviews, sampling was continued until diversity was reached [108].

The interviews were digitally recorded and transcribed verbatim. Fieldnotes taken after the interviews were used to note the interviewer's immediate reflections on the interview and tentative themes. The material was analysed using a six-step data-driven thematic analysis in accordance with Braun and Clarke [109]. A hermeneutic approach was used for further interpretation of data [110]. Familiarisation with the material was achieved by relistening to the recordings and reviewing the transcripts while taking descriptive notes. Transcripts were coded using open and descriptive codes. To search for potential themes, we categorised all codes into preliminary

Table 5 Interview guide

Domain	Subdomain	Main questions	Supporting theory
Discharge and coming home	Discharge	*Did you feel prepared to go home?* *Do you remember being told what had happened?* *Was there anything that made you feel worried or unsafe?*	[41, 43, 112]
	Being at home	*How did you experience being home in the first weeks/months after the stroke?* *Did you have any symptoms or difficulties after the stroke?* (We specifically ask about: motor/sensory deficits, speaking impairments, trouble reading, writing, watching television, fatigue, concentration, planning, and social interaction) *Did the remaining symptoms affect your everyday life?*	
Health	Self-perceived health	*How do you perceive your own health?* *Has your perception of your health changed after the stroke?* *Why do you think you had the stroke?* *Are you worried about your health?* *Do you do anything in particular to be healthy?*	[113]
	Perceived barriers and facilitators	*What motivates you to participate in healthy activities?* *Are there any barriers/facilitators for participating in healthy activities?*	[77]
	Perceived control	*Do you feel that you can have an impact on your own health?* *Do you feel that your health behaviour is important?*	[77, 114]
Medication	Importance of medication	*How do you feel about taking medication?* *Have you experienced any side-effects?*	[35, 115]
	Medication adherence	*How good are you at remembering to take your medication?* *Have you ever forgot to take the medication?* *Has your medication been changed after the discharge?* (Why? By whom?)	
Physical activity		*Do you engage in any physical activity?* (Which type? How often?)	
Tobacco use *(if relevant)*		*Do you intend to stop smoking?* *Have you tried to stop smoking?*	
Social support		*In whom do you find your primary social support?* *Have you sought support anywhere else?* *Have you lacked any kind of support* (relatives, family, professional)?	[66]

Table is reproduced from Table 1 in Paper 3. References are modified.

categories and used concept maps to visually explore connections between the codes. Observations and reflections were continually documented using memos. Patterns identified in the concept maps and memos were used to model temporary themes, and descriptions of each theme were written to define overall narratives of the content across individual interviews. To ensure that the themes were supported by the material all text connected to each theme was systematically reread. In a few instances the themes were found to be too vague in relation to the material, and relevant bundles of text were then re-coded to explore new interpretations. The themes were further developed and refined through researcher triangulation. NVivo version 12 (QSR International, Chadstone, Australia) was used for organizing the data [111].

Findings

Participants

A total of 16 stroke survivors took part in the semi-structured interviews lasting 30 to 68 minutes. On two occasions the spouses participated as co-participants.

The time since the stroke was 3–13 months (median 6.5 months). Three participants lived alone, five were still working, and eleven were retired, seven of whom still did volunteer work. Four were initially admitted with TIA, and the rest had minor ischemic stroke (SSS 58–56). Two had been readmitted for suspected stroke and one suffered a new ischemic stroke before discharge. At the time of the interview all participants were able to carry out the same activities as before the stroke, although half of them reported having remaining symptoms. Table 6 summarises the characteristics of the stroke survivors.

Themes

From the analysis we identified four overarching themes: (1) experiencing symptoms as intrusive in everyday life, (2) worrying – a new companion, (3) mastering health in a changed life situation, and (4) family relationships – balancing support and independence.

The participants generally felt ready and secure in being discharged home and expressed a wish to return to their everyday life as it had been before the stroke. Resuming everyday activities was possible for some participants within weeks, with the perceived benefits of feeling less isolated and gaining structure – while others had to face the reality that the conditions for their life situation had changed and life was not as before. This realisation led to feeling a sense of vulnerability and an awareness of being at risk, which caused them to worry. The realisation that ‘things are not as before’ did not come right away but developed over time through experience with difficulties in everyday situations that faced the participants with changes in function and persistence of symptoms. Functional changes and symptoms included neurological deficits, with fatigue and problems with memory and planning being the most disruptive. To overcome fatigue and lack of energy certain activities were given lower priority, especially social activities.

The realisation of everyday life difficulties was associated with a sense of vulnerability and caused them to worry about consequences of the stroke and of having another stroke in the future, which would become a new companion in their daily life. They worried about their current situation and the future, including the long-term prospect of becoming disabled by a new stroke and the more imminent concern of being unable to get help in the event of another stroke. The worrying was not constant but would come in waves and was experienced as reasonable in proportion to the seriousness of the illness. Some were able to regulate the worrying to prevent it

from disrupting their everyday life by for instance taking an action-oriented approach, such as taking the prescribed medication and staying active, or by cognitive strategies, such as rationalisation.

The stroke, in itself, had a minor impact on how the participants rated their own health, though it did serve as a wake-up call that their health needed more attention. The changes to the participants life conditions entailed various degrees of modification to their behaviour, ranging from not finding any changes being necessary to adapting to functional limitations, such as living healthily, taking the prescribed medication, and taking proper safety measures were warranted in order to master their new situation. Health promoting behaviour was motivated by social support in the form of encouragement from their family or having people to exercise with, an experience of being responsible for their own health, a new focus on health, monitoring their health, and being active, all of which gave them a sense of satisfaction. Barriers to physical activity included musculoskeletal pain and lack of time due to work or family obligations while side-effects were a significant barrier for taking medication. Several participants took measures to be able to get help if they fell ill again, such as carrying their mobile phone or making sure that there were people nearby.

The consequences of the stroke affected not only the participants but also their families. Family relationships were described as a significant factor in the participants mastering their new life situation, and inversely, family relationships were also affected by the way the participants mastered the situation. Support was expressed as being more considerate of each other's needs, e.g. accepting that the participant needed to rest more and encouraging them to take it easier. Conflicts might arise from the participants not feeling understood by others, e.g. relatives becoming impatient when the participant did things slower than normal or struggled to find the right words. Occasionally, they found it necessary to negotiate a balance between relatives being supportive and being overprotective, as they wanted to be as independent as possible.

Conclusion

Patients with minor stroke and TIA experience changes as both being concrete in the form of persisting symptoms and abstract in the form of worries and uncertainty about the future. Perceived health was associated with a new sense of vulnerability due to realisations about the risk of recurrent stroke. Worries were anchored within the individual to handle. For some this serves as a motivator to regulate their behaviour in order to master health. The support from relatives' is highly pronounced even that this study does not cover its significance in detail and the fact that the vast majority were having marital partner.

Table is reproduced from Table 3 in Paper 3

Table 6 Characteristics of stroke survivors in the qualitative interview study

							At RCT baseline						
Pseudonym	**Days since stroke**	**Age**	**Sex**	**Habitation**	**Occupational status**	**Education**	**Self-rated health**	**CCI**	**Smoking**	**Alcohol** (units per week)	**NIHSS**	**Allocation**	**mRS**
Neal	88	78	Male	Living with a partner	Retired, volunteer	College degree	Good	0	Previous smoker	10	1	Intervention	0
Karen	89	72	Female	Living with a partner	Retired, volunteer	College degree	Good	1	Never smoked	5	0	Control	0
Otto	92	77	Male	Living with a partner	Retired, volunteer	Master' s degree	Pretty good	1	Previous smoker	10	2	Control	1
Lisa	105	73	Female	Living alone	Retired, volunteer	Vocational	Good	1	Previous smoker	0	0	Control	0
Oliver	138	72	Male	Living with a partner	Working part-time	College degree	Good	0	Never smoked	3	0	Intervention	0
David	148	72	Male	Living with a partner	Retired	Vocational	Pretty good	0	Previous smoker	2	2	Intervention	1
Gunnar	156	68	Male	Living with partner	Retired, volunteer	College degree	Pretty good	1	Never smoked	2	0	Control	1
Frederik	195	52	Male	Living with family	Working full-time	Master' s degree	Pretty good	0	Previous smoker	1	0	Control	1
Kenneth	197	64	Male	Living alone	Working full-time	Master' s degree	Good	1	Never smoked	7	0	Control	0
Carl	232	73	Male	Living with a partner	Retired, volunteer	College degree	Good	1	Previous smoker	5	0	Intervention	1
Elisabeth	233	73	Female	Living with a partner	Retired	College degree	Pretty good	2	Previous smoker	7	0	Intervention	1
Julia	240	74	Female	Living alone	Working part-time	Vocational	Pretty good	0	Previous smoker	7	4	Control	1
James	286	69	Male	Living with a partner	Retired	Vocational	Pretty good	0	Previous smoker	0	2	Control	2
Paul	287	67	Male	Living with a partner	Working full-time	College degree	Pretty good	1	Never smoked	21	1	Intervention	0
Patrick	331	77	Male	Living with a partner	Retired, volunteer	Vocational	Good	4	Previous smoker	1	0	Intervention	0
Oscar	399	76	Male	Living with a partner	Retired	Vocational	Good	0	Previous smoker	30	1	Intervention	0

CCI Carlson Comorbidity Index, **NIHSS** National Institute of Health Stroke Score, **mRS** modified Rankin Scale at the time of the interview

Part 3 – General discussion

Discussion of results

This thesis used different study designs with the common purpose of developing a procedure for providing health behavioural counselling and interventions to patients with minor stroke or TIA. We performed a systematic review and meta-analysis to gain an overview of the approaches already described in the scientific literature, which showed that behavioural intervention could potentially have beneficial effects on stroke risk factors, especially when exercise elements were included. Methodological heterogeneity and limitations, however, prevented us from providing clear recommendations on potentially superior approaches.

Based on existing evidence and theories of behavioural change we hypothesised an approach and performed a randomised controlled feasibility study to test the intervention in clinical practice. We found that it was possible to identify relevant patients early after hospital admission, to randomise participants, and to retain them in the study until follow-up. Few, yet appreciable, changes had to be made to the study protocol, but the overall setup and the structured, theory-based counselling approach was found to be feasible.

Lastly, we conducted a qualitative interview study with selected participants from the pilot study to explore the experience of daily life in patients discharged home with a focus on perceived health and reflection on their health behaviour, and how this is associated with their overall experience of returning to everyday life in relation to potential sequelae of stroke. We found that the stroke had given the patients a new sense of vulnerability related to the awareness of being at risk and the persistence of symptoms. This was nonetheless perceived as normal and reasonable in view of the gravity of the disease. Some participants found that their concerns served as a motivation to modify health behaviour, while others found that engaging in healthy activities helped them control their worries.

Effects of behavioural interventions after stroke

The systematic review contributed evidence on the potential effects of various interventions designed to modify health behaviour to mitigate vascular events or risk factors for vascular events in patients with cerebrovascular diseases. The most promising effect was found on systolic blood pressure, which was also the most frequently reported outcome measure, and the effect seemed to be enhanced by including physical activity in the intervention.

Several systematic reviews have previously explored a variety of issues related to health behaviour and secondary prevention in patients with stroke [6, 58, 59, 116]. Deijle *et al.* [59] found an effect on blood pressure related to cardiac exercise and the length of the intervention; Lawrence *et al.* [58] observed an effect on waist circumference, anxiety, cardiac events, and blood pressure; and Bridgwood *et al.* [6] saw that implementing organizational changes had an effect, but not due to interventions on patient behaviour.

The varying results might be caused to some extent by differences in research questions and eligibility criteria, though differing statistical approaches might be the cause, implying that different assumptions were made about the data. We used random effects models for all our meta-analyses, similar to Bridgwood *et al*. [6]. Lawrence *et al.* [58] used fixed effect models for all meta-analyses assuming that "*all studies were functionally identical*", while Deijle *et al.* [59] alternated between fixed and random effects models depending on the observed heterogeneity.

Fixed effect models assume that the results of the different studies represent the same underlying effect and that all variation can thus be attributed to sampling error, while random effects models allow the effect size to differ between studies, and therefore takes variation from other sources into account. Fixed effect models have more statistical power, but it is rarely reasonable to assume sampling to be the only source of error in clinical research [117]. The studies we included had substantial methodological heterogeneity, and we did not find the assumption of a fixed effect model to be justified as differences in study populations, procedures, and length of both interventions and follow-up might all potentially contribute variation to the models.

Suitable approaches to health counselling

The overall purpose of our research was to identify approaches to health counselling suitable for patients with minor or transient cerebrovascular diseases. In the systematic review we examined the content of the interventions to assess if any practical or theoretical approaches had advantages over others, though we were unable to find any clear patterns. Almost all included studies used multimodal approaches and we identified several different targets, procedures, and modes of disseminating skills and information, such as different combinations of counselling, patient and relative education, and changes to the organisation of health care provision. The degree of diversity prevented us from designating any single approach as superior, but it does emphasise the complexity of the area, which calls for interventions integrating several approaches in parallel in a manner flexible enough to accommodate the problems of individual patients.

Our feasibility study used the 5As model to guide the counselling sessions [69], in combination with selected techniques from Miller and Rollnick [78]. The 5As model organises the counselling session into a sequence of distinct phases. Through the study we found that the model provided

the sessions with a rigorous structure helping to keep the conversation on track. Each of the distinct phases has a specific function in the session, adding varying emphasis to the contribution of the patient and the health professional. This helps the counselling to become a two-way conversation with a balance of contributions from both the patient and the health professional. Using a well-structured approach to health behavioural counselling might be helpful to health professionals [118].

The aim of our intervention was to support the patients in being able to take care of their own health, either independently or with formal or informal support, by providing them with knowledge, abilities, and confidence when needed. This included knowledge about the disease and behavioural risk factors, the ability to set realistic goals and to identify strategies for obtaining these goals and where to find help and support, while confidence was supported through encouragement and recognition.

In the intervention we employed a patient-centred approach to the counselling with inspiration from Miller and Rollnick, which emphasises an acceptance of the patient and a focus on the patient's needs and life situation [78]. The role of the health professional in the patient-centred approach is not to tell the patient what to do or to provide answers. Their role is to accept patients as experts in their own lives and contribute with specific knowledge about potential consequences of the behaviour and support patients in setting goals and finding appropriate strategies to obtain them [78, 81, 82].

Hospital stays are often of a short duration and health professionals therefore only have a limited time frame to provide counselling. Gaining deeper insight into the life of the patient is therefore not always possible. Solutions based on an insufficient understanding of the patient's situation would likely be generic and possibly based on a stereotypical preconception of the patient [119], rendering them unhelpful. For this reason, patients are likely better equipped to find solutions that fit into their own lives. In our qualitative interviews the participants reported a variety of circumstances that were of importance for their health behaviour, such as work, family responsibilities, physical limitations, safety concerns, and previous experiences. Their health behaviour was not separate from these circumstances and any change to their behaviour would need to be integrated into their general life situation.

Miller and Rollnick also highlight the patient-centred approach as an effective tool to prevent or diminish conflicts, which would otherwise divert attention from the actual focus of the counselling. Negative attitudes among health professionals can have substantial consequences for the quality of care. Patients' experience of stigma or judgement in relation to overweight have, for instance, been reported to result in patients mistrusting the care providers, making them less

inclined to adhere to health recommendations and more inclined to avoid future contact with health care providers. Stereotypical attitudes among care providers have also been found to affect their clinical decision making and how they communicated with the patients [119]. One American survey study reported that the terms *obese*, *fat*, and *morbidly obese* were perceived as blaming and stigmatising when used by health professionals in relation to weight loss [120]. Notably, 19% reported that feeling stigmatised would make them avoid future appointments, and 21% that they would seek a new doctor [120]. In our qualitative study a few participants noted that "preachy" comments from family members or health professionals would make them more obstinate towards changing their behaviour.

Targets of the counselling

Although the term *lifestyle intervention* is frequently used and implies that the target of the intervention is the participant's lifestyle, most studies only address specific health behaviours or a limited array of behaviours and evaluate the effects using behavioural or physiological parameters as outcomes. The scientific literature therefore only provides evidence for the effects of changing these behaviours, and consequently health professionals can only make evidence-based recommendations regarding specific health behaviours, while broader recommendations on how to live one's life become moralising in nature.

Our feasibility study focused on a predefined set of health behaviours (smoking, physical activity, and adherence to preventive medication), because we hypothesised, based on existing evidence, that these potentially would have the greatest influence on blood pressure and the risk of recurrent stroke.

Physical activity had the highest priority among the participants, in both previously active and inactive participants. Adherence to medication was addressed with all participants, although those participants not already taking medication emphasised this the most. Counselling on smoking cessation was only relevant with two participants.

In the qualitative interviews, participants highlighted physical activity as important for their health, while several also mentioned being more focused on eating a healthier diet. All interviewees perceived medication as important, although persistence in taking it was frequently affected by side effects.

Lifestyle is per definition an internalised part of a person's self-identity, while a person's temporal actions can be externalised. Addressing the patient's lifestyle, rather than the specific behaviours, might seem more threatening, pushing the patient to control the fear instead of the danger [121]. In a systematic review Peters *et al.* [122] found that appealing to negative emotions, such as fear, had a positive effect on participants with high self-efficacy, but had the opposite

effect on participants with low self-efficacy making them more likely to retain an unwanted behaviour.

Furthermore, using the term *lifestyle change* might imply that health can only be obtained through radical changes to one's way of living, which can be overwhelming to some patients. However, the evidence does not support that simultaneous change of broad behavioural domains is more effective than focusing specific behaviours or a limited array of behaviours. There might, on the other hand, be some indication that most of the health benefit from behavioural change is obtained just from an increase in physical activity alone, although it cannot be ruled out that the participants who increased physical activity were also more likely to change other behaviours that enhance the effect of the physical activity, such as being more adherent to medication.

The 5As model recommends providing specific and individually relevant advice and facilitating the participant to set concrete goals, which can realistically be obtained within a given timeframe. This presumes a focus on concrete behavioural elements.

During the interviews all participants were asked to talk about their experience of what happened when they had their stroke and were admitted to the hospital. Most participants were able to give reasonable descriptions of the stroke itself – but many had difficulties describing what had happened once they were hospitalised. Some even had trouble recalling the exact diagnosis they received. Other studies have found dispersal in stroke patients' ability to receive and retain information given by health professionals [51, 67]. Reed *et al.* [51] found that the patients considered the information more relevant if it had a connection to their life situation, making it easier to acquire. As a result, health behavioural counselling might be more efficient if specifically targeting the problems relevant for the individual patient and is provided in a manner that takes the patient's life situation into account.

Length and timing of the intervention

In the feasibility study we attempted to recruit participants before they were discharged based on the assumption that the time just after admission constitutes a window of opportunity in which the patient might be more receptive to counselling. Most stroke patients from the catchment area are admitted to Nordsjællands Hospital, while post-discharge care is mainly provided by the primary care physicians. Early recruitment consequently offered the opportunity to get in contact with a large proportion of the target population. The disadvantages of very early recruitment, in the context of an accelerated patient pathway, is the short length of the hospital stay, within which potentially eligible patients had to be identified, invited to participate, given time to consider participation, and the intervention had to be administered. As a result, there was not enough time

to invite some potentially relevant patients before discharge, and one patient was excluded because he was discharged before the intervention could be given (Figure 2).

Deijle *et al.* [59] found an enhanced effect on systolic blood pressure in interventions lasting more than four months, however, we were unable to reproduce any association between length of the intervention and effect size when using different cut-offs (*3–12 weeks*; *13–52 weeks; >52 weeks*). In a meta-analysis of smoking cessation interventions on hospitalised patients Rigotti *et al.* [123] found, on the other hand, that the interventions needed to have follow-up sessions at least one month after discharge for them to be effective. This implies that a certain amount of intervention time is needed for the behavioural change to become established, but that prolonging the intervention beyond this does not enhance the effect further. However, we did not find any evidence of an association between the length of the interventions and their attrition rates. Thus, a longer intervention length is not likely to cause a higher drop-out rate.

Our meta-analysis showed a trend towards a greater effect size in studies with very early recruitment of participants (recruitment before discharge), although it was not statistically significant (p-value = 0.19). As a result, we do not have any evidence supporting that a window of opportunity exists, as we had otherwise hypothesised. In contrast, we did identify an association between the time of recruitment and the attrition rates, implying higher drop-out rates in studies with very early recruitment [73]. However, the differences in attrition rates might be a sign of a selection bias, suggesting that participants recruited later potentially represent a selected subpopulation. Approaching patients while they are still hospitalised rather than at the post-discharge follow-up might allow health professionals to reach a broader segment of the target population despite some practical feasibility issues.

Use of technology to promote physical activity

Wearable activity trackers to monitor physical activity have become popular in research and among ordinary consumers. A convincing amount of research has documented that wearable activity trackers have a low to moderate positive effect on physical activity in various types of target groups [124–126].

In our feasibility study we issued wearable activity trackers to participants in the intervention group to motivate them to do physical activity. They showed no noticeable resistance to using the device but did identify several challenges. The device had a long battery life which meant participants did not have to charge the device. The tracker's four-week memory limited the number of times participants had to transfer data to the smartphone application. The data transfer required downloading and installing an application on a smartphone or tablet, creating a unique user account on the application, and a Bluetooth connection. None of the participants were able to do this

without some level of support or supervision. A few participants either did not own a smartphone or tablet, or they had older version that was unable to run the application.

In a systematic review of 28 RCTs (n = 7454) that used activity trackers to promote physical activity in healthy adults Laranjo *et al.* [124] found that participants who used the trackers were significantly more active with a mean of 1850 more steps per day corresponding to a standardised mean difference of 0.35 (95%CI 0.236–0.465). Liu *et al.* [125] observed similar results, although with smaller effect sizes, in sedentary elderly, which Chaudhry *et al.* [126] also found to be the case in community-dwelling adults. Lynch *et al.* identified four RCTs that tested the effect of wearable activity trackers in stroke survivors, but the meta-analyses were too underpowered to draw any clear conclusions on the effects in this patient group.

Both Liu *et al.* and Chaudhry *et al.* were able to compare studies using simple step counters and more advanced activity trackers and found the effects to be either similar or slightly better for simple step counters [125, 126].

Elsworth *et al.* [127] found that pedometers might have a bias towards underestimating steps taken by adults with neurological conditions compared the healthy adults. In a trial of web-based patient education to increase stroke knowledge in Korean stroke survivors Kim *et al.* [100] found that 70% of otherwise eligible patients had to be excluded because they did not have access to a computer with internet connection.

When using technology as part of interventions for the elderly and patients with neurological conditions it is advisable to thoroughly consider possible limitations in terms of accessibility and the technical skills of the participants, and possibly allocate resources to provide help and support.

Patients' experience of health and returning to everyday life

The exploratory qualitative interview study (Study III) contributed with insights into novel aspects of patient experiences of returning to everyday life with the difficulties that the stroke had entailed and a more nuanced depiction of their thoughts and feelings related to this.

It suggested that the participants associated their health and behaviour within a lens of worrying for future life prospect and perceived changes in their life condition. Some were able to resume participation in everyday life within weeks, though often they became increasingly aware that minor cognitive deficits, difficulties in planning and multi-tasking, decreased memory and fatigue influenced their health believes and behavioural patterns.

The experienced changes could be concrete in the form of persisting symptoms and abstract in the form of worries and uncertainty about the future. Wood *et al.* [128] described the return as a non-linear process that involves patients progressing slowly one step at a time, while Barnsley *et al*. [52] described it as a continuous process of exploration of their abilities, not just to carry on as

usual, but also as a way of regaining a meaningful sense of independence and belonging in the world [50, 112, 128].

An important theme in our study was the presence of a new sense of vulnerability and feeling of being at risk of a new stroke, which prompted the patients and their relatives to worry. The worries were an individual experience that they had to handle and keep bay for themselves to maintain their everyday life. The concerns were perceived as reasonable in light of the seriousness of the illness and for some it served as a motivator to engage in health-promoting activities. However, some participants found that they had to regulate their worrying to maintain their everyday life. Connolly and Mahoney [43] found that participants would persistently have worries in the back of their minds, but that understanding why the stroke had happened and integrating the illness into their self-image helped them master the new situation.

Social support, usually from the spouse, was important for the participants in mastering their illness, while they simultaneously wanted to maintain independence – not only to be functional independence, but also as an acknowledgement of mutual obligations and not wanting to be a burden on the relatives. Previous studies have further emphasised the importance of support from relatives and health professionals in protecting against negative emotions, increasing resilience, and providing hope and motivation [128, 129]. The participants reported that the sense of support could be weakened when they did not feel acknowledged, e.g. if the relatives were being overprotective or impatient with them, which supports the findings of previous studies that noted the lack of support could make the participants feel unimportant and unheard [47, 50, 67, 128].

Stroke risk was attributed to a range of potential causes, such as an active lifestyle, positive and negative thoughts, or just coincidence. Different narratives about the cause and urgency of the stroke seem to affect patients' willingness to engage in or change health behaviour. Some stroke victims seem to perceive an association between their own health behaviour and the stroke, urging them to change behaviour, while some might blame themselves for the stroke as reported by Taule and Råheim [47]. Patients who do not perceive any connection between their own behaviour and the stroke or perceive the stroke as a lesser threat might on the other hand be more reluctant to change their health behaviour [67].

Methodological strengths and limitations

To obtain an overview of the research field we conducted a systematic review of the existing literature and thoroughly examined the feasibility and potential effects of the proposed interventions. The meta-analyses of potential effects allowed us to examine the effects on various

outcomes and to make stratified models of the impact of a variety of characteristics. A content analysis of the proposed interventions allowed us to identify elements hypothesised to influence patient behaviour.

Defining the eligibility criteria of a systematic review is often a trade-off between sensitivity and specificity. Setting specific criteria in terms of population, intervention, comparison, or outcomes, makes it easier to generalise the results of the study. However, it will also narrow the sensitivity in terms of identifying studies that could potentially be clinically relevant and benefit the patients. Although the overall focus was patients with minor stroke and TIA, we chose to broaden the scope of the review to include all studies on stroke and TIA populations to identify all studies of potential clinical relevance. The term 'minor stroke' lacks a formal definition and using this as an eligibility-criteria might cause the cut-off for inclusion to become arbitrary. In thirteen of the included studies the study population had minor stroke and/or TIA, of which eight had specified this as the target population, while five on included such according to the description of the participants. Only five studies provided a specific definition of minor stroke (either based on symptom severity or functional ability). Ten studies had broader inclusion criteria resulting in a wider range of stroke severities, although most participants seemed to have milder strokes. In six studies the stroke subtype or severity was not reported. Stratifying the meta-analysis of systolic blood pressure by study population (*Minor stroke/TIA*; *All strokes*; *Unknown*) did not show a difference in the effects of the intervention ($p = 0.16$), although this might be due to fewer participants and a high degree of heterogeneity ($I^2 = 66\%$) in the *Minor stroke/TIA* strata. Due to the complex nature of behavioural change we chose to include all interventions targeting health behaviour with only minor assumptions about the potential causal structure behind the effects of the interventions. The broad inclusion allowed us to investigate the versatility of the approaches already researched, although it inversely restricted the generalisability of the results and the possibility to make clinical recommendations.

Based on the reviewed literature and theoretical models we proposed an intervention. To test the feasibility of the intervention in clinical practice we performed a pilot study with a randomised controlled design on a limited sample size, primarily to assess the efficacy and acceptability of randomising the participants. The strength of a randomised design is that the allocation of participants becomes independent of any *a priori* participant characteristics making the observed contrasts between allocation groups unaffected by confounding factors [130]. Designed to test interventions on a limited sample pilot studies are not usually powered to show an effect of the intervention [131]. Employing a randomised design increases the likelihood of generating data that

can aid in planning larger randomised trial and that can be incorporated in meta-analyses in the field.

In the protocol we had planned to use a simple five-level Likert scale to evaluate the participants satisfaction with the intervention, along with an open-ended question about how the intervention could be improved. This approach turned out to be incapable of capturing sufficiently nuanced answers, which is why the results have not been reported. A more sensible approach to evaluating the intervention might be focus-group interviews or workshops with previous participants and relevant clinicians in which new ideas and perspectives could be developed through shared discussions.

The use of resources, such as time and materials, are reasonable to consider when a new treatment is implemented into an existing patient pathway. It is therefore not uncommon to estimate the use of resources as part of a feasibility study, so that the overall cost of implementing the treatment can be evaluated. We chose not to include quantitative estimation of resource use in our feasibility study as we wanted the content of the counselling and the patient-centred approach to be the primary focus. We were concerned that the measurement of e.g. use of time would shift the focus away from the patient- and professional perspective and towards organisational considerations.

The qualitative interview study (Paper 3) allowed us to directly ask the participants about their experiences, reflections, motives, and attitudes – providing detailed insights into aspects that are not readily observable but can aid in better understanding why people act as they do [132]. We chose to use the method of interpretive thematic analysis proposed by Braun and Clarke [109] because it has a clearly defined procedure for inductively developing themes but still permits approaching each step flexibly. The well-defined procedure adds transparency to the process and facilitates the involvement of the research team.

Thematic analysis is well-suited for identifying patterns in the data by coding features in the raw data and then combining these codes into preliminary themes for further development and interpretation to describe central tendencies of interest. The focus of thematic analysis is to identify themes across the data, making this type of analysis suitable describing tendencies in a broader set of data, though less suited for making deeper descriptions of individual experiences [109].

Behaviour is complex and relies on a multitude of biological, psychological, and social factors. To embrace this complexity, we need to study behaviour from multiple perspective, which is achieved by applying a variety of methodologies to the same research field. Quantitative methods are appropriate for describing health behaviour in terms of what the participants do and its effects; while qualitative methods are suitable for understanding the motives and intentions that go beyond

the observable actions and the social context in which the behaviour is performed. Examining health behaviour using methods from both research traditions provides a broader, more detailed understanding of the subject at hand.

Considerations regarding outcomes

The predominant purpose of providing health behavioural counselling to patients with stroke is to prevent recurrent cardiovascular events. As a result, the optimal outcome measure of interventional studies the prospective rate of recurrent events. However, determining this can be challenging, and most studies, including ours, use intermediate outcome measures, such as changes in the behaviour of interest (amount of physical activity) or physiological measures (blood pressure).

Our systematic review identified four studies measuring the effect of behavioural interventions on the rate of recurrent strokes. However, when the results were pooled the effect size was not statistically significant (RR 1.08 [95%CI 0.78–1.50]). Although this result was based on a large sample size the lack of observed effect might be due to insufficient time of observation, as only 10% of the participants were observed for more than a year [73].

An early recurrent event is likely linked to baseline factors that are already present and thus independent of the intervention, which means a time lapse potentially exists from the effect of the intervention on the behaviour and onwards to the effect on the risk of recurrent strokes. Consequently, an extended follow-up time might be required to observe a potential effect, but the optimal duration of the observation time is presently unclear.

A further challenge to the statistical power of a study with a long observation period could be attrition due to mortality. In a randomised design the mortality rate should be independent of group allocation, but a substantial loss of participants would limit the final sample size, a result that can only be counteracted by recruiting hundreds to thousands of participants.

The primary measure of effect in the feasibility study was systolic blood pressure because it: (1) is the main risk factor for stroke, (2) is likely to have changed within the 12-weeks intervention period of, and (3) can potentially be affected by several aspects of the intervention (physical activity, better adherence to antihypertensive medication, and smoking cessation).

Selected self-reported health behaviours (physical activity, adherence to prescribed medication and smoking) were used as secondary outcome measures.

The advantage of using intermediate outcome measures, such as blood pressure or time spent on physical activity, is that changes often can be observed quickly, making it possible to estimate the effects of the intervention with a limited follow-up time. But we rely on the assumption that the changes we observe are strong enough to affect the risk of a recurrent stroke and that the derived change in the recurrence risk will persist.

Physical activity was measured using the International Physical Activity Questionnaire - Short Form, which includes questions about time spent on activities of varying intensities within the last seven days. Most participants were reasonably specific about the time spent on exercise, but some found it difficult to state time spent on non-exercise activities and sedentary time. This issue might introduce variation with a bias towards overestimating the time spent on low intensity activities.

We considered the option of using activity trackers to measure the amount of physical activity directly in both allocation groups. But a solution was not available that prevented the usual care group from seeing the measurements. The inability to sufficiently blind the usual care group could potentially alter their physical activity, weakening the contrast between the groups.

In the feasibility study (Study II) we assessed the rate of adherence to medication by asking the participants how many doses they had missed in the past seven days, however, none of them reported having missed any doses. Yet, in the qualitative interviews, when asked if they had missed any doses after discharge, several participants confirmed that they had and recalled specific situations. It cannot be ruled out that non-adherence was also underreported because some participants were simply not aware of it happening.

Although the intervention did not target body composition, fatigue, and self-rated health in the follow-up assessment, we chose to include them. Body mass index and waist-hip ratio are commonly used in research, and we included both as measures of body composition as they might represent secondary indicators of changes in health behaviour.

Fatigue, common after a stroke [41], might affect patient motivation and capacity for engaging in health behavioural change, although this has not previously been investigated. For this reason, we wanted to test the feasibility of assessing fatigue both at baseline and at follow-up. Patients' self-assessment of health have been found to be associated with a range of health outcomes [113] and might also have some influence on health behaviour.

Considerations for selecting participants and for non-participation

The target population was patients with minor stroke or TIA who were discharged home. The generalisability of the results of an interventional study to a broader target population can be affected by how participants are selected. If the eligibility criteria are too restrictive potentially relevant patients might be excluded, and if the criteria are not specific enough unsuitable patients might be included – both scenarios potentially resulting in selection bias.

The study protocol (Paper 2A) defined a set of eligibility criteria that limited participation to patients who were in the target population of interest and to patients who would be able to undertake all aspects of the intervention. Most exclusions in the feasibility study were in accordance with the eligibility criteria defined in the protocol, either because they were not part of

the target population or would be unable to complete the intervention. However, we also had to exclude 106 patients due to unanticipated reasons (Figure 2). Further development of the protocol must incorporate these factors as formal exclusion criteria to enhance specificity although these patients would have been excluded regardless.

The qualitative interview study only recruited participants from the feasibility study, as we already knew them and their background story, which could enhance the quality of the interviews. It is possible, though, that patients who chose not to participate in the feasibility study differed from participants in ways that might affect both their experiences of returning home and their relationship to health and health behaviour.

Additional analysis on the differences between participants and non-participants in the feasibility study was not possible because the non-participants did not provide consent for collection of personal data. But the proportion of non-participants was within the range identified in the systematic review. Auton *et al*. [68] found that stroke survivors who participated in a motivational interviewing intervention rarely had a clear intention to change behaviour shortly after the stroke, as they focused on getting better and on the relation to their family. The phenomenon is thus not exceptional and might imply that a part of the target population lacks the resources to engage in behavioural change shortly after the stroke.

In a clinical context some of the patients who declined to participate could potentially be motivated to participate in counselling if it is offered as part of the standard treatment. But this may have required several inquiries, which would be unethical in a research context.

Three former participants in the feasibility study declined to participate in the qualitative interviews because they did not feel they had anything to contribute, while three additional former participants never replied to the invitation to participate. Participants who had been excluded or had dropped out of the feasibility study were not contacted.

Considerations for the qualitative interviews

Braun and Clarke emphasise that sufficient time must be spent on each phase of the analysis to allow an analytic narrative to form beyond the specific content of the data [109]. When I first began the coding process it quickly became clear that I had not spent enough time on the familiarisation phase, which resulted in codes that were too broad and that relied too much on the structure of the interview guide. Consequently, the first set of codes was discarded and the material relistened/reread while descriptive notes were about the content taken to aid the subsequent coding.

A second potential pitfall highlighted by Braun and Clarke is how to determine which patterns constitute a theme and developing the themes into coherent. rich interpretations of the data [109]. To facilitate the development of the themes we employed researcher triangulation consisting of

regularly scheduled discussions of potential interpretations of the data. Especially the themes involving worrying and the participants' relationship to their families were initially unsatisfactory. All data connected to these domains were reread and recoded in the context of a more comprehensive interpretation.

The sample size was limited by the bounded number of potential participants in the feasibility study, but the strong quality of the interviews contributed *information power* to the study [108], for example: (1) the interview guide was based on well-established theories and extensive clinical experience within stroke care, (2) the informants were well-reflected and articulate about their experiences, and (3) all informants knew the main interviewer from the feasibility study.

We attempted to recruit participants to maximise variation and diversity, but there may be aspects of the target population that were not captured. This will naturally limit the scope of our conclusions and thus also the transferability of the results beyond the study population. Patients with severe speech impairments or cognitive deficits were excluded from the feasibility study and consequently also from the qualitative study. These patients constitute a particular challenge when doing qualitative research in populations with neurological conditions because their symptoms may affect both their ability to express themselves and their perception of their situation. Consequently, they are often excluded from studies, causing their perspectives and needs to be underreported [50, 133].

Conclusion

From the current research project we can conclude that: (1) behavioural intervention likely have a beneficial effect on a range of outcomes in patients with stroke, including blood pressure and blood lipids, and including physical training in the intervention might enhance the effect, (2) it was possible to identify patients who could potentially benefit from behavioural intervention, recruit and randomise them early after admission and retain most participants in the study until follow-up, and derive statistical estimates that may guide the design of large-scale randomised controlled trials, and (3) that participants experienced a new sense of vulnerability related to persisting symptoms and awareness of the risk of recurrent strokes which can affect their health behaviour.
In summary, we can conclude that patients with minor stroke or transient ischemic attacks experience a new sense of vulnerability beyond functional limitations. They might therefore need early initiated interdisciplinary supportive care to restructure health and life prospects.

Supportive behavioural interventions may help to optimise care outcomes in minor stroke, such as lowering blood pressure and optimising medical adherence. Structured health promotion

counselling may engage patients to initiate health behaviour change and promote increased levels of physical activity.

Clinical implications and future research

In the current research project, we found that it was possible to identify a considerable number of patients for whom health behavioural counselling might be beneficial and that the patients found this sort of counselling meaningful.

Some participants noted that the health professionals had not asked them about their behaviour. This implies that health professionals might experience barriers to initiating this type of conversation, perhaps because they are not confident about how to do it or because they do not want to pry into their patients' personal lives. We must nevertheless be cautious in assuming that patients and their relatives already know how their behaviour affects their health and how to take care of their own health.

Our results imply that some patients with stroke have a limited ability to take in information, and therefore prefer health behavioural counselling to be specific and personally relevant to allow them to focus on the issues that directly concern them.

Patient disease and health behaviour cannot be seen in isolation; both are woven into their entire life situation. The most suitable strategies for patients to take care of their own health are often the ones that take the entire life situation into account. Generic one-way communication will not be relevant for all patients and cannot attend to every patient's individual conditions and problems. Making the counselling a conversation with the patient can help identify the areas relevant for each patient and aid the patient in sorting out less relevant information. It will further assist the health professional in ensuring that the information is provided in a useful way that can be put into action.

However, providing behavioural counselling as an individualised conversation requires that the health professional is capable of provide specific, relevant recommendations for the patient's behaviour – which again requires knowledge about the disease and patient group. The health professional must also be able to manage the conversation to keep it on track, while giving patients the opportunity to reflect of their own behaviour and find suitable goals and strategies. The 5As model represents a good method for giving the conversation structure while still being flexible enough to fit a range of issues.

The purpose of health counselling is not necessarily to make the patients do what the health professional recommends, but to prepare patients to take care of their own health. This does not always mean that patients should know everything or be able to do everything on their own. For some of them it might mean being able to know when and how to seek help and support.

Although it is beyond the scope of this research project, an important consideration is how health behavioural interventions should be organised. Previous research has proposed different models of organisation, including interventions that are based in hospitals, out-patient clinics, at primary care physicians, or in community settings. A few studies have proposed shared care models, which involve collaboration among several parties [87, 98, 99, 102].

All of these models have strengths and limitations and transferring specific models between different health care systems might be challenging. Consequently, the model of organisation must be adapted to the needs and resources of the specific healthcare system while taking into account organisational (resource allocation), professional (qualifications and expertise), and user (needs and preferences of patients and relatives) perspectives.

Previous research represents a substantial body of evidence describing the prognoses of patients with stroke, but this evidence mainly describes mortality and severe disability. More research is required on the long-term consequences of minor strokes and the more subtle effects they have on patients' everyday lives. Although some of the consequences are unspecific or vague, causing them to fall under the radar, they can still be of significant burden for the patients and their relatives and have considerable impact on their lives. Additional research is necessary on the prevalence and impact of the physical, mental, and cognitive consequences of minor strokes and how they affect people's lives and health behaviour.

Research on behavioural interventions in patients with stroke are marked by selection bias, where distinctive groups of patients are not included in the research. Greater knowledge is required about how non-participating patients differ from those that participate, and about their reasons for not participating, as alternative approaches might be needed to activate this group.

Further, a more detailed understanding is required of the prevalence of certain health behaviours in patients with stroke and of patient perception of risk and readiness for changing behaviour. Our qualitative interview study found implications that some patients did not have a clear understanding of the association between their stroke and their own behaviour. In future research developing approaches to change health behaviour it might be useful to address the patient perceptions of the cause of their stroke and how they perceive health recommendations.

The relatives have been highlighted as pivotal for patients with stroke to manage their lives after stroke. Previous research further implies that the consequences of a stroke and the changes to everyday life can be a considerable burden for relatives. As a result, a deeper understanding is needed of how relatives are affected and how we, as health professionals, can involve and support them in being better prepared to take on their new role in the relation to the patient.

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Appendices

PAPER 1: Jacob Liljehult, Thomas Christensen, Stig Molsted, Dorthe Overgaard, Monique Mesot Liljehult, Tom Møller. Effect and efficacy of lifestyle interventions as secondary prevention. Acta Neurol Scand. 2020 Oct; 142(4): 299-313. Doi: 10.1111/ane.13308. PMID 32620044.

PAPER 2A: Jacob Liljehult, Stig Molsted, Tom Møller, Dorthe Overgaard, Mary Jarden, Lis Adamsen, Thomas Christensen. Lifestyle counselling as secondary prevention in patients with minor stroke and transient ischemic attack: study protocol for a randomized controlled pilot study. Pilot Feasibility Stud. 2020 Mar 25;6: 40. doi: 10.1186/s40814-020-00583-4. PMID 32226634.

PAPER 2B: Jacob Liljehult, Stig Molsted, Tom Møller, Dorthe Overgaard, Thomas Christensen. Lifestyle counselling as secondary prevention in patients with minor stroke or transient ischemic attack: a randomized controlled pilot study. (Manuscript prepared for submission)

PAPER 3: Jacob Liljehult, Tom Møller, Thomas Christensen, Stig Molsted, Dorthe Overgaard. Mastering health, safety, and worries after minor stroke: a qualitative study. (Manuscript prepared for submission)

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REVIEW ARTICLE

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Effect and efficacy of lifestyle interventions as secondary prevention

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Introduction: Improvements in health behaviour are often recommended as part of secondary prevention in patients with stroke and transient ischaemic attack. However, there is a lack of knowledge as to how this is applied in clinical practice.

Aim: In this systematic review and meta-analysis, we examined the effect of counselling or educational intervention directed at individual or multiple behavioural risk factors on blood pressure and other reported outcomes.

Methods: PubMed, Embase, PsycInfo, CINAHL, Scopus and Web of Science were systematically searched. Meta-analyses were conducted on all outcome measures if appropriate. A qualitative analysis of the content of the interventions was conducted to review which elements the interventions consisted of.

Results: Twenty-nine randomized controlled trials were identified. Fourteen reported effects on systolic blood pressure, and pooled results showed a significant beneficial effect (n = 2,222; −3.85 mmHg [95%CI −6.43; −1.28]). The effect was greatest in the four interventions which included supervised training (n = 174; −9.83 mmHg [95%CI −16.56; −3.09]).

Conclusion: Modifying health behaviour in stroke survivors might have a moderate beneficial effect on blood pressure, especially if the intervention includes supervised physical training.

KEYWORDS

adherence, exercise, health behaviour, health counselling, physical activity, smoking, stroke, transient ischaemic attack

1 | BACKGROUND

Stroke is one of the leading causes for morbidity, disability and death worldwide. The risk of recurrent stroke is 12%-13% within the first year of the index stroke and 4%-5% in the following year.[1] Recurrent stroke is an independent risk factor for loss of function, institutionalization and death.[2] Secondary and tertiary prevention are therefore important parts of stroke management.

The pathological mechanisms behind vascular diseases are complex. It is evident that hypertension and other modifiable risk factors, such as smoking, physical inactivity, unhealthy diet and abdominal obesity, are all contributors to the risk of both ischaemic and haemorrhagic stroke.[3,4]

Improved health behaviour is therefore widely recommended as part of the secondary prevention,[5] yet our knowledge as to how these recommendations are applied effectively in clinical practice is sparse.

The results of previous systematic reviews have been inconsistent. In a meta-analysis of 42 randomized controlled trials (RCT) of stroke service-based secondary prevention interventions, Bridgwood et al[6] found no significant difference in any outcome measures, although there was a tendency towards a greater effect of organizational changes compared to educational/behavioural interventions. In a meta-analysis of 20 RCTs of multi-modal behavioural interventions, Lawrence et al[7] found a significant effect on systolic and diastolic blood pressure, waist circumference, but not on blood lipids, blood glucose, body composition, smoking or fruit/vegetable consumption. In a meta-analysis of 22 RCTs of lifestyle interventions in patients with stroke or transient ischaemic attacks (TIA), Deijle et al[8] found a significant effect on systolic blood pressure, but not on diastolic blood pressure, cardiovascular events or blood lipids. A greater effect on systolic blood pressure was found in interventions which included aerobic exercise training and with a duration > 4 months.

Most behavioural interventions are multi-modal and complex. The varying results in previous studies might imply that some elements contribute more to the effect than others. We therefore need to examine the content of the interventions in order to identify the most effective approaches to behavioural change after stroke or TIA.

2 | OBJECTIVES

The primary objective was to examine the effect of single- or multimodal counselling or educational intervention directed at individual

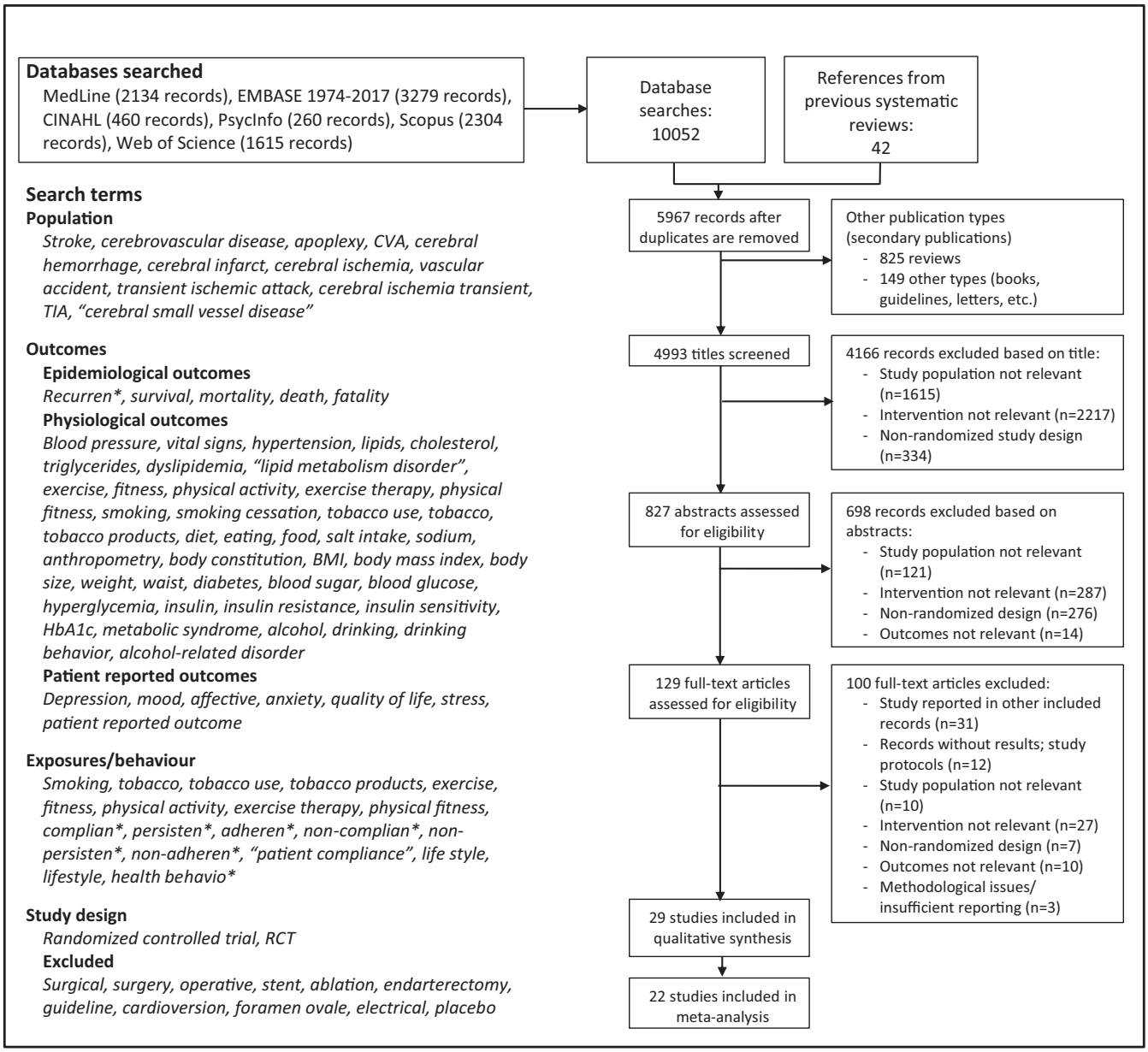


FIGURE 1 Search strategy and selection of reports

TABLE 1 Characteristics of the study participants

Study (Country)	Number of participants				Age (y)	Female (%)	Included diagnoses	Primary inclusion criteria
	Screened	Eligible	Randomized	Completed				
Adie 2010 (UK)[36]	*NA*	*NA*	56	56	72.5 ± 8.9	50%	TIA (43%)/minor stroke (57%)	Age ≥ 18 y, hypertension, living at home
Allen 2002 (USA)[20]	417	238	93	73	70.5 ± 11.0	56%	IS (70.5%), TIA (29.5%)	Admitted from home, Rankin scale ≤ 3
Allen 2009 (USA)[37]	*NA*	*NA*	380	319	65 ± 14.3	50%	IS (NIHSS ≥ 1)	Discharge to home
Barker-Collo 2015 (NZ)[21]	3487	*NA*	386	331	*NA*	*NA*	Stroke *(not specified)*	Age ≥ 16 y
Boss 2014 (NL)[38]	*NA*	*NA*	20	18	63 y (range 46-78)	30%	TIA (40%), minor stroke (60%) (NIHSS < 4)	Age ≥ 18 y, able to walk independently
Boysen 2009 (DK)[39]	2000	*NA*	314	276	69.7 y (IQR 60-78)	44%	IS	Age ≥ 40 y, able to walk unassisted
Brunner Frandsen 2012 (DK)[40]	*NA*	*NA*	94	88	53% 50-65 y/ 26% >65 y	42%	IS & TIA	Age < 76 y, current daily smoker
Chanruengvanich 2006 (TH)[41]	*NA*	*NA*	72	62	63 ± 7.2	68%	TIA & minor stroke	Age > 45 y, able to exercise safely
Cheng 2018 (USA)[22]	1476	*NA*	404	404	57.4 y	40%	IS & TIA	SBP ≥ 120 mmHg, English or Spanish speaker
Damush 2011 (USA)[23]	1017	*NA*	63	63	65.6 ± 10.5	2%	IS	Age ≥ 18 y, English speaker
English 2016 (AU)[42]	*NA*	72	33	33	67.3 ± 13.0	33%	IS (76%) & ICH (24%)	Living at home
Evans-Hudnall 2014 (USA)[43]	210	*NA*	60	52	53.0 ± 10.7	39%	IS & TIA	Age ≥ 18 y, discharged home
Faulkner 2014 (NZ)[24]	167	97	60	51	68.5 ± 10.4	48%	TIA/minor stroke	First ever TIA/ stroke
Flemming 2013 (USA)[44]	1083	110	41	36	71 ± 11.0	41%	Atherosclerotic IS (54%) & TIA (46%)	Age ≥ 55 y, at least one uncontrolled risk factor
Gillham 2010 (UK)[25]	91	*NA*	52	50	68.3 ± 12.5	*NA*	First time IS & TIA	First time stroke/ TIA
Holzemer 2011 (USA)[45]	274	*NA*	52	27	62.4 ± 12.0	*NA*	IS & TIA	Age ≥ 18 y
Hornnes 2009 (DK)[26]	917	470	349	303	69.3 ± 12.9	49%	IS, ICH, TIA	Relevant diagnosis
Irewall 2015 (SE)[27]	1102	*NA*	537	484	70.8 ± 10.8	43%	IS (60%), ICH (4%), TIA (37%)	Able to participate
Joubert 2006 (AU)[28]	421	224	97	80	66.5 ± 13.7	50%	IS, ICH, TIA	Age ≥ 20 y, discharged to GP management
Joubert 2009 (AU)[46]	*NA*	*NA*	233	186	65.9 ± 13.4	45%	IS, ICH, TIA	Age ≥ 20 y, discharged to GP management
Kim 2013 (KR)[29]	278	*NA*	36	34	65.7 ± 7.5	36%	IS	Living at home, access to the internet

(Continues)

TABLE 1 (Continued)

Study (Country)	Number of participants				Age (y)	Female (%)	Included diagnoses	Primary inclusion criteria
	Screened	Eligible	Randomized	Completed				
Kirk 2014 (UK)[30]	70	*NA*	24	24	67.2 ± 9.4	21%	Minor stroke (25%), TIA (75%)	Fit for exercise
Kono 2013 (JP)[31]	159	134	70	68	63.5 ± 9.4	31%	Minor stroke (non-cardioembolic)	Discharged home, mRS 0-1
McManus 2009 (UK)[47]	1804	*NA*	205	102	65.1 ± 9.3	48%	Stroke (63%), TIA (27%), amaurosis fugax (4%), TGA (1%), RAO (2%), MID (3%)	At least one relevant risk factor
Moren 2016 (SE)[32]	127	*NA*	88	56	71.1 ± 8.7	53%	TIA	Medically stable, able to communicate in Swedish
Nir 2004 (IL)[48]	*NA*	*NA*	155	*NA*	73.1 ± 7.3	48%	Stroke *(not specified)*	Relevant diagnosis
Peng 2014 (CN)[49]	*NA*	*NA*	3821	3330	60.9 ± 11.6	32%	IS & TIA	Age ≥ 18 y, clinically stable, habitually independent in ADL
Wan 2016 (CN)[33]	186	103	91	80	59.7 ± 12.4	29%	IS	Age > 35 y, habitually independent in ADL
Wolfe 2010 (UK)[34]	941	*NA*	523	487	21% >80 y	47%	IS (85.7%)	Registered with a study GP

Abbreviations: ADL, Activity of Daily Living; GP, General practitioner; ICH, Intracerebral haemorrhage; IS, Ischaemic stroke; MID, Multi-Infarct Disease; mRS, Modified Rankin Scale; NIHSS, NIH Stroke Scale; RAO, Retinal Artery Occlusion; TIA, Transient Ischaemic Attacks.

or multiple lifestyle risk factors on blood pressure and hypertension in patients with stroke or TIA.

The secondary objectives were to examine the effects on other outcomes, including recurrence of stroke and TIA, biochemistry, and health behaviour, and to examine the content and methodology of previous interventional studies.

3 | METHODS

A systematic review of RCTs of counselling and educational interventions with stroke patients was conducted in accordance with the PRISMA statement.[9]

3.1 | Search method and eligibility criteria

Database searches were made in PubMed, Embase, PsycInfo, CINAHL, Scopus and Web of Science (see Figure 1); citations in previous articles were screened for relevant references. The search strategy was designed in collaboration with an experienced research librarian. Studies were included if they were RCTs of counselling or educational interventions (individual or group) targeting single or multiple lifestyle risk factors in hospital, outpatient or community settings, including adult (≥18 years) patients with first or recurrent stroke or TIA. The primary outcome of interest was systolic blood pressure; secondary outcomes included stroke recurrence, vascular events, mortality, physiological outcomes (eg blood pressure, blood lipids, body composition), health behaviour (eg smoking habits, alcohol consumption, diet, physical activity) or patient-reported outcomes.

Studies were excluded if they were not randomized and if the intervention was a pharmacological treatment (eg nicotine replacement) or focused on neurological rehabilitation of physical function or everyday activity.

Titles were screened, and duplicates and non-original publications (reviews, editorials, guidelines etc) were excluded by JL. Titles and abstracts were assessed by JL in the remaining references excluding studies that clearly included patients without cerebrovascular diseases, if the intervention was not relevant, if the design was

non-randomized, or no relevant outcomes were reported. In case information in the abstract was insufficient for exclusion the full text article was assessed. Full-text assessment was performed by three reviewers independently (JL, MML, TM), and discrepancies were discussed until consensus was achieved.

Data extraction was done by two reviewers independently using a standardized extraction form. Extracted data included details of the study design, population, intervention (timing, setting, procedures, dosage, mode of delivery), comparator intervention and relevant outcomes.

Methodological quality and risk of bias were assessed by two reviewers independently using the Cochrane Risk of Bias tool (RoB),[10] and discrepancies were resolved by discussion. If agreement was not meet, a third reviewer was consulted.

3.2 | Qualitative analysis of the content of the intervention

A qualitative analysis of the reported interventions was conducted with the aim of gaining an overview of how the interventions attempted to modify the behaviour of the participants. Relevant parts of the articles, explaining the procedures of the interventions, were evaluated line by line and coded with explanatory expressions. Summaries of the interventions were constructed based on the codes, simple enough to give an overview but with enough details to be loyal to the original reports. The summaries were used to identify the main elements of the approaches and the targets of the intervention.

Each element of the intervention was categorized using the World Health Organization's ICF-model as a framework, categorizing the elements according to *body function & anatomy*, *activity*, *participation*, *personal factors* and *environmental factors*.

3.3 | Quantitative meta-analyses

Meta-analyses were performed to estimate the overall treatment effect on all outcome measures reported in a comparable manner in at least two studies using Review Manager 5.3.[11] As a result of variance in study populations, we used random effects models in all meta-analyses.[12] For continuous variables, we used mean differences if all studies reported the same scale of measurement; or standardized mean difference if the studies reported the same outcome with different measures or scales. For dichotomous variables, we used the Mantel-Haenszel method for the risk ratios with 95% CI. All tests were two-sided, and P-values $< .05$ were considered statistically significant.

Subgroup analyses were based on standardized mean differences in systolic blood pressure as it was the most commonly reported outcome measure. Kendall's rank correlation coefficient (Kendall's tau) was used to quantify the associations between study characteristics and standardized mean differences and completion rates, respectively.

4 | RESULTS

We identified 10 052 records through database searches and additionally 42 through citations in previous systematic reviews.[7,8,13] Of the 10 094 records, 4127 were duplicates, 825 were reviews, and 149 were other publication types (eg guidelines or editorials). The remaining 4993 records were screened for eligibility based on title and abstract, and 4864 records were excluded. All 129 remaining records were full text assessed by JL, MML and TM, and inclusion/exclusion

TABLE 2 Content of the interventions

Targets of the intervention
Looking after one's health (16 studies)
Modification of behaviour, such as smoking, alcohol use, diet, or adherence to medication[24-26,30,31,33,34,36,40,41,43-45,47-49]
Physical activity
Counselling in physical activity (8 studies)[24,30-32,38,39,41,42]
Supervised training (aerobic and strength training) (4 studies)[24,30,31,38]
Managing stress & anxiety (5 studies)[23,24,30,41,43]
Activities of daily living (2 studies)
Planning or training of everyday activities[23,48]
Knowledge about stroke and health
Knowledge about stroke, risk factors, lifestyle, or medication (21 studies)[20,22-26,29-31,34,36,37,39,41,43-47,49]
Increasing cognitive skills, such as motivation and self-management (10 studies)[21-25,32,33,36,42,44]
Specific skills such as goal setting or planning behaviour (7 studies)[23,33,41-44,48]
Approaches of the intervention
Communicating knowledge
Written material (4 studies)[36,43,45,47]
Computer-based patient education (4 studies)[29,31,34,49]
Patient education/group education (12 studies)[22,24,25,29-31,37,41,44,46,47,49]
Counselling
Counselling in health behaviour and behavioural change (20 studies[22,26,27,31,33,38-40,47,49]; of which 10 studies used a specific technic or theoretical framework[21,23,25,32,36,41-43,45,48])
Medication
Nicotine substitution (1 study) [40]
Self-monitoring
Monitoring of behaviour, physical activity, blood pressure (4 studies)[22,26,41,42]
Evaluation of needs
Evaluation of the participants' needs (6 studies)[20,27,28,37,46,48]
Support
Professional support (22 studies)[20-23,25,27,28,32,33,36-48]
Peer support from other patients (4 studies)[22-24,38]
Social support from family, friends or relatives (6 studies)[20,37,41,43,46,48]

TABLE 3 Characteristics of the interventions

Study (Country)	Time of recruitment	Length of intervention	Time of follow-up	Main elements of the intervention	Theoretical framework	Targets
Adie 2010 (UK)	<1 mo	4 mo	6 mo	Individual counselling; written educational material; telephone follow-up	Social-cognitive theory	Medication, blood pressure, lipids, smoking, diet, exercise
Allen 2002 (USA)	Before discharge	3 mo	3 mo	Home visits; evaluation of need for care and support; plan for primary physician		Health, psycho social well-being
Allen 2009 (USA)	Before discharge	6 mo	6 mo	Home visits; evaluation of need for rehabilitation, care and support; plan for primary physician	The chronic illness model	
Barker-Collo 2015 (NZ)	28 d	9 mo	12 mo	Individual counselling; support in goal setting; telephone follow-up	Motivational interviewing	
Boss 2014 (NL)	<1 wk	8 wk	6 + 12 mo	Supervised exercise; individual counselling	Motivational interviewing	Physical activity
Boysen 2009 (DK)	<90 d	24 mo	24 mo	Individual counselling; repeated encouragement for physical activity; inpatient follow-up		Physical activity
Brunner Frandsen 2012 (DK)	*Unclear*	4 mo	6 mo	Individual counselling; telephone follow-up; nicotine substitution		Smoking
Chanruengvanich 2006 (TH)	*Unclear*	12 wk	12 wk	Individual counselling; patient education; self-regulation training; home visits; telephone follow-up	Self-regulation theory (Bandura, Pender)	Stroke knowledge, diet, weight, stress management
Cheng 2018 (USA)	<90 d	12 mo	12 mo	Group & individual counselling; telephone follow-up; blood pressure monitoring	The chronic care model	Blood pressure, medication adherence, smoking, physical activity, depression
Damush 2011 (USA)	<1 mo	12 wk	6 mo	Patient education; individual counselling in goal setting; telephone or face-to-face follow-up	Self-efficacy theory (Bandura)	Risk factor management
English 2016 (AU)	>6 mo	7 wk	7 wk	Individual counselling; monitoring of physical activity; telephone follow-up	Motivational interviewing	Physical activity
Evans-Hudnall 2014 (USA)	Before discharge	4 wk	4 wk	Individual counselling; training in self-management skills; written material; out-patient follow-up		Risk factor management
Faulkner 2014 (NZ)	<2 wk	8 wk	12 mo	Supervised exercise; individual counselling; patient education; group exercise	The health belief model	Vascular risk factor control, diet, blood pressure, medication adherence, stress management
Flemming 2013 (USA)	<12 wk	1 y	1 y	Patient education; individual counselling; summary to the primary physician; out-patient and telephone follow-up	Motivational interviewing	Diet, exercise

(Continues)

TABLE 3 (Continued)

Study (Country)	Time of recruitment	Length of intervention	Time of follow-up	Main elements of the intervention	Theoretical framework	Targets
Gillham 2010 (UK)	*Unclear*	3 mo	3 mo	Individual counselling; patient education; face-to-face or telephone follow-up	Motivational interviewing, the transtheoretical model	Risk factor control
Holzemer 2011 (USA)	Before discharge	3 wk	3 mo	Individual counselling; face-to-face and telephone follow-up	Self-determination theory	Smoking, diet, exercise, stroke knowledge, medication
Hornnes 2009 (DK)	*Unclear*	10 mo	1 y	Home visits; individual counselling; monitoring of blood pressure		Medication adherence, lifestyle factors
Irewall 2015 (SE)	1 mo after discharge	12 mo	12 mo	Individual counselling; evaluation of preventive treatment; telephone follow-up		Medication, lifestyle factors
Joubert 2006 (AU)	Before discharge	12 mo	12 mo	Shared care between hospital and primary physician; regular outpatient follow-up; telephone reminders		Physical activity, smoking, alcohol, medication, depression, blood pressure, lipids, risk factors
Joubert 2009 (AU)	Before discharge	12 mo	12 mo	Shared care between hospital and primary physician; regular outpatient follow-up; telephone reminders		Physical activity, smoking, alcohol, medication, depression, blood pressure, lipids, risk factors
Kim 2013 (KR)	1-12 mo	9 wk	3 mo	Web-based patient education		
Kirk 2014 (UK)	<1 mo	6 wk	6 mo	Supervised exercise; group education		Physical activity, medication, alcohol, exercise, diet, stroke knowledge, well being
Kono 2013 (JP)	Before discharge	24 wk	3.3 y	Supervised exercise; computer-based patient education		Exercise, salt intake
McManus 2009 (UK)	<3 mo	3 mo	3.6 y	Individual counselling; written material; patient education; out-patient follow-up		Lifestyle, medication, stroke knowledge
Moren 2016 (SE)	<2 wk	Unclear	6 mo	Individual counselling; exercise prescription; outpatient follow-up	Motivational interviewing	Physical activity
Nir 2004 (IL)	<13 d	12 wk	3 + 6 mo	Individual counselling; evaluation of self-care agency; regular home visits	The self-care model (Orem)	Self-care (incl. lifestyle management)
Peng 2014 (CN)	<30 d	Unclear	12 mo	Implementation of standard guidelines; individual counselling; web-based patient education		Smoking, diet, exercise, stroke knowledge
Wan 2016 (CN)	Before discharge	3 mo	6 mo	Individual counselling; training of self-management skills; telephone follow-up		Self-management, health behaviour
Wolfe 2010 (UK)	<6 mo	6 mo	12 mo	Algorithm-based prevention plan sent by mail; enhanced corporation with the primary physician		

was based on agreement between all three authors. Ultimately, 29 studies were included in the review (Figure 1 and Table 1).

4.1 | Description of the studies

4.1.1 | Targets of the intervention

Table 2 provides an overview of study rationales and contents of the interventions. In 16 studies, the aim was to enable the participants to take care of their own health, for example facilitate modification of lifestyle factors or adherence to preventive medication. In eight studies, the primary aim was to increase the participants' level of physical activity, and in additionally four studies physical activity was a minor part of the counselling. Four studies included supervised strength and aerobic exercise. Studies including physical activity also included other elements, such as patient education or health counselling (Table 2).

Counselling on anxiety or stress management was included in five studies, and two studies included counselling on participation in everyday life. Twenty-one studies aimed at providing participants with knowledge on their disease, lifestyle and vascular risk factors, or preventive medication. Nine studies aimed at providing participants with the cognitive skills and know how to modify their health behaviour, such as motivation, self-efficacy or self-management skills, while seven studies aimed at providing specific behavioural skills, such as self-monitoring, goal setting and planning behavioural change.

4.1.2 | Approaches of the interventions

Of the 21 studies, which included communication of knowledge, twelve included direct patient education, of which two were provided in a group setting. Four studies employed written educational material and four employed computer-based education. Patient counselling was part of the invention in twenty of the studies, and in ten of them, the counselling was based in a specific technic or theoretical framework. Most of them employed face-to-face counselling the first time, while the following sessions were provided either face-to-face or by telephone. Only one study provided nicotine substitution as a medical aid for smoking cessation.

Four studies used self-monitoring; either of physical activity, behaviour or blood pressure as a part of the intervention. Additionally, six studies had a regular assessment of the participants need for assistance or help.

Systematic support in relation to behavioural change or handling own health was a part of the intervention in 23 of the studies. In 22 of the studies, the support was provided by health professionals affiliated with the intervention team, in some cases in addition to other types of support, and in a single study, the support was provided by the participants' primary physician. Four studies employed group elements or activities to facilitate peer support from other participants, and in six studies, the participants' own social network was used as support, either by directly including the relatives in activities or by encouraging participants to seek support from friends and relatives.

In nine studies, the intervention or part of the intervention comprised changes to the organization of the care, for example home visits, implementation of clinical guidelines, or changes in the communication or collaboration between the hospital and the primary physicians.

4.1.3 | Time of recruitment and length of intervention

In eight studies, participants were recruited before hospital discharge; in ten studies, they were recruited within the first month; and in seven studies, they were recruited between 1-12 months after admission. In four studies, the time of recruitment was not reported (Table 3).

The length of the interventions varied between three weeks and two years, with seven studies in each interval of 3-12 weeks, 12-13 weeks, 13-52 weeks and ≥ 52 weeks. One study did not report the length of the intervention (Table 3).

4.2 | Risk of bias in included studies

Random allocation of participants was an inclusion criterium in this review, and all studies therefore stated that they were RCTs. In 25 of the studies, the method of randomization was clearly reported, but in three studies this was unclear, and in one study, the method was not adequately described. In 19 studies, measures to conceal future allocations were clearly stated; in nine studies, it was unclear, and in one study, measures were inadequate. None of the studies had adequate blinding of participants and personal delivering the intervention; although one study used "placebo" counselling, it was unclear if this blinding was effective as the personnel was not blinded. In 13 studies, the outcome assessments were adequately blinded, but in the remaining studies outcome measurements were performed by unblinded study personal. In 22 of the studies outcome, data were either complete or the incompleteness was clearly accounted for. In four studies, the completeness of data was unclear, and in three studies, outcome data were clearly missing and not adequately accounted for. In 24 of the studies, results of all outcome measures were clearly reported; in four studies, the results were not clearly reported in the secondary outcomes measures, and in one study, the results were reported in an ambiguous and unclear manner. Other potential biases were found: Five studies had baseline imbalances of

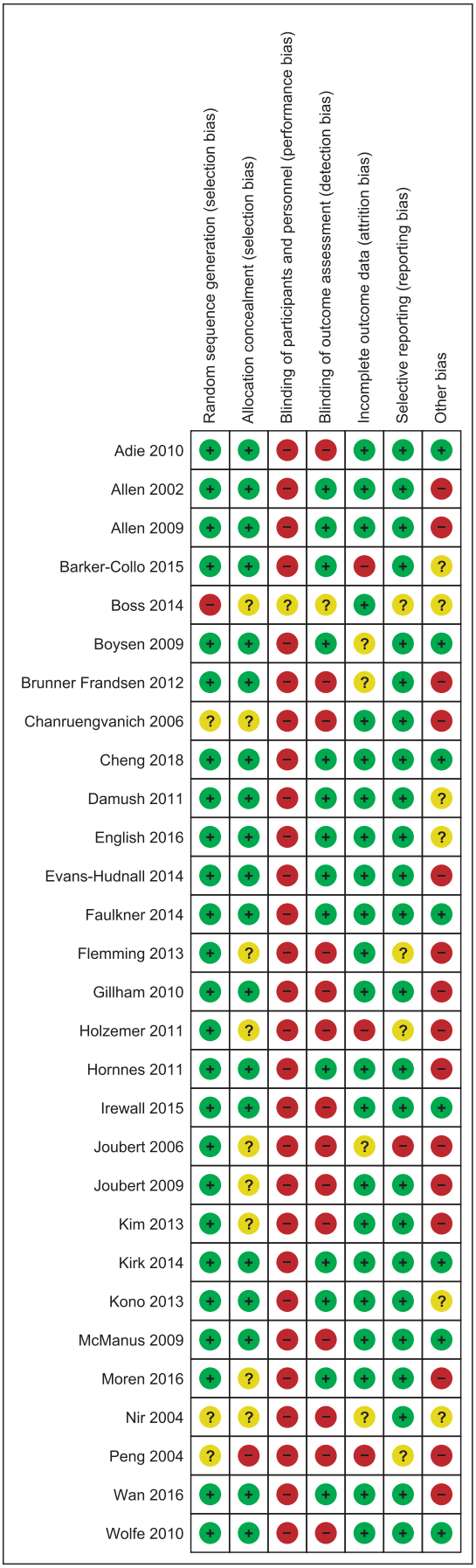


FIGURE 2 Risk of bias summary: the authors' judge-ments about each risk of bias item for each included study

potential clinical importance; two studies were stopped early without a clear reason stated; and several studies used block randomization with fixed block sizes potentially resulting in study personal being able to foresee the allocation of some participants before recruitment (Figure 2).

4.3 | Effects of interventions

The most frequent outcome reported were systolic and diastolic blood pressure, which were both significantly lower among participants in the interventions (Tables 4 and 5, Figure 3). Six studies reported the number of participants with a systolic blood pressure < 140 mmHg at follow-up. In a random effects model, the pooled risk ratio was 1.14 (95%CI 1.03-1.25), equivalent to a number needed to benefit of 13.83 (95%CI 8.25-42.84) (Table 5, Figure 3).

Sub-analyses of the studies reporting systolic blood pressure showed that both interventions with and without supervised physical training had a significant effect, but the effect was greater in interventions including supervised training (9.4 (95%CI 3.1-16.6) vs. 2.6 (95%CI 1.0-4.3) mmHg). The inter-strata differences were not significant for time of recruitment, length of the intervention, intervention based on a specific theoretical framework or family support (Table 5).

4.4 | Feasibility

The number of potential participants screened for eligibility was reported in 20 studies; of 16,227 screened, 3545 were included for participation. The inclusion rates ranged from 3.8%-69.3% with a weighted mean of 22% (95%CI 21.2-22.5). The rate of inclusion from the number of patients eligible for participation was reported in eight studies; out of 1448 eligible patients, 836 were included for participation. Inclusion rates ranged from 37.3%-88.3% with a weighted mean of 58% (95%CI 55.2-60.3). Completion rates of participants were reported in 28 studies. Of 8254 participants randomized, 7173 were retained until the final follow-up. Completion rates ranged from 49.8%-100% with a weighted mean of 86.9% (95%CI 86.2-87.6). Five studies achieved a completion rate of 100% (Table 1).

There was a significant correlation between completion rate and the timing of recruitment (tau = 0.377; $P = .018$), an indication of a more complete follow-up in studies with late recruitment. No significant correlation was found between completion rate and the length of the intervention (Kendall's tau = −0.07; $P = .63$) or time of follow-up (Kendall's tau = −0.08; $P = .59$), respectively.

TABLE 4 Outcomes reported in each study as either primary, secondary, or part of a compound outcome measure

	Adie 2010	Allen 2002	Allen 2009	Barker-Collo 2015	Boss 2014	Boysen 2009	Brunner Frandsen 2012	Chanruengvanich 2006	Cheng 2018	Damush 2011	English 2016	Evans-Hudnall 2014	Faulkner 2014
Vital signs	1			1	2			2	1				1
Biochemistry	2			1	2			2	2				2
Body composition	2												2
Adverse events		c	c		1	2					1		
Function	2	c	c			2		1					
Medication adherence					2				2	2		c	
Patient activation	2		c							2			
PROM	2	c	c	2				2		1	2	2	
Risk factors		c	c		2		1		2	2		1	
Physical activity	2					1			2		2		

Note: 1: Primary outcome, 2: secondary/tertiary outcomes, c: part of a composite outcome, PROM Patient Reported Outcome Measure.

5 | DISCUSSION

In this systematic review, we have explored the effects of health behaviour counselling and behavioural modification in patients with cerebrovascular diseases, and potential mediators of the effects. We found that, although the effect sizes are modest, supportive behavioural interventions might have some additional effect on systolic and diastolic blood pressure, the prevalence of hypertension and low-density lipoprotein in the blood compared to usual care. Including supervised exercise as part of the intervention seems to enhance the effect on systolic blood pressure. Besides that, we did not find any intervention elements capable of mediating the effectiveness.

Interventions were applied as add-on to usual care though the exact definitions and components of usual care seldom were elucidated. Consequently, we are not able to determine the causal mechanism and effects related to the intervention as the effect on, for example systolic blood pressure might have been mediated by enhanced adherence to medication rather than an isolated interventional effect.

We identified a range of different intervention element, which might all contribute to the overall effect of the interventions, but only blood pressure and total blood cholesterol were reported in ≥ 10 studies, and the lack of uniformly reported outcomes made it difficult to compare the effectiveness of the elements.

The inclusion and completion rates varied considerably between studies. Approximately half of eligible patients consented to participation, and the rate of successful follow-up ranged from 50%-100%. We found some association between the timing of recruitment and the completion rates, implying that participants are more likely to leave the study if they are recruited early. A reason for this might be that studies with late recruitment primarily approached patients in outpatient clinics, hence including patients who are more motivated to participate in additional treatment, if offered. In contrast, the time of recruitment did not seem to impact the effect of the intervention. Recruiting participants at an early stage is therefore feasible, but a higher rate of attrition should be expected.

Previous systematic reviews of behavioural interventions in patients with stroke have arrived at different conclusions. Deijle et al[8] found an effect on systolic blood pressure; Lawrence et al[7] found an effect on waist circumference, compliance to preventive medication, anxiety, cardiac events, and systolic and diastolic blood pressure, while Bridgwood et al[6] found no effect of behavioural interventions, but minor effects on TIA recurrence and cardiovascular risk scores in organizational changes. Different statistical approaches might explain the varying results: Lawrence et al used fixed effect models, assuming that "all studies were functionally identical," whereas Bridgwood et al used random effects models and Deijle et al different models depending on the degree of heterogeneity. We used random effects models in all our meta-analyses, assuming that clinical diversity in study populations, settings and interventions contributed to variation between studies,[12] and therefore, we did not find the assumptions of a fixed effect model to be justified.

In a systematic review of qualitative interviews with participants in secondary stroke prevention interventions and their family members, Lawrence et al[14] found that the participants experienced the interventions as meaningful. The informants highlighted the importance of support from health professionals, family and other stroke survivors, and that the interventions helped them acquire the knowledge and confidence needed to change behaviour.

Several interventions incorporated formal support from health professionals and informal support from peers and the participants' family and social network; patient education or other means of communicating knowledge; or counselling in goal setting,

Flemming 2013	Gillham 2010	Holzemer 2011	Hornnes 2009	Irewall 2015	Joubert 2006	Joubert 2009	Kim 2013	Kirk 2014	Kono 2013	McManus 2009	Moren 2016	Nir 2004	Peng 2014	Wan 2016	Wolfe 2010
2		2	1	1	2	1		2	2	2					
2		2		2	2	2	2	2	2	2					
2						2		2	2						
									1	2			2		
						2					2	2		2	
			2				2			2			2	2	2
	1		2	2		2	2					2		2	
2	2					2		2		2		2			
1	2	1		2	2	2	2	1	2	1		2	1	1	1
											1				

planning and confidence to change behaviour. Although the formal effects of the behavioural interventions might be vague, they could be meaningful and beneficial to the patients. Cognitive difficulties and fatigue are prevalent, even among patients with minor stroke[15] and for some having a stroke can be a considerable change in their life.[16]

Health behaviour is regulated by a multitude of biological, psychological and social factors.[17] Interventions to modify patient behaviour are therefore complex in nature. At this point, we are not able to recommend any specific approach to behavioural modification. The evidence supports that the interventions should include physical exercise. Previous research indicates that behavioural interventions should address several domains[8] and have multiple points of follow-up over at least a month.[8,18]

Several potential biases were identified in the included studies. All included studies were randomized, and most of them reported the procedure of randomization and measures to conceal the allocation of future participants. Blinding measure such as assessor blinding was only reported in less than half of the studies. Furthermore, the use of self-reported outcome measures might be sensitive to rapport between the participant and the assessor.

In five studies, the results were reported in an inadequate manner: one study only reported results from a model adjusted for baseline imbalances. The remaining four lacked necessary details, for example. standard deviations, confidence intervals or exact p-values. Such inaccuracies made it difficult to assess the risk of selective reporting.

To assess the risk of publication bias, we attempted to match preliminary reports to subsequent full-text publications. We identified 23 conference proceedings, 18 study protocols and one academic thesis that were potentially relevant. Of these records, 10 did not fulfil all inclusion criteria and 20 were matched to publications already included in the search results. Of the remaining 12 reports, we managed to find trial registrations on 10 studies. This might indicate that there is a risk of publication bias, although this was less than observed in other research areas.[19]

Generalizability of the results might be limited by selection bias. The number of patients screened for eligibility was reported in 19 studies, and the number of eligible patients was reported in nine studies (Table 1). The number of refusals was reported in 15 studies[20-34] with proportions ranging from 0.6%-66.7% (median 36.8%). Only two studies[25,30] reported reasons for refusal (eg lack of time, work commitments, transportation problems, lack of interest).

Although this review was designed to be comprehensive, there is still a risk that relevant research was not included. We searched several different medical databases and searched references of previous studies, and we attempted to find full publications of preliminary reports. Due to language restrains, we could only include literature in English and Scandinavian languages. We only included study results as they were reported in the full-text articles or supplementary material-supplementary material. But we did not attempt to obtain the original datasets or any missing data.

6 | CONCLUSIONS

Interventions to modify health behaviour in patients with stroke and prevent stroke recurrence might have a modest effect; but may still be meaningful to the patient. Recruiting patients at an early stage after stroke does not seem to affect the effect, but a higher attrition rate should be expected. Supervised exercise most likely enhances the effect of the interventions on blood pressure. However, we need further research on how other approaches, including health counselling, support from professionals, relatives, or peers, patient education, monitoring of behaviour and health status, and primary and secondary sector collaboration, could benefit the patients and their relatives.

TABLE 5 Results of the meta-analyses

Outcomes	Studies	Participants	Effect Estimate	*P*-value	I^2	Quality of evidence (GRADE)
Vital signs						
Systolic blood pressure (mmHg)[21,22,24,26-28,30,31,36,38,41,45-47]	14	2222	MD −3.85 [−6.43, −1.28]	.003**	53%	⊕⊕◯◯ Low[A, B]
Diastolic blood pressure (mmHg)[21,24,26,27,30,31,36,38,41,45-47]	12	1711	MD −1.60 [−3.09, −0.11]	.04*	40%	⊕⊕◯◯ Low[A, B]
SBP < 140 mmHg[22,27,28,37,38,46]	6	1546	RR 1.14 [1.03, 1.25]	.01**	23%	⊕⊕◯◯ Low[A, B]
Heart rate (Beats per minute)[24,41]	2	113	MD −2.87 [−6.34, 0.61]	.11	0%	⊕◯◯◯ Very low[A, B, C]
Biochemistry						
Total cholesterol[21,24,28-30,36,41,45-47]	10	925	MD −4.25 [−9.27, 1.22]	.13	9%	⊕⊕◯◯ Low[A, B]
HDL[21,24,30,31,41,45]	6	552	MD 1.64 [−1.12, 4.40]	.24	0%	⊕⊕◯◯ Low[A, B]
LDL[22,27,31,38,45]	5	1003	SMD −0.23 [−0.41, −0.05]	.01**	36%	⊕⊕◯◯ Low[A, B]
Triglycerides[29,45]	2	63	MD −14.71 [−43.07, 13.56]	.31	0%	⊕◯◯◯ Very low[A, B, C]
Fasting blood glucose[24,30]	2	75	MD −0.19 [−0.47, 0.10]	.20	0%	⊕◯◯◯ Very low[A, B, C]
HbA1c[31,47]	2	170	MD 0.12 [−0.46, 0.70]	.69	63%	⊕◯◯◯ Very low[A, B, C]
TC/HDL-ratio[24,30]	2	75	MD 0.0 [−0.49, 0.49]	.99	0%	⊕◯◯◯ Very low[A, B, C]
Body composition						
Body mass index[24,30,31,46]	4	329	MD −0.44 [−1.38, 0.51]	.37	0%	⊕◯◯◯ Very low[A, B, C]
Body weight [24,31,36,44]	4	175	MD −0.53 [−4.09, 3.03]	.77	0%	⊕◯◯◯ Very low[A, B, C]
Waist-hip ratio[24,30]	2	75	MD 0.0 [−0.04, 0.03]	.83	0%	⊕◯◯◯ Very low[A, B, C]
Adverse events						
Death (All causes)[20,24,37,39,49]	5	4668	RR 0.97 [0.58, 1.61]	.37	0%	⊕⊕◯◯ Low[A, B]
Recurrent stroke/TIA[20,39,47,49]	4	4330	RR 1.08 [0.78, 1.50]	.77	0%	⊕⊕◯◯ Low[A, B]
Adverse events (All)[20,31,37,39,42,47,49]	7	4813	RR 0.77 [0.56, 1.08]	.83	0%	⊕⊕◯◯ Low[A, B]
Functional level						
Modified Rankin scale[33,36,39,46]	4	606	SMD −0.26 [−0.58, 0.05]	.11	69%	⊕◯◯◯ Very low[A, B, C]
Patient reported outcomes						
Quality of life[21,23,30,46,47]	6	1546	SMD −0.09 [−0.53, 0.34]	.67	85%	⊕◯◯◯ Very low[A, B, D]
Sub-analyses	**Studies**	**Participants**	**Effect Estimate**	***P*-value†**	I^2	**References**
Time of recruitment	**11**	**1777**	**SBP (mmHg)**	.19	40%	⊕⊕◯◯ Low[A, B]
Early recruitment[31,38,45,46]	4	303	MD −0.54 [−0.98, −0.10]			
1-4 wk[21,24,27,30,36]	5	968	MD −0.16 [−0.31, −0.00]			
Late recruitment[22,47]	2	506	MD −0.03 [−0.40, 0.33]			
Length of the intervention	**13**	**2142**	**SBP (mmHg)**	.99	0%	⊕⊕◯◯ Low[A, B]
3-12 wk[24,30,38,41,45]	5	193	MD −0.21 [−0.55, 0.13]			
13-51 wk[21,26,31,36,47]	5	875	MD −0.19 [−0.51, 0.12]			
≥52 wk[22,27,46]	3	1074	MD −0.21 [−0.33, −0.09]			
Training interventions	**13**	**2142**	**SBP (mmHg)**	.04*	76%	⊕⊕◯◯ Low[A, B]
Training[24,30,31,38]	4	174	MD −9.83 [−16.56, −3.09]			
No training[21,22,26,27,36,41,45-47]	9	1968	MD −2.61 [−4.26, −0.96]			
Theory-based intervention	**13**	**2142**	**SBP (mmHg)**	.71	0%	⊕⊕◯◯ Low[A, B]
Theory based[21,22,24,36,38,41,45]	7	973	MD −3.99 [−6.36, −1.61]			
Non-theory based[26,27,30,31,46,47]	6	1169	MD −3.35 [−5.67, −1.03]			
Family support	**13**	**2142**	**SBP (mmHg)**	.74	0%	⊕⊕◯◯ Low[A, B]
Family/relative support[41,46]	2	248	MD −2.44 [−11.26, 6.38]			
No family support[21,22,24,26,27,30,31,36,38,45,47]	11	1894	MD −4.00 [−6.91, −1.10]			

Note: All meta-analyses are based on random effects models. Mean difference (MD) was used for parametrical outcomes when all studies reported the same unit; standardized mean difference (SMD) was used for parametrical outcomes when different units were reported; risk ratio (RR) was used for binominal outcome measures.

Abbreviations: HDL, High-density Lipoprotein; LDL, Low-density lipoprotein; MD, Mean difference; RR, Risk ratio; SBP, Systolic blood pressure; SMD, Standardized Mean Difference; TC/HDL ratio, Total cholesterol/HDL ratio.

*$P < .05$,

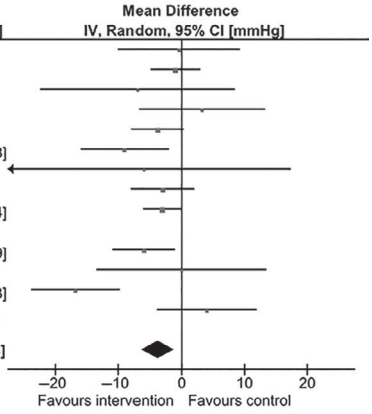
**$P < .01$,

†*P*-value for the overall effect of the model. GRADE [**50**]: A, Down-graded due to insufficient blinding, B, Down-graded due to indirectness caused by substantial different intervention, C, Down-graded because the analysis is based on limited data (few studies or few participants), D, Down-graded due to the use of indirect outcome measures.

(A) Systolic blood pressure (mmHg)

Study or Subgroup	Intervention Mean [mmHg]	SD [mmHg]	Total	Control Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI [mmHg]
Adie 2010	142	19.3	29	142.4	17.2	27	5.2%	−0.40 [−9.96, 9.16]
Barker-Collo 2015	137.41	18.79	172	138.42	17.69	172	12.7%	−1.01 [−4.87, 2.85]
Boss 2014	120	12.6	10	127	21.3	10	2.4%	−7.00 [−22.34, 8.34]
Chanruengvanich 2006	141.19	16.77	31	137.94	22.74	31	4.9%	3.25 [−6.70, 13.20]
Cheng 2018	132.3	20.5	204	136.1	20.8	200	12.4%	−3.80 [−7.83, 0.23]
Faulkner 2014	129	12	30	138	15	30	7.8%	−9.00 [−15.87, −2.13]
Holzemer 2011	138.7	31	12	144.7	30.2	15	1.1%	−6.00 [−29.26, 17.26]
Hornnes 2011	139.4	21.3	145	142.4	22.2	158	10.8%	−3.00 [−7.90, 1.90]
Irewall 2015	131.9	15.7	241	135	17.5	243	14.3%	−3.10 [−6.06, −0.14]
Joubert 2006	132.34	0	35	136.58	0	45		Not estimable
Joubert 2009	128.5	13.7	91	134.5	19.4	95	10.9%	−6.00 [−10.81, −1.19]
Kirk 2014	131.92	15.2	12	131.92	18.1	12	3.1%	0.00 [−13.37, 13.37]
Kono 2013	122.1	15.9	35	138.9	13.8	35	7.7%	−16.80 [−23.77, −9.83]
McManus 2009	143	18.8	49	139	21.6	53	6.7%	4.00 [−3.84, 11.84]
Total (95% CI)			**1096**			**1126**	**100.0%**	**−3.85 [−6.43, −1.28]**

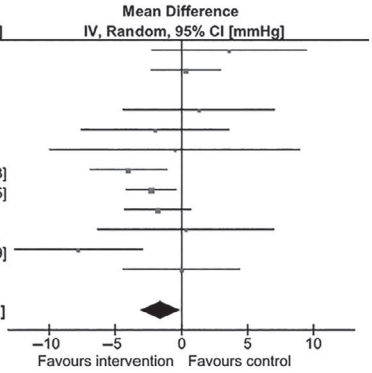
Heterogeneity: $\tau^2 = 9.78$; $\chi^2 = 25.36$, df = 12 ($P = 0.01$); $I^2 = 53\%$
Test for overall effect: $Z = 2.93$ ($P = 0.003$)



(B) Diastolic blood pressure (mmHg)

Study or Subgroup	Experimental Mean [mmHg]	SD [mmHg]	Total	Control Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI [mmHg]
Adie 2010	75.7	10.1	29	72.1	12.1	27	5.2%	3.60 [−2.26, 9.46]
Barker-Collo 2015	77.77	12.58	163	77.46	11.66	165	14.5%	0.31 [−2.32, 2.94]
Boss 2014	71	0	10	75	0	10		Not estimable
Chanruengvanich 2006	77.13	11.34	31	75.81	11.54	31	5.4%	1.32 [−4.38, 7.02]
Faulkner 2014	78	9	27	80	11	24	5.7%	−2.00 [−7.56, 3.56]
Holzemer 2011	78.4	13.6	12	78.9	10.8	15	2.3%	−0.50 [−9.94, 8.94]
Hornnes 2011	82	13.1	145	86	12.3	158	13.4%	−4.00 [−6.87, −1.13]
Irewall 2015	77.3	10.3	241	79.6	10.5	243	18.8%	−2.30 [−4.15, −0.45]
Joubert 2009	77.3	8.3	91	79.1	8.9	95	15.3%	−1.80 [−4.27, 0.67]
Kirk 2014	75	7.9	12	74.67	8.7	12	4.2%	0.33 [−6.32, 6.98]
Kono 2013	72.9	9.5	34	80.7	10.7	34	7.1%	−7.80 [−12.61, −2.99]
McManus 2009	74	10.3	49	74	12.2	53	8.1%	0.00 [−4.37, 4.37]
Total (95% CI)			**844**			**867**	**100.0%**	**−1.60 [−3.09, −0.11]**

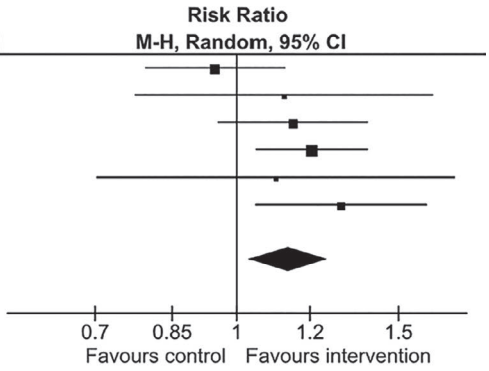
Heterogeneity: $\tau^2 = 2.18$; $\chi^2 = 16.53$, df = 10 ($P = 0.09$); $I^2 = 40\%$
Test for overall effect: $Z = 2.10$ ($P = 0.04$)



(C) Probability of reaching recommended systolic blood pressure (<140 mmHg)

Study or Subgroup	Intervention Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Allen 2009	106	190	112	190	22.4%	0.95 [0.80, 1.13]
Boss 2014	9	10	8	10	6.4%	1.13 [0.78, 1.63]
Cheng 2018	115	204	98	200	20.3%	1.15 [0.96, 1.39]
Irewall 2015	165	241	138	243	29.8%	1.21 [1.05, 1.39]
Joubert 2006	18	35	21	45	4.5%	1.10 [0.70, 1.73]
Joubert 2009	66	88	52	90	16.5%	1.30 [1.05, 1.61]
Total (95% CI)		**768**		**778**	**100.0%**	**1.14 [1.03, 1.25]**
Total events	479		429			

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 6.51$, df = 5 ($P = 0.26$); $I^2 = 23\%$
Test for overall effect: $Z = 2.52$ ($P = 0.01$)



(D) Blood LDL

Study or Subgroup	Intervention Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
Boss 2014	82	0	10	98.6	0	10		Not estimable
Cheng 2018	86.8	38.9	204	92.3	41.1	200	39.8%	−0.14 [−0.33, 0.06]
Holzemer 2011	81	21.8	12	100.9	55.8	15	5.2%	−0.44 [−1.21, 0.33]
Irewall 2015	88.8	27	241	100.39	34.7	243	42.8%	−0.37 [−0.55, −0.19]
Kono 2013	103.4	24.8	34	102.6	20.8	34	12.2%	0.03 [−0.44, 0.51]
Total (95% CI)			**501**			**502**	**100.0%**	**−0.23 [−0.41, −0.05]**

Heterogeneity: $\tau^2 = 0.01$; $\chi^2 = 4.65$, df = 3 ($P = 0.20$); $I^2 = 36\%$
Test for overall effect: $Z = 2.51$ ($P = 0.01$)

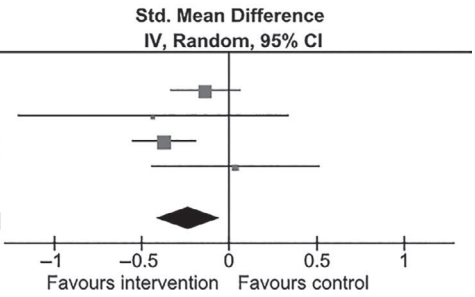


FIGURE 3 Forest plots (Only statistically significant analyses are shown)

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interests.

AUTHORS CONTRIBUTIONS

All contributors eligible for authorship are listed as authors according to the Danish Code of Conduct for Research Integrity.[35] JL designed the study and wrote the protocol in collaboration with TM, TC, SM, DO; JL performed the literature search; Study selection was performed by JL, TM, MML; Analysis was performed by JL; All authors participated in the assessment of quality and risk of bias, data extraction, and writing the report.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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Pilot and Feasibility Studies

STUDY PROTOCOL Open Access

Lifestyle counselling as secondary prevention in patients with minor stroke and transient ischemic attack: study protocol for a randomized controlled pilot study

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Abstract

Background: Most patients with minor stroke or transient ischemic attack (TIA) are discharged with little or no specialised follow-up. Nonetheless, these patients have a high prevalence of cognitive impairments and a considerable risk of recurrent stroke. Smoking cessation, physical activity, and adherence to antihypertensive and antithrombotic medication are highly recommended in patients with minor stroke and TIA. Evidence suggests that simple encouragement to change lifestyle is ineffective. Behavioural interventions might therefore be needed to support patients in managing their own health post-discharge.

Objectives: We aim to test the (1) feasibility of randomisation acceptance and an early initiated, client-centred lifestyle and behavioural intervention in a clinical setting, and (2) potential effect of the intervention on arterial blood pressure in patients with minor stroke or TIA and (3) explore the participants experience of barriers and facilitators for health behaviour after a stroke, including perceived needs and social support.

Methods: We will conduct a randomized controlled pilot trial: Eligible patients with acute minor stroke or TIA (n = 40) will be randomly allocated to either early initiated counselling with four weekly post-discharge follow-up sessions for 12 weeks or usual care. The primary outcome will be program feasibility and to discuss the relevance of arterial blood pressure as primary outcome after 12 weeks intervention. Selected participants will be invited to participate in semi-structured interviews, based on purposeful sampling, to evaluate the intervention and explore their experience of life after a stroke. The interviews will be analysed using a five-step thematic analysis approach.

(Continued on next page)

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Discussion: The study will provide evidence of the feasibility and potential effect of early initiated counselling on cardiovascular risk factors in patients with minor stroke and TIA. Qualitative interviews will contribute with a more nuanced understanding of the barriers and facilitators of health enhancing behaviour. Optimizing health behaviour counselling and providing formal support to the patients' post-discharge may ease the transition and help more patients adhere to lifestyle and medication recommendations.

Trial registration: ClinicalTrial.gov, NCT03648957

Keywords: Stroke, Transient ischemic attack, Smoking, Exercise, Physical activity, Adherence, Early rehabilitation, Health counselling

Background

Stroke is a significant cause of morbidity, mortality, and disability in both western countries and globally [1]. In Denmark, the incidence rate is 3/1000 per year, with a mortality rate of 10% in the first month [2]. More than half of patients admitted with a stroke or transient ischemic attack (TIA) only have mild neurological symptoms and are often discharged after 3-5 days of hospital admission. In spite of this, there is evidence that the patients after discharge often experience cognitive and communicative impairments such as difficulties with everyday activities, memory, fatigue, reading and participating in conversations [3]. This indicates that patients with recent minor stroke or TIA need more support than previously assumed.

One in four patients admitted with acute stroke has previously suffered a stroke or TIA. The risk is greatest shortly after the incident stroke; and within the first year the recurrence rate is 12-13% and subsequently plateauing at 5-6% per year [4]. Recurrent stroke is an independent risk factor for loss of function, institutionalization and death [5].

In the past decades, there has been an increasing focus on health behaviour in relation to the prevention of vascular diseases [6]. Arterial hypertension is the most important and prevalent risk factor for stroke and TIA (odds ratio (OR) 2.64 [2.26-3.08]; Population Attributable Risk (PAR) 34.6%). However, other lifestyle factors, such as smoking (OR 2.09 [1.75-2.51]; PAR 18.9%), physical inactivity (OR 1.45 [1.11-1.89]; PAR 28.5%), abdominal obesity (OR 1.42 [1.18-1.71]; PAR 26.5%), and unhealthy eating habits (OR 1.35 [1.12-1.61]; PAR 18.8%) contribute to the risk of stroke [7].

Preventive medication is of utmost importance for secondary and tertiary prevention in patients with stroke and TIA. The majority of patients are treated with antithrombotic drugs or drugs to reduce blood pressure or blood lipids [8]. However, several studies have found that a substantial part of the patients discontinue the drug treatment overtime [9, 10].

The harmful effects derived from lifestyle factors, and the importance of adherence to preventive medication in relation to stroke is well-documented [10, 11]. But there is still insufficient knowledge regarding how to most effectively communicate this to the patients and how to support the patient in making suitable choices to prevent recurrent strokes and progression of the disease. The results from previous studies have been contradictory. It is difficult to identify the most effective components and recommend specific interventions or components of interventions for implementation in clinical practice. Lawrence et al. [12] found in a systematic review of 20 randomized controlled trials that multimodal behavioural interventions had a beneficial effect on blood pressure in patients with stroke. Deijle et al. [13] found that lifestyle interventions had a greater effect if the intervention contained elements of physical activity. Lager et al. [14] on the contrary found no significant reduction in cardiovascular events in a systematic review of 26 randomized controlled trials of lifestyle intervention for stroke patients.

The time of inclusion in previous stroke/lifestyle intervention studies varied from a few days after stroke onset [15, 16] to several years [17]. The timing of the intervention might affect the patient's motivation and ability to adhere to the intervention, which will ultimately have an effect on the outcome. In other patient groups, it has been hypothesised that the time just after the diagnosis constitutes a certain *window of opportunity*; i.e. a limited period of time in which the patient is particularly receptive to information and behavioural changes [18].

The hypothesis of the present study is that early client-centred patient counselling with repeated follow-up sessions after discharge can reduce the blood pressure through smoking cessation, physical activity, and improved adherence to preventive medication in patients with minor stroke or TIA compared to simple encouragement to lifestyle change. The overall purpose of our research is to develop effective and clinically feasible interventions to support patients with minor stroke and TIA in engaging in health enhancing behaviour and ultimately prevent recurrent strokes.

Little research has explored how old age and cognitive impairments of this patient group affects their ability, readiness and willingness to participate in early initiated

health behavioural interventions or if there are particular circumstances both during admission and post-discharge that should be taken into account when designing this type of research study.

The aims of this study are the following:

1) to evaluate the feasibility of a client-centred patient counselling intervention focused on smoking cessation, physical activity, and adherence to preventive medication in patients with minor stroke or TIA
2) to test the potential effects of the intervention on blood pressure and other cardiovascular risk factors in patients with minor stroke or TIA, and estimate means and standard deviations for subsequent sample-size calculations
3) to explore and evaluate the perceived needs and experience of social support of the participants in relation to health behavioural changes

Methods

The study will consist of a parallel group randomized controlled feasibility trial and a qualitative interview study. Participants will be randomly allocated to either an individual face-to-face counselling intervention, with follow-up sessions post-discharge at 4 week intervals for 12 weeks, or usual care. Semi-structured qualitative interviews will be conducted with selected participants after the last follow-up.

Setting and participants

The target population is hospitalised patients with recent minor stroke or TIA who are discharged home from the hospital.

We will include patients with acute minor stroke or TIA admitted to the Department of Neurology at Nordsjællands Hospital (n = 40). Nordsjællands Hospital is a university hospital with a catchment area of 310,000 citizens. All patients with stroke or TIA in the catchment area are admitted to the hospital and treatment is free of charge. The Department of Neurology has a specialized unit for patients with acute stroke and treatment is guided by a standardized patient pathway. Patients with minor stroke and TIA are generally hospitalised for observation for 72 h.

Study and recruitment procedures

All new patients at the Department of Neurology will be screened for eligibility by the research investigator (JL). Patients are eligible if they are ≥ 18 years old, are diagnosed with TIA (ICD-10 G45.9) or minor stroke (ICD-10 I61, I63, I64; Scandinavian Stroke Scale 45-58), are discharged to their home, and can provide valid written consent. Diagnoses must be confirmed by a neurologist. Patients are excluded from the study if they have severe communication barriers, are not able to use a telephone, have severe disability prior to the stroke (WHO Performance Status > 2; incapable of self-care and mobilised less than 50% of the day), have an active abuse of alcohol or narcotics or have a severe psychiatric illness (affective disease, dementia, schizophrenia, anxiety). Eligible patients will be invited to participate through verbal and written information regarding the study purpose and method by JL. All participants must give written informed consent before participation. Participant flow is summarised in Fig. 1.

Randomization and group allocation

Simple non-stratified 1:1 randomisation will be used to allocate participants into two trial arms (intervention or usual care) after baseline testing. Randomization will be conducted in the Research Electronic Data Capture (RedCap) software [19] using a computer generated randomization sequence. The randomization sequence will be generated by JL, then concealed in RedCap, and any changes can only be made by an external administrator. Participants will be automatically randomized after baseline testing and the allocation will be subsequently locked and cannot be altered. Participants will remain in the allocated arm for the entire intervention period.

Intervention

Participants in the intervention arm will receive usual care and a nurse-led targeted lifestyle counselling focusing on smoking cessation, everyday physical activity, and adherence to preventive medication. The initial counselling will be provided face-to-face by a research investigator before the participant is discharged from the hospital. The aim of the counselling will be to engage the participant to partake a healthy lifestyle and adhere to the preventive medication and to assist the participant in finding suitable strategies to achieve his/her goals. Participants will be encouraged to bring a relative or close friend to the initial counselling session, who can be a support for the participant after discharge. The counselling will be based on the 5A's approach (Ask/assess, Advice, Agree, Assist and Arrange, see Fig. 2) [20, 21]. *Ask/assess*. At baseline all participants will be asked about self-rated health, smoking habits, and physical activity, and body mass index, waist/hip-ratio and lung capacity will be assessed. During the counselling, the participants are asked to reflect on the following: the relevance of changing behaviour; how the specific behaviour affects their risk of disease; how they think changing behaviour could be beneficial as well as perceived barriers and facilitators of behavioural change. Perceived barriers and facilitators for changing behaviour can be both personal (e.g. attitudes towards changing behaviour,

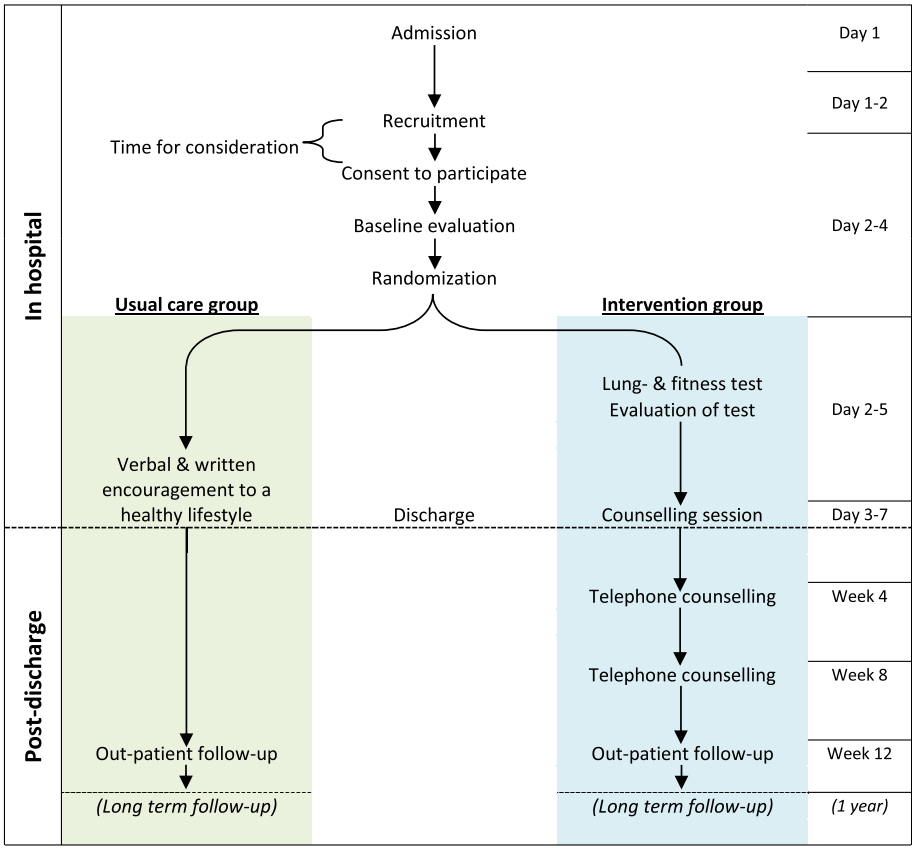

Fig. 1 Flowchart of recruitment, inclusion, allocation and follow-up of participants

attribution of risk and self-efficacy) and environmental (e.g. products, technology, surroundings, social support and services). The focus at this point in the counselling is not to find solutions, but to facilitate the participant's reflection on his or her health and health behaviour. *Advise*. The participant is given clear, specific and personal recommendations, including information on potential harms and benefits to their health and well-being. *Agree*. The participant is supported in setting goals. *Assist*. The investigator assists the participant in finding strategies to achieve the agreed-upon goals and helps the participant in acquiring the skills, confidence and social support within the participant's own environment to change behaviour. The strategies should be grounded in the previous reflections and customised to the needs, capacities, and preferences of the individual participant. *Arrange*. Follow-up sessions are arranged and, if necessary, the participant is referred to other relevant treatments.

Prior to of the initial counselling session a detailed assessment of the participant's lifestyle and physical condition will be conducted by JL (research investigator); including spirometry (FEV1/FVC measured using SpiroBank II) [22] and aerobic capacity (Åstrand-Rhyming Bike Test) [23].

Further counselling will be provided by telephone 4 and 8 weeks after discharge and will aim at maintaining motivation and adjusting goals and strategies if necessary. If the participant has not previously been motivated for changing behaviour, the willingness for change is re-assessed.

All parts of the intervention will be delivered by JL, who has extensive clinical experience as a nurse in the field of neurology.

After each counselling session, a written summary is included in the electronic patient record which is available to the participant via a personal log-in. The participant's relatives will be involved in the counselling at the participant's discretion to facilitate social support. Social support might be of particular importance in participants with cognitive impairments or limited ability to take in information.

The level of physical activity in the intervention arm will be monitored throughout the intervention period using an electronic activity tracker (Garmin VivoFit 4), which measures steps, intensity (light/moderate/vigorous activity) and estimated calories burned. The activity tracker should work as a reminder and motivator for everyday physical activity but will also provide feedback to support the post-discharge counselling.

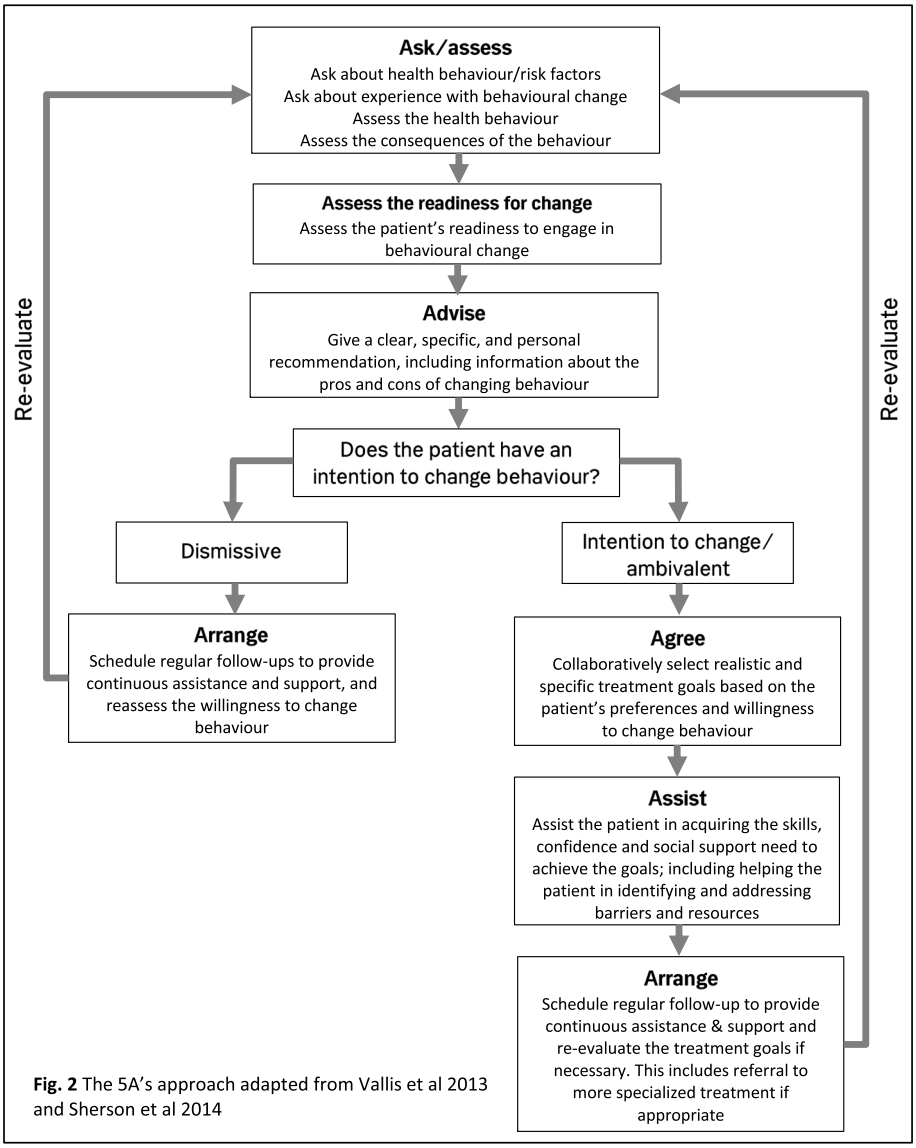

Fig. 2 The 5A's approach adapted from Vallis et al 2013 and Sherson et al 2014

Usual care

Participants in the control arm will receive standard care, which includes a review of prescribed medication, and both verbal and written encouragement of a healthy lifestyle (see Table 1) [24].

Table 1 Standard recommendations for a healthy lifestyle after stroke or TIA in Denmark [24]

- Smoking cessation is encouraged
- Regular physical activity is encouraged to the extent of the patient's ability
- Patients with a substantial use of alcohol (> 7/14 units of alcohol per week for women and men, respectively) should reduce the consumption of alcohol or cease to use alcohol all together
- Patients are encouraged to eat a diet high in fruits, vegetables, wholegrain products, and sea food; and to limit the intake of salt and saturated fats

Participants from both treatment arms will be re-assessed in the hospital-based outpatient clinic 12 weeks after they are discharged from the hospital. The evaluation will include arterial blood pressure, smoking status, body mass index, waist/hip-ratio, and adherence to preventive medication (proportion of missed doses in the past 7 days) Fig 2.

Study tests and assessments

Baseline and outcome measures are summarised in Table 2.

Baseline data

After written consent has been obtained baseline data will be collected by the research investigator. Demographic

Table 2 Baseline and outcome parameters

Parameters	Methods	Baseline test	Discharge	12-weeks follow-up	1-year follow-up
Baseline data					
Demographic data		X			
Age, gender, living conditions, education, performance status [25] prior to stroke					
Health status					
Stroke type	ICD-10 I61, I63, I64, G45.9	X	X		
Stroke severity	Scandinavian Stroke Scale [26]	X			
Vital signs	Early warning score [27]	X			
Heart arrhythmia	Result of 48-72 h telemetry [28]		X		
Prior health problems	Charlson comorbidity index [29]	X			
Biochemistry	Glucose, HbA1c, cholesterol, LDL, VLDL, HDL, triglycerides [11]		X		
Prescribed medication	Prescribed preventive medication (Antihypertensives, antithrombotic, anticoagulatives, NOAC, statins)		X		
Primary outcome					
Eligibility rate		X			
Study participation rate		X			
Adherence to the program				X	
Attrition rate				X	
Satisfaction				X	
Secondary outcome				X	
Resting arterial blood pressure	Average of two or more measurements in sitting position after > 10 min resting according to 2017 US Guidelines [30]	X		X	
Tertiary outcomes					
Current smoking	Self-reported tobacco smoking (daily, weekly, rarely, has quit smoking, never smoked) [31]	X		X	
Physical activity	Self-reported participation in leisure time physical activities (minutes per week of light/moderate/strenuous) [32]	X		X	
Body composition	Body mass index, hip/waist ratio	X		X	
Fatigue	Fatigue Assessment Scale [33]; 10-item questionnaire	X		X	
Self-rated health	Self-rated health current and in the last year [31]	X		X	
Adherence to preventive medication	Adherence to preventive medication (Antihypertensives, antithrombotic, anticoagulatives, NOAC, statins) the last 7 days prior to assessment			X	
Units of alcohol per week	Self-reported [31]	X		X	
Recurrent stroke/TIA	Patient medical report data				X
Ischemic heart disease	Patient medical report data				X
All-cause mortality	Danish Central Person Registry				X

LDL low-density lipoprotein, *VLDL* very low-density lipoprotein, *HDL* high-density lipoprotein, *NOAC* novel oral anticoagulants

data will include age, gender, living arrangements, educational level and ECOG performance status [25] prior to stroke onset. Lifestyle factors will include self-rated health, smoking habits, alcohol consumption and anthropometric measures, assessed using standardised questions from the Danish National Health Survey Questionnaire [31]. The International Physical Activity Questionnaires short form (IPAQ-SF) [32] will be used to assess the level of physical

activity prior to admission. Scandinavian Stroke Scale [26] will be used to assess stroke severity. Charlson Comorbidity Index [29] will be used to assess the burden of comorbidities. Early Warning Score [27] will be used to summarize vital signs. Serum lipids (total cholesterol, HDL, LDL, VLDL, triglycerides), random blood glucose and HbA1c are routinely collected on all patients [11].

Outcome measures

Measures of feasibility

The primary outcome measures are the following:

1) the eligibility rate (proportion of eligible patients compared to the total number of stroke patients)
2) the study participation rate (proportion of patients accepting participation in the study)
3) the degree of adherence to the program (proportion of attendance in follow-up sessions)
4) attrition (drop-out and withdrawal)
5) participant satisfaction with the intervention, using both quantitative (Likert scale) and qualitative (semi-structured interviews) measures, to guide the design of a future full-scaled randomized controlled trial

Measure of potential effect

The secondary outcome measure will be *arterial blood pressure* measured before and 12 weeks after the start of the intervention. Measurements will be performed in accordance with the American Heart Association guidelines [30]. To avoid extreme values, the blood pressure will be measured at least twice. If the two measurements of the systolic pressure are more than 5 mmHg apart the measurement will be repeated. The average of the last two measurements will be used for analysis.

Other outcome measures

Tertiary outcomes after 12 weeks will include the following: self-reported smoking status, physical activity level (IPAQ-SF) [32], adherence to medication (number of missed/consumed doses in the past seven days), anthropometrics (body weight, waist/hip ratio) and Fatigue Assessment Scale [33].

Long term outcome

All participants will be followed up twelve months after the incident stroke/TIA through the national patient registry, which contains information on all patient admissions in Danish hospitals. The outcome measure will be recurrent strokes/TIA, myocardial infarcts, other cardiac admissions and death.

Analysis plan

Quantitative data

Data will be entered into a RedCap database in real-time using electronic case report forms. Statistical analyses will be carried out using R 3.3.1/R Studio 0.99.

Recruitment, randomization, allocation and follow-up will be reported in a flow-chart stating the number of participants at each step. Characteristics of participants and non-participants (e.g. excluded, non-consenting or lost to follow-up) will be reported as detailed as possible according to CONSORT guidelines for feasibility studies [34].

Baseline data on participant demographics and characteristics will be presented in a descriptive table in accordance with the CONSORT guidelines.

The primary endpoint (12 weeks study retention in the two randomization groups) will be reported as absolute numbers and proportions with 95% confidence intervals. The secondary endpoint (arterial blood pressure) will be reported as an absolute number for each group and estimate of the between group difference with 95% confidence intervals. Twelve months follow-up data will be reported as absolute numbers, absolute risk reduction and risk ratio (with 95% confidence intervals) comparing the risks of a negative event (recurrent stoke, TIA, cardiovascular incident or death) in the two groups. An intention-to-treat approach will be employed in the analysis of all endpoints.

Qualitative data

Based on purposeful sampling [35] selected participants from both randomization groups will be invited to participate in in-depth semi-structured interviews. The participants are encouraged to invite a relative to participate in the interview. The sampling strategy will aim at achieving maximal variation concerning sex, time since discharge, and whether they have been successful in changing behaviour. The sample size will be based on achieving theoretical data saturation (expected n = 15 – 20). A semi-structured interview guide will be designed to give structure to the interviews.

The interviews will be digitally recorded and transcribed, and analysed using thematic analysis as described by Braun and Clarke [36]. The qualitative software system NVivo version 12 (QSR International) will be used to organize data and support the process of analysis.

Approvals and registrations

The study protocol has been approved by the Scientific Committee of the Capital Region (H-17040484) and the Danish Data Protection Agency (j.nr. VD-2018-306, I-6552). The study protocol is registered at ClinicalTrials.gov (NCT03648957).

Discussion

Most patients with TIA and minor stroke are discharged to their own home with little or no specialised follow-up. Previous studies have reported a high prevalence of cognitive impairments such as poor memory, fatigue and difficulty with reading and writing [3] as well as a high risk of stroke recurrence [37, 38]. The overall purpose of the current study is to develop an early initiated, client-centred behavioural intervention to support patients with minor stroke and TIA in managing their own health post-discharge. The intervention is pragmatically integrated within the existing standard treatment and guidelines.

Self-management of health is complex and requires both knowledge, skills, and confidence [39]. Optimizing counselling and providing formal support from health professionals might help patients obtain a greater adherence to lifestyle recommendations and medication prescriptions.

The rationale behind early initiation of the intervention was an assumption that patients might be more susceptible to information and behavioural change close to the initial event. In studies of other patient populations, it has been hypothesized that the time close to the initial diagnosis constitutes a certain *window of opportunity*, i.e. a limited period of time where the patient is more receptive to information [18]. In previous studies of behavioural interventions in patients with stroke and TIA, it has been shown that the time of inclusion has varied from a few days to several years post-stroke [15–17]. This might be part of the reason why results have been inconsistent.

Part of the purpose of the pilot study will therefore be to examine whether the patients are willing and able to participate in this type of intervention in the early phase of their disease. We anticipate that some patients will not be ready to participate at this stage, either because they find it too overwhelming to participate or because they are unable to take in the amount of information needed to engage in behavioural change.

Furthermore, we will examine whether it is feasible to initiate and complete the counselling within the limited time of admission in an acute setting. Patients with minor stroke and TIA are generally hospitalized for 3-4 days (72 h of observation) and this time frame might prove to be difficult to identify and include relevant patients in the study and provide the intervention.

Smoking, physical activity, and adherence to preventive medication were chosen as the main focus of the counselling intervention as these factors have been shown to be both modifiable [40, 41] and, in our judgement, were the most likely to have an impact on the systolic blood pressure [42, 43].

Systolic blood pressure was chosen as the main measure of effect because it is the greatest risk factor of both ischemic and haemorrhagic stroke [7] and has been demonstrated to be modifiable in previous intervention studies [12].

The randomized controlled design will be used to test the feasibility and acceptability of the overall study methodology and the specific elements of the intervention. This includes testing whether the screening procedure is suitable for identifying relevant patients, inclusion and exclusion criteria has the right balance of sensitivity and specificity, the procedure of recruiting and attaining consent is suitable, and delivery of the intervention and follow-up is acceptable. Through this process, we will gain knowledge and experience which can guide further development of the study protocol [44].

The qualitative interviews with the study participants will be used to gain insights into the lived experience of life going home after hospitalisation for stroke, as well as their experience of managing their own health. This will give us a more profound understanding of the needs of patients who are discharged from the hospital and which type of support and counselling should be provided before and after the discharge.

Furthermore, the qualitative interviews will be used to evaluate the randomized controlled trial and the intervention. Even though this area of research is relatively new, previous studies have found that engaging patients and other stakeholders in the development of clinical studies might help the researcher in developing more meaningful and feasible methods and to identify more useful outcome measures [45]. The qualitative interviews might also contribute with a deeper and more nuanced understanding of the barriers and facilitators of health enhancing behaviour in patients with stroke. The needs of this particular group of patients might differ from other patient groups because of the combination of older age and cognitive impairments.

A key part of a pilot study is to evaluate the feasibility of conducting a full-sized trial in the future.

A potential impediment for conducting a full-sized trial of this type might be a restricted number of willing participants. To assess whether a full-sized trial is feasible, we must therefore (1) assess how many participants can realistically be recruited within a reasonable time period, and (2) analyse available data on non-participants and low adherence to find potential strategies to reduce non-participation.

Limitations

The present study will have some limitations. First off, we wish to evaluate the feasibility of the study design and the intervention, and the sample size of the study will therefore be limited increasing the risk of both type 1 and type 2 error. The sample size of 40 participants was not based on a formal sample size calculation, but rather on a pragmatic estimate of how many participants

we would be possible to recruit within a reasonable timeframe, knowing full well that the trial would likely be under-powered for hypothesis testing. Though we assumed that 40 participants would be enough to reliable test all procedures of the trial even with a substantial rate of attrition.

The measurement of blood pressure will be done according to a standardized study manual to increase the validity and reliability. Self-reported data at baseline and follow-up will be collected using the same method in both treatment groups to minimize information bias.

Given the nature of the intervention the possibility of blinding is limited. Blinding of the assessors or participants is not possible in studies in which patient activation and counselling is part of the intervention. However, blinding in the analysis of the quantitative data will be possible.

Ethical considerations

The study will be conducted in accordance with the Helsinki Declaration [46] including respect for the participants' autonomy and right to informed consent. Participants will be informed that participation is voluntary, and that participation can be declined at any time and without explanation. Participant data will be kept confidential in accordance with guidelines from the Danish Data Protection Agency.

The inconveniences of participating will be minor, and we are convinced that the potential benefits will outweigh the drawbacks. Withdrawal symptoms associated with smoking cessation and muscle soreness associated with increased physical activity are to be expected. Generally, these will be both minor and transient [47, 48]. Participants will be encouraged to report any suspected adverse effects, including side effects to the medication as this might affect adherence. At all follow-up contacts (telephone and outpatient), the participants will be asked if they have experienced adverse effects or side effects to the medication. If potentially serious adverse effects are reported, a department physician will be consulted. All reports of adverse or side effects will be qualitatively evaluated and quantitatively compared between the trial arms.

The use of a control group as a comparison is necessary if we wish to find evidence of the potential hypothesized effect of the treatment and gain a better understanding of the variation in the outcome measures. It will also be necessary to test the feasibility of the randomization process prior to the design of a full scale randomized controlled trial. The treatment of the participants in the control group will at no point be inferior to the treatment of non-participants.

Dissemination

Results of the study will be published in international peer-reviewed scientific journals and presented at national and international conferences. Results will be made public regardless of them being positive, negative, or inconclusive.

The principal investigator (JL) will draft all publications under the supervision of the other members of the project group. The order of authorship will be in order of contribution and has been agreed upon in the project group beforehand. The rights and responsibilities of the authors will be in accordance with *The Danish Code of Conduct for Research Integrity* [49] and the ICMJE recommendations [50].

Trial status

Recruitment has been completed in January 2020.

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We wish to thank the Department of Neurology's head nurse Lene Hamberg, RN, MPO, for her collaboration in establishing the research program.

Project organization

The project was initiated as part of the *CIRE neuro/psych* research program in collaboration between Nordsjællands Hospital, Hillerød; Copenhagen University College; and The University Hospitals Centre for Health Research UCSF, Copenhagen University Hospital (Rigshospitalet).
The instigators of the *CIRE neuro/psych* research program consist of researchers and managers from UCSF and Copenhagen University College, in collaboration with the UCSF steering committee consisting of representatives of the hospital managers in Region Hovedstaden.
Progress of the project is presented to the members of the *CIRE neuro/psych* collaboration at bi-yearly meetings with representatives of all the involved parties. The UCSF steering committee has initiated the program but has no direct involvement in the design or implementation of the individual studies.

Authors' contributions

JL is the principal investigator who will conduct the study and has drafted the article. The protocol was designed by JL in collaboration with TC, TM, DO, SM, MJ and LA. TC will be the responsible neurologist. All authors have made a substantial contribution to the conception and design of the study protocol and all authors approved the final manuscript.

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Availability of data and materials

Data used during the current study will be available from the corresponding author upon reasonable request.

Ethics approval and consent to participate

Approved by the Danish Data Protection Agency (j.nr. VD-2018-306, I-6552). The protocol is in accordance with the rules of the Scientific Committee of the Capital Region, Denmark (H-17040484). The study protocol is registered at ClinicalTrials.gov (NCT03648957). Registered 28 August 2018, https://clinicaltrials.gov/ct2/show/record/NCT03648957.

Consent for publication

Not applicable

Competing interests

None

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Publisher's Note

Lifestyle counselling as secondary prevention in patients with minor stroke or transient ischemic attack: A randomized controlled pilot study

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Abstract

Background

Patients with minor stroke or transient ischemic attacks have a significant prevalence of cognitive deficits and a risk of recurrent stroke. The patients are, however, often discharged home with limited specialized follow-up. Patients with stroke are encouraged to avoid smoking, be physically active, and to take preventive medication, though these encouragements are insufficient in making the patients change their behaviour. Comprehensive interventions are needed to support the patients in adapting healthy behaviour.

The aim of this study was to test the feasibility and potential effect of an early initiated, patient-centred intervention to patients with minor stroke or transient ischemic attacks targeting smoking, physical activity, and medication adherence, in a randomized, controlled pilot trial.

Methods

Patients were included while hospitalized in a specialized stroke ward and randomized to usual care or an intervention consisting of health behavioural counselling based on the 5A's model, telephone follow-up (four and eight weeks), and monitoring of physical activity. Follow-up time was twelve weeks.

Results

Forty patients of 84 potentially eligible were included and randomized to the two treatment arms (20 intervention/20 usual care). Thirty-two completed the twelve-week follow-up, while eight were either excluded or lost to follow-up. The between group difference in blood pressure reduction was not statistically significant within the limited sample-size of the study.

Conclusion

It was possible to identify patients with minor stroke or transient ischemic attack who could potentially benefit from a behavioural intervention, recruit and randomize them early after admission and retain most participants in the study until follow-up and derive statistical estimates that may guide the design of large-scale randomized controlled trials.

Trial registration: ClinicalTrial.gov Identifier: NCT03648957

Background

Although stroke is often associated with severe disability and high fatality more than half of patients who are admitted with a stroke have minor or transient neurological deficits, and up to 40 percent of stroke survivors are discharged home without significant disabilities. However, a large part of patients with minor stroke or transient ischemic attack (TIA) experience cognitive and communicative problems, predominantly problems with memory, fatigue, reading, and participating in conversations when re-evaluated three months after discharge [1].

The risk of a recurrent stroke is considerable among stroke survivors, with rates of 12-13% in the first year and subsequently 5-6% per year. One in four patients admitted with a stroke has previously had a stroke or TIA [2]. Potentially modifiable risk factors, including hypertension, smoking, physical inactivity, abdominal obesity, and unhealthy diet all contribute to the risk of stroke [3, 4]. We assume that the risk factors are the same for recurrent stroke, although the evidence for this association is weaker. Preventive medication, such as antithrombotics, antihypentensives, and statins, also has an importance in the prevention of recurrent stroke [5], yet, evidence suggests that adherence to preventive medication in stroke survivors is impaired and decreases with time [6, 7].

Behavioural interventions have previously demonstrated a beneficial effect on hypertension and blood lipids, but due to methodological heterogeneity the grade of evidence is low to very low. Furthermore, we lack a clear answer as to which approach is preferable or most efficient to prevent a new stroke, though including physical exercise in the invention has shown a beneficial effect on hypertension [8].

Thus, we need more research on how old age and cognitive impairments affect stroke survivors' health behaviour and how behavioural interventions can support the patients' needs related to improving self-management strategies in secondary and tertiary prevention following stroke.

The aims of this study were to evaluate the feasibility of a patient-centred counselling intervention focused on smoking cessation, physical activity, and adherence to preventive medication in transitional care of patients with minor stroke or TIA, and to test the potential effects of the intervention on blood pressure and other cardiovascular risk factors in patients with minor stroke or TIA.

Methods

We conducted a parallel group randomized controlled feasibility trial to test randomization acceptance and potential effects of an individual face-to-face health behavioural counselling with post-discharge follow-up sessions against usual care. A protocol article outlining the study design and procedures has previously been published [9].

Setting and participants

The target population was patients hospitalized with recent minor stroke or TIA who were discharged home. We included patients with acute minor stroke (ICD-10 I61, I63, I64; Scandinavian Stroke Scale 45-58) or TIA (ICD-10 G45.9) admitted to the Department of Neurology at Nordsjællands Hospital, Denmark. Patients were eligible if they were ≥18 years old, could consent to participation, and were discharged home. Exclusion criteria were severe communication barriers, inability to use a telephone, severe disability prior to the stroke (WHO Performance Status >2; incapable of self-care and mobilised less than 50% of the day), active abuse of alcohol or narcotics, or severe psychiatric illness (affective disease, dementia, schizophrenia, anxiety). All new patients with suspected cerebrovascular disease in the Department of Neurology from October 2018 to January 2020 were screened for eligibility by the primary researcher (JL). Potential participants were invited through verbal and written information regarding the study purpose and method and allowed sufficient time for consideration. All participants gave written informed consent before participation.

Procedures

Baseline assessment

Demographic and health behavioural information was collected using standardized questions from the Danish National Health Survey [10], in addition with assessment of stroke severity [11, 12], prior health problems [13], vital signs [14], spirometry (FEV1/FVC) [15], and biochemistry (HbA1c and blood lipids) [5].

Randomization and group allocation

Participants were allocated to either intervention or usual care after baseline testing using a simple non-stratified 1:1 randomization. A computer-generated (using the *rbinom*-function in R [16]) randomization sequence was implemented into the Research Electronic Data Capture (RedCap) software [17], which

secures concealment of future allocations and prohibits post hoc changes to the allocation. The participants remained in the allocation group for the entire study period.

Intervention

In brief, participants randomized to the intervention arm received nurse-led targeted health behaviour counselling focusing on smoking cessation, physical activity, and adherence to preventive medication, in addition to usual care. When possible, we tested the participants aerobic capacity prior to the initial counselling using the Astrand-Rhyming cycle test [18]. The initial counselling session was provided face-to-face by the primary investigator before discharge from the hospital. The counselling employed a patient-centred approach [19] and was structured around the 5A's model [20, 21] (Figure 1) and aimed at engaging the participant in partaking health behaviour and adhere to preventive medication with the intention of reducing the participants risk of a recurrent cerebrovascular event. Participants in the intervention arm were issued a VivoFit activity tracker to count daily steps and aerobic walking time. We hypothesized that the activity tracker could work as a reminder and motivator for everyday physical activity and provide feedback to support the post-discharge counselling. Further counselling was provided via telephone four and eight weeks after discharge and aimed at maintaining motivation and adjusting goals and strategies if necessary. The telephone counselling was conducted by the primary investigator according to an interview guide questions on overall well-being, persistence of symptoms or functional deficits, adherence to medication, side-effects, physical activity, smoking, and use of health care services. The intervention is described in details in the published protocol [9].

Usual care

Participants in the control arm received standard care, which included a review of prescribed medication, and verbal and written encouragement to cease use of tobacco, diminish the intake of alcohol, be physically active to the extent possible and eat a healthy diet (reduce the consumption of red meat and salt, and increase the consumption of fish, fruit, and vegetables) [22]

Outcome measures

The primary outcomes were measures of feasibility: (1) *eligibility* including the eligibility rate (proportion of eligible patients compared to the total number of stroke patients), (2) *acceptance* including the study

participation rate (proportion of patients accepting participation in the study), (3) *demand and practicality* (proportion of study elements that could be delivered according to the protocol), (4) *adherence* including the degree of adherence to the program (proportion of attendance in follow-up sessions), and (5) *attrition* (drop-out and withdrawal).

The main clinical outcome was the change in arterial blood pressure between inclusion and 12 weeks follow-up. Arterial blood pressure was measured in accordance with the US guidelines [23]. To avoid extreme values the blood pressure was measured at least twice. If the two measurements of the systolic pressure were more than five mmHg apart the measurement was repeated until two consequent measurements with a difference of less than five mmHg was obtained. The average of the last two measures were used for analysis.

The other outcome measures included self-reported smoking status, physical activity level using the International Physical Activity Questionnaire - Short Form [24], adherence to medication (number of missed/consumed doses in the past seven days), anthropometrics (body weight, waist/hip ratio), and Fatigue Assessment Scale [25]. Long-term outcomes included readmission with recurrent stroke/TIA or ischemic heart disease, and fatality within one year of inclusion.

Follow-up

Participants from both allocation groups were reassessed by the primary investigator (JL) in a hospital-based outpatient clinic 12 weeks after discharge. The evaluation included measurements of arterial blood pressure, body weight, and waist/hip circumference, and a structured interview about self-rated health, fatigue, smoking status, physical activity, and adherence to the initially prescribed preventive medication.

Analysis

The model for designing feasibility studies in preventive medicine proposed by Bowen et al. [26] was used to evaluate the feasibility study.

Continuous outcome measures were compared between groups using change scores from baseline to follow-up and reported as mean difference with a symmetrical 95% confidence interval based on t-distributions. Logistic regression was used to compare the odds of a more favourable outcome of categorical outcome measures at follow-up than at baseline. The Exact method was used to calculate confidence intervals of

proportions. Differences between allocation groups were tested using an intention-to-treat model, with last value carried over when follow-up data were missing [27]. Per protocol analysis, including all participants who received initial counselling and attended re-evaluation after 12 weeks. P-values are not reported because the study was not powered for formally hypothesis testing. Data was collected in real-time using RedCap electronic case report forms. Statistical analyses were carried out in R 3.3.1/R Studio 0.99.

Ethical considerations

The study was conducted in accordance with the Helsinki Declaration [28] including respect for the participants' autonomy and right to informed consent. The participants were informed that participation was voluntary, and that further participation could be declined at any time without explanation.

The study protocol was approved by the Scientific Committee of the Capital Region (H-17040484) and the Danish Data Protection Agency (j.nr. VD-2018-306, I-6552). The study protocol was registered at ClinicalTrials.gov (NCT03648957).

Results

Forty patients accepted participation and were randomly assigned to the two treatments arms (20 intervention and 20 usual care, Table 1 presents the study population characteristics). The median follow-up time was 85 days (range 82-104 days). Though the study was not powered to formally test the significance of the changes of outcomes, all included outcome measures proved to be manageable according to the study protocol. Estimates for the allocation groups at baseline and follow-up are presented in Table 2.

A significant reduction in systolic blood pressure was observed in both allocation groups from baseline to 12 weeks follow-up (overall reduction 7.3 mmHg [2.93; 11.72]), although the difference between groups was non-significant. A reduction was also observed for diastolic blood pressure, but this was not significant.

No changes were observed in any of the body composition measures (weight, body mass index, and waist to hip ratio). A 3-point increase was observed in the fatigue score overall, signifying a significant increase in the burden of fatigue. Although the increased burden of fatigue was greatest in the control group, the between group difference was not significant. On the single-item level the most distinct difference was in the item "Mentally, I feel exhausted", in which a greater increase was observed among the control group. There

was a slight, but non-significant, tendency towards a decrease in time spent on physical activity, but no clear change in the level of intensity. Of the 32 participants who completed follow-up 17 had remained as active as before the stroke, 9 were more active, and 6 less active, with no between group difference. One participant from each group suffered a recurrent stroke within one year after enrolment.

Feasibility

Acceptability: A total of 1010 patients who attended the acute stroke ward were screened for eligibility, of whom 84 were invited to participate in the study. The most common reasons for non-eligibility were not having a stroke (n = 365), the severity or nature of the stroke (n = 146), or other health conditions (n = 251). Forty patients accepted participation, while eight were excluded before inclusion and 36 declined participation. Exclusion after invitation to participation were due to the patient being discharged before consent was obtained (n = 4), the stroke diagnosis was refuted (n = 2), or changes to the patients' condition (one suffered a new stroke and one developed delirium). Reported reasons for declining participation were: did not find the intervention to be relevant, either because they already perceived their lifestyle to be healthy (n = 5) or they did not find their disease to be connected to their behaviour (n = 4); already had regular contact with the health care system (n = 2); time constrains due to work or family responsibilities (n = 5); did not have sufficient energy to participate in anything beyond the standard treatment (n = 15); no reason specified (n = 5). For practical clinical and organisational reasons 28 patients were not available for invitation (Patient flow and reasons for exclusion are summarised in Figure 2).

Demand and practicality: In general, the baseline procedures (NIHSS, spirometry, and face-to-face counselling) were carried out in high accordance with the protocol (>95%), (Figure 3). Setting up the activity tracking devices (VivoFit 4.0) proved to be more time consuming than expected. All participants needed some degree of assistance in installing the smartphone application, setting up the user profile, and connecting the device. A few participants needed support in transferring data to the application after they were discharged.

However, due to time constrains and organisational challenges the Astrand-Rhyming cycle test had to be omitted from the baseline assessment. In addition, we received some negative feedback from the

participants: two participants declined performing the test due to joint pains and those who performed the test only found it vaguely relevant in relation to the counselling. In just seven intervention cases (35%) the Astrand-Rhyming cycle test was performed at baseline.

Attrition: Thirty-two patients completed the twelve-week follow-up period. The attrition rate was 20% (five from the intervention group and three from the usual care group). Four were drawn out after randomisation (one participant was discharged before the intervention had been provided and in three cases the diagnosis was changed after magnetic resonance imaging) and four were lost to follow-up. Two follow-up sessions had to be conducted via telephone due to COVID-19 pandemic restrictions at the hospital and in these we used blood pressure measurements performed by the patient or the general practitioner.

Adherence: Of the participants in the intervention group, we were able to contact 15 after four weeks and 12 after eight weeks for telephone follow-up (Figure 2 and 3). We received sufficient activity tracker data from 12 of the intervention group participants (60%). In additional, two participants wanted to use their own devices (no data returned), one was drawn out before the activity tracker was issued, and five never transferred any data. Among the participants who transferred data the activity tracker was worn in 90.0% of the days (959 applicable measurements per 1066 follow-up days, 95%CI 88.0 – 91.7) of the intervention period with four participants wearing it all days (range 62-100%; Table 2 & Figure 4). Evaluation of the activity tracker data showed a substantial variation in steps per day and aerobic steps per day both within and between subjects. In four participants the data showed a clear central tendency approximating a normal distribution, while the rest had several clusters throughout their range of activity which might resemble multiple concurrent patterns in the individual activity (Figure 4).

Implementation and integration: We intended to recruit all participants before discharge and integrate the intervention pragmatically within the existing standard treatment. In general, the protocol was manageable within the clinical setting, although we did identify some challenges. To identify the relevant patients, 1010 patients had to be screened. In 84 cases the initial medical records lacked sufficient information to evaluate the eligibility of the patients and acquiring the information proved to be time consuming. All participants were discharged home without the intervention causing any delay of care. One participant was initially

transferred to another hospital for a carotid endarterectomy and unfortunately suffered a new stroke during the procedure but was able to continue participation in the study.

Content and feasibility of the counselling

Nineteen intervention participants (95%) received face-to-face counselling, while 15 (75%) and 12 (60%) received subsequent telephone counselling after four and eight weeks, respectively. Medication adherence was discussed with all participants: two participants had not taken any medication before and nine had changes to their medication which urged them to change previous habits; four were ambivalent towards taking medication; four had no changes to their medication. Eighteen participants (90%) received counselling in increasing the level of physical activity. Walking was the preferred type of activity in twelve participants, while other types included biking, yoga, fitness, and running. Three participants (15%) were current smokers and were recommended to stop smoking: one was already following a cessation course, while the last two had an intention to stop smoking. Three participants asked for dietary recommendations, which was supplied at their discretion, although this was not part of the protocol.

The 5A's model organizes the counselling session into a sequence of distinct phases. Through the study we found that the model provided rigorous structure to the sessions and guided the direction of the conversation. Each of the distinct phases have a specific function in the session and gives varying emphasis to the contribution of the patient and the health professional. This helps the counselling to become a two-way conversation with balanced contributions from the patient and the health professional. Most participants found it difficult to set specific and measurable goals.

Discussion

This study found that it was possible to identify relevant patients early after hospital admission, to randomize participants, and retain them in the study until follow-up. Few, yet appreciable, changes had to be made to the study protocol, but the overall setup and the structured, theory-based counselling approach proved to be feasible in the early diagnostic stages and within a hospital-based environment.

The aim of our intervention was to support the patients to be able to take care of their own health following a minor stroke or TIA, either independently or with formal or informal support, by providing the patients with

the required knowledge, abilities, and confidence. This included knowledge about the disease and behavioural risk factors, abilities to set realistic goals and identify strategies for obtaining these goals and where to find help and support, while confidence was supported through encouragement and recognition.

The early recruitment of participants allowed for a large part of the target population to be identified. Implementing this in a fast-track patient pathway might, however, have resulted in potentially relevant patients being unavailable for recruitment and four participants being drawn out due to their stroke/TIA diagnosis being refuted. In order to capture as many eligible patients as possible and estimate the potential demand for the intervention we implemented a very sensitive screening procedure, in which all patients admitted to the ward were assessed. As a result, a large number of non-eligible patients were excluded, either because they did not have cerebrovascular disease or because they would not realistically benefit from receiving the intervention. Even though, stroke mimics were excluded or drawn out of this study some did present significant vascular risk factors and in clinical practice health behavioural counselling might in fact be warranted.

We used the 5A's model to guide the counselling sessions [9], in combination with techniques from Miller and Rollnick [19], which helped structure the counselling and for it to become a two-way conversation with balanced contributions from both the patient and the health professional. Using a well-structured approach to health behavioural counselling might be helpful to health professionals [29]. The 5A's model emphasis that recommendations should be specific and personal, which supports Reed et al. [30] finding that patients with stroke found it easier to acquire health information if it was connected to their current life situation. Health counselling might therefore be more efficient if it specifically targets problems relevant for the individual patient and is provided in a way that takes the patient's life situation into account.

Providing effective health counselling requires that the health professional has the relevant knowledge to make specific recommendations and is able to make situated clinical decisions, which further involves knowing the recipient both as a patient and as a person and the context in which the behaviour is performed [31]. In this study all counselling was provided by the primary investigator who had substantial clinical experience as a nurse in the stroke ward. This might have strengthened the quality of the counselling

provided and have limited the amount of training required. It is uncertain how much training it would require if less experienced health professionals were to adapt the same model.

Wearable activity trackers to monitor physical activity have become popular both in research and among common consumers, and evidence supports that they have a beneficial effect on physical activity in different populations [32–34]. We issued wearable activity trackers to participants in the intervention group to motivate the participants to physical activity. We met no noticeable resistance from the participants regarding using the device but identified several challenges. We had chosen a device with a long battery time so that the participants were not required to charge the device, and with a four-week memory to limit the number of times the participants had to transfer data from the device to the smartphone application. The data transfer required an application to be downloaded and installed on a smartphone or tablet, the creation of a unique user account within the application, and the device to be connected to the application via Bluetooth. None of the participants were able to do this without some level of support or supervision. A few participants did not have a smartphone or tablet, or they had older versions that was unable to run the application. When using technology as part of interventions provided to elderly and patients with neurological conditions it is advisable to thoroughly consider possible limitations in terms of accessibility and technical skills of the participants, and possibly allocate resources to help and support.

Limitations

By design the sample size of this study was limited as the main purpose was to test the feasibility. We assumed, *a priori*, that a sample-size of 40 participants would be enough to test all procedures of the study protocol. Overall, this number of participants proved to be sufficient in terms of testing the procedures and estimating rates of inclusion and attrition. It also helped us gain valuable experience on how to integrate this type counselling into a relatively compressed patient pathway.

A general limitation of behavioural counselling interventions, as well as this study, is the limited possibility of blinding, making a large scale RCT prone to potential bias with influence from social desirability.

Because close to half of the invited patients declined to participate in the study it is reasonable to suspect a selection bias. Only three (7.5%) participants were current smokers, as opposed to 23% of Danish stroke patients being registered as current smokers [35], implying that smokers might be underrepresented.

To reduce the risk of information bias data were collected according to a standardised study manual and self-reported data were collected at baseline and follow-up using the same methods in both treatment groups.
In future research on health behaviour in patients with stroke we need to address the prevalence of different health behaviours in more detail including the patients' understanding of the causes of their stroke and awareness of risk, their readiness to change behaviour, and how patients who refuse to participate differ from participants, as alternative approaches might be needed to reach these patients.

Conclusion

The study showed that despite several implementation challenges, it is within a narrow time frame of initial care possible to identify, recruit and randomize relevant patients early after admission and retain most participants in the study until follow-up. Some adjustments had to be made to the study protocol during the pilot period including the general omittance of the Astrand-Rhyming cycle test. The activity trackers were generally accepted and provided new insight on longitudinal physical activity behaviour in the vulnerable population. The study was not designed to formally test the effect of the intervention on blood pressure, though the findings may serve as basis for designing large-scale randomized controlled trials.

Declarations

Ethics approval and consent to participate

Approved by the Danish Data Protection Agency (j.nr. VD-2018-306, I-6552). The protocol is in accordance with the rules of the Scientific Committee of the Capital Region, Denmark (H-17040484). The study protocol is registered at ClinicalTrials.gov (NCT03648957). Registered 28 August 2018, https://clinicaltrials.gov/ct2/show/record/NCT03648957.

Consent for publication

Not applicable

Availability of data and material

Data used during the current study will be available from the corresponding author upon reasonable request.

Competing interests

None

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extern funding from Anita & Tage Therkelsens Fond and TrygFonden (ID 126993). The CIRE neuro/psych collaboration has been involved in the design of the study protocol and are acting as overseers of the execution of the study.

Project organization

The project was initiated as part of the CIRE neuro/psych research program in collaboration between Nordsjællands Hospital, Hillerød; Copenhagen University College; and The University Hospitals Centre for Health Research UCSF, Copenhagen University Hospital (Rigshospitalet).
The instigators of the CIRE neuro/psych research program consist of researchers and managers from UCSF and Copenhagen University College, in collaboration with the UCSF steering committee consisting of representatives of the hospital managers in Region Hovedstaden.
Progress of the project is presented to the members of the CIRE neuro/psych collaboration at bi-yearly meetings with representatives of all the involved parties. The UCSF steering committee has initiated the program but has no direct involvement in the design or implementation of the individual studies.

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Table 1 Baseline study population characteristics

	Intervention n = 20	**Usual care** n = 20
Age (years)	66.1 ± 9.3	68.0 ± 6.3
Sex (n/% female)	5 (25%)	6 (30%)
Diagnosis (IS/TIA)	12/6 (60%/30%)	11/8 (55%/40%)
Scandinavian Stroke Scale (SSS)		
58	15 (75%)	17 (85 %)
57	3 (15%)	0
56	1 (5%)	2 (10%)
55	1 (5%)	0
54	0	1 (5%)
Living arrangements		
Living alone	3 (15%)	5 (25%)
Living with a partner	17 (85%)	15 (75%)
Educational attainment		
Secondary school	7 (35%)	3 (15%)
Vocational education or training	2 (15%)	8 (40%)
Bachelor's degree or equivalent	6 (15%)	4 (20%)
Master's degree	3 (5%)	5 (25%)
Pre stroke performance status		
0 (asymptomatic)	18 (90%)	17 (85%)
1 (some symptoms, no disabilities)	2 (10%)	3 (15%)
Self-rated health		
Less good	3 (15%)	0
Good	12 (60%)	7 (35%)
Very good	4 (20%)	13 (65%)
Comorbidities		
Charlson Comorbidity Index		
0	10 (50%)	10 (50%)
1	5 (25%)	9 (45%)
2	3 (15%)	0
>2	2 (10%)	1 (5%)
Known diabetes	4 (20%)	0
Previous stroke	4 (20%)	4 (20%)
Previous myocardial infarction	2 (10%)	1 (5%)
Heart arrythmia (known or diagnosed)	2 (10%)	3 (15%)
Risk factors		
Smoking		
Current	3 (15%)	0
Former smoker	11 (55%)	9 (45%)
Never smoked	5 (25%)	11 (55%)
Package years	10 (IQR 3-15)	10 (IQR 3.9-10.5)
Alcohol intake (units/week)	6 (IQR 1.75-20.25)	5 (IQR 2.5-8.5)
Body composition		
Body weight (kg)	88.5 ± 15.5	82.6 ± 13.6
Body mass index (kg/m^2)	26.9 (IQR 25.5-30.9)	25.5 (IQR 23.5-28.1)
Waist/hip ratio	1.00 ± 0.09	0.98 ± 0.12
Biochemistry		
HbA1c, mmol/L	7.05 ± 2.15	6.51 ± 0.66
Total cholesterol, mmol/L	4.96 ± 1.16	5.16 ± 1.05
LDL, mmol/L	2.76 ± 0.97	3.09 ± 0.87
HDL, mmol/L	1.38 ± 0.50	1.34 ± 0.30
VLDL, mmol/L	0.71 ± 0.25	0.75 ± 0.35
Triglycerides, mmol/L	1.62 ± 0.63	1.90 ± 1.11

Measures are presented as *mean* ± *SD*, *n (%)*, or *median (IQR)*
IS Ischemic stroke **TIA** Transient Ischemic Attack **NIHSS** National Institute of Health Stroke Score **IQR** Intra-Quartile Range **HbA1c** Haemoglobin A1c **LDL** Low Density Lipoprotein **HDL** High Density Lipoprotein **VLDL** Very Low-Density Lipoprotein

Table 2 Measures of effect (Secondary and tertiary outcomes)

	Intention to treat		Per protocol	
Arterial blood pressure	**Intervention**	**Control**	**Intervention**	**Control**
Systolic blood pressure *(mmHg)*	n = 20	n = 20	n = 14	n = 17
Baseline [A]	144.5 ± 14.71	140.5 ± 16.55	143.71 ± 12.98	141.58 ± 16.81
12-weeks follow-up [A]	137.1 ± 14.84	133.5 ± 14.41	134.57 ± 12.34	131.88 ± 13.62
Change [A]	-6.4 ± 9.32	-8.3 ± 17.29	-9.14 ± 10.00	-9.70 ± 18.44
Difference [B]		**1.85** [-7.13; 10.83]		**-0.56** [-10.16; 11.28]
Hypertension *(SBP >140 mmHg)*	n = 20	n = 20	n = 14	n = 17
Baseline	13 (65%)	11 (55%)	9 (73%)	10 (53%)
12-weeks follow-up	7 (35%)	6 (30%)	3 (66%)	5 (76%)
Difference [C]		**OR 1.0** [0.26; 3.87]		**OR 1.5** [0.33; 6.77]
Diastolic blood pressure	n = 20	n = 20	n = 14	n = 17
Baseline [A]	86.1 ± 11.49	83.0 ± 11.32	87.93 ± 11.01	84.06 ± 11.61
12-weeks follow-up [A]	81.35 ± 12.23	78.75 ± 8.74	81.14 ± 12.59	79.06 ± 8.98
Change [A]	-4.75 ± 10.52	-4.25 ± 10.84	-6.79 ± 12.12	-5.00 ± 11.65
Difference [B]		**0. 5** [7.34; -6.34]		**-1.78** [-10.6; 7.03]
Physical activity				
MET-minutes per week	n = 20	n = 20	n = 15	n = 17
Baseline [A]	2809 ± 3732	1538 ± 1180	3606 ± 4009	1596 ± 1263
12-weeks follow-up [A]	2048 ± 2242	1498 ± 801	2591 ± 2336	1594 ± 843
Change [A]	-761 ± 3868	-179 ± 1207	-1015 ± 4476	-211 ± 1312
Difference [B]		-**582** [-2458; 1294]		**-804** [-3344; 1736]
Time spent on physical activity *(min/week)*	n = 20	n = 20	n = 15	n = 17
Baseline [A]	765 ± 1071	344 ± 240	985 ± 1158	364 ± 255
12-weeks follow-up [A]	537 ± 583	343 ± 193	681 ± 604	363 ± 202
Change [A]	-228 ± 1130	- 31 ± 234	-304 ± 1306	-36 ± 255
Difference [B]		**-197** [-734; 340]		**-268** [-999; 463]
Moderate to vigorous physical activity	n = 20	n = 20	n = 15	n = 17
Baseline	13 (65%)	11 (55%)	11 (73%)	9 (53%)
12-weeks follow-up	12 (60%)	15 (75%)	10 (66%)	13 (76%)
Difference [C]		**OR 0.5** [0.10; 2.32] [B]		**OR 0.62** [0.10; 3.78] [B]
Body composition				
Body weight (kg)	n = 19	n = 19	n = 14	n = 17
Baseline [A]	88.5 ± 15.46	82.6 ± 13.58	89.2 ± 13.82	83.4 ± 13.22
12-weeks follow-up [A]	87.1 ± 13.18	80.6 ± 13.0	87.8 ± 10.20	81.2 ± 12.70
Change [A]	-1.3 ± 5.11	-1.9 ± 4.40	-1.9 ± 6.09	-2.2 ± 4.71
Difference [B]		**-0.59** [-3.65; 2.47] [B]		**-0.37** [-4-47; 3.74] [B]
Body Mass Index	n = 19	n = 19	n = 14	n = 17
Baseline [A]	28.6 ± 4.46	26.3 ± 3.48	28.5 ± 4.30	26.4 ± 3.59
12-weeks follow-up [A]	28.2 ± 3.71	25.6 ± 3.31	27.9 ± 3.13	25.7 ± 3.43
Change [A]	-0.41 ± 1.61	-0.61 ± 1.45	-0.59 ± 1.92	-0.72 ± 1.55
Difference [B]		**-0.2** [-1.18; 0.78] [B]		**-0.13** [-1.44; 1.18] [B]
Waist-hip ratio	n = 18	n = 19	n = 12	n = 10
Baseline [A]	1.0 ± 0.09	0.98 ± 0.11	1.01 ± 0.1	0.99 ± 0.1
12-weeks follow-up [A]	0.99 ± 0.07	0.97 ± 0.11	1.00 ± 0.07	0.97 ± 0.09
Change [A]	-0.01 ± 0.03	-0.01 ± 0.05	-0.01 ± 0.04	-0.03 ± 0.07
Difference [B]		**0.0** [-0.02; 0.03] [B]		**0.01** [-0.04; 0.06] [B]
Fatigue	n = 19	n = 20	n = 15	n = 17
Baseline [A]	18.9 ± 6.15	16.2 ± 4.58	18.4 ± 6.67	14.9 ± 1.96
12-weeks follow-up [A]	20.3 ± 8.27	19.9 ± 7.46	20.2 ± 9.23	19.2 ± 7.36
Change [A]	1.42 ± 4.21	3.7 ± 7.45	1.8 ± 4.69	4.35 ± 7.93
Difference [B]		**2.27** [-1.65; 6.21] [B]		**2.55** [-2.12; 7.22] [B]
Long-term follow-up *(1 year)*	n = 20	n = 20	n = 17	n = 19
Recurrent stroke	1 (5%)	1 (5%)	1 (5.9%)	1 (5.3%)
Other vascular events	0	0	0	0
Fatalities	0	0	0	0

MET Metabolic Equivalents, A mean ± standard deviation, B mean difference [95% confidence interval], C odds ratio [95% confidence interval]

Table 3 Activity tracker data presented per participant (3A) and per time interval (3B)

	Steps per day mean ± SD	**Aerobic walking time** mean ± SD	**Adherence*** % [95%CI]
3A Participant (sorted from lowest to highest median)			
A	3606 ± 1861	4.72 ± 12.11	62.4% [51.2 - 72.6]
B	4358 ± 2077	3.32 ± 10.99	73.8% [63.1 - 82.8]
C	4096 ± 1652	0.16 ± 1.52	100% [95.8 - 100]
D	4833 ± 2218	34.77 ± 21.85	100% [96.0 - 100]
E	7066 ± 4225	23.67 ± 33.49	98.8% [93.6 - 100]
F	8884 ± 3079	8.45 ± 12.02	62.9% [52.9 - 72.1]
G	8585 ± 3118	30.90 ± 27.77	96.5% [90.1 - 99.3]
H	9572 ± 2455	1.76 ± 4.34	95.6% [89.0 - 98.8]
I	10068 ± 3124	13.02 ± 24.14	100% [95.7 - 100]
J	11897 ± 8597	61.40 ± 60.96	100% [95.7 - 100]
K	11168 ± 5322	10.37 ± 16.53	95.3% [88.4 - 98.7]
L	13024 ± 1781	53.06 ± 18.38	97.8% [92.3 - 99.7]
3B Time			
T1: weeks 1-3	7282 ± 3998	16.80 ± 24.23	91.7% [87.5 - 94.8]
T2: weeks 4-6	8809 ± 4641	24.70 ± 34.10	86.1% [81.2 - 90.1]
T3: weeks 7-9	8851 ± 4970	24.54 ± 35.56	86.9% [82.1 - 90.8]
T4: weeks 10-12	7941 ± 5089	20.60 ± 35.22	98.4% [96.0 - 99.6]

*Percentage of days patients wore the VivoFit, confidence intervals were calculated using the Exact-method

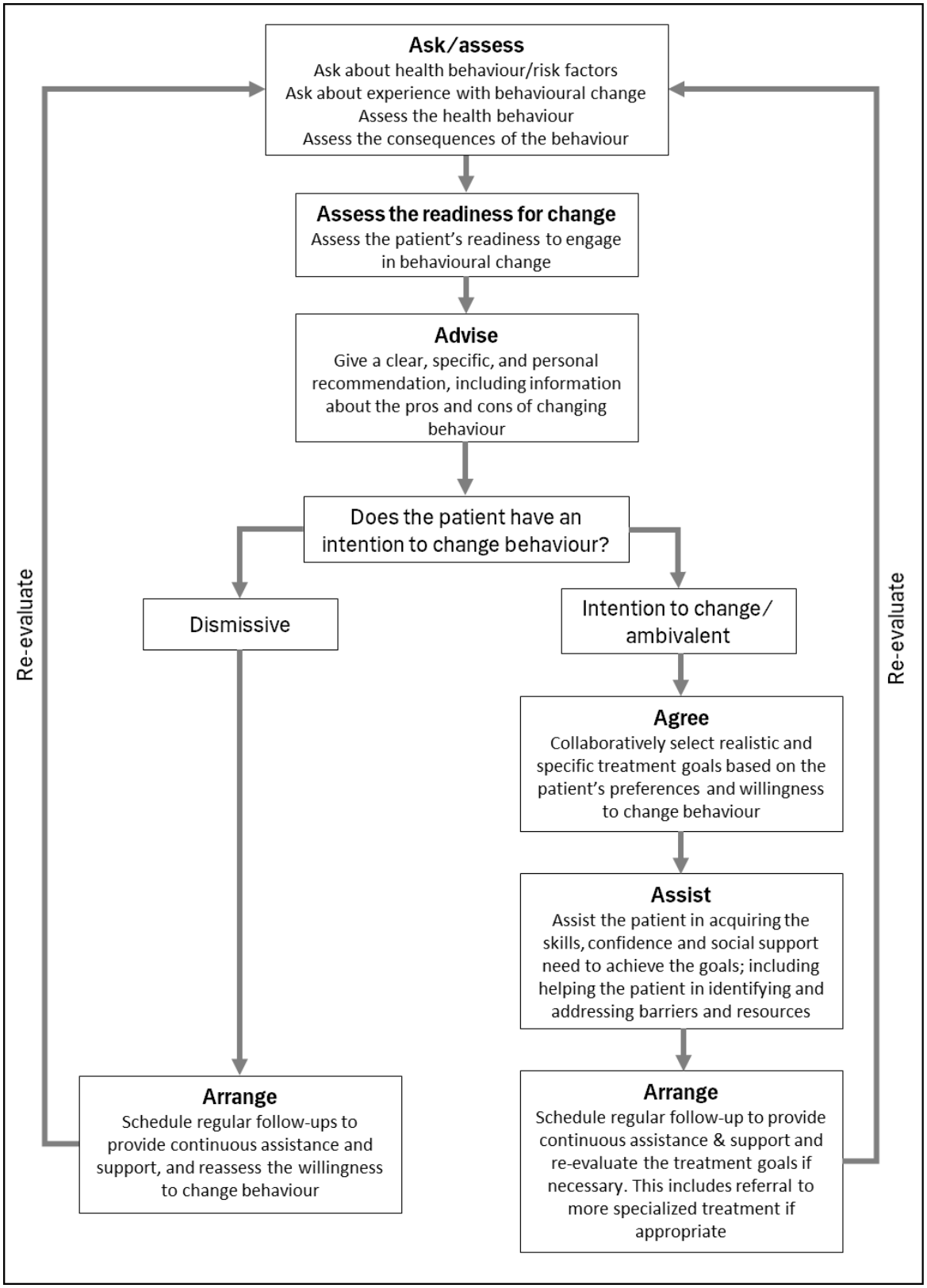

Figure 1 The 5A's approach modified from Vallis *et al*. 2013 [20] and Sherson *et al*. 2014 [21], as proposed in Liljehult *et al*. 2020 [9].

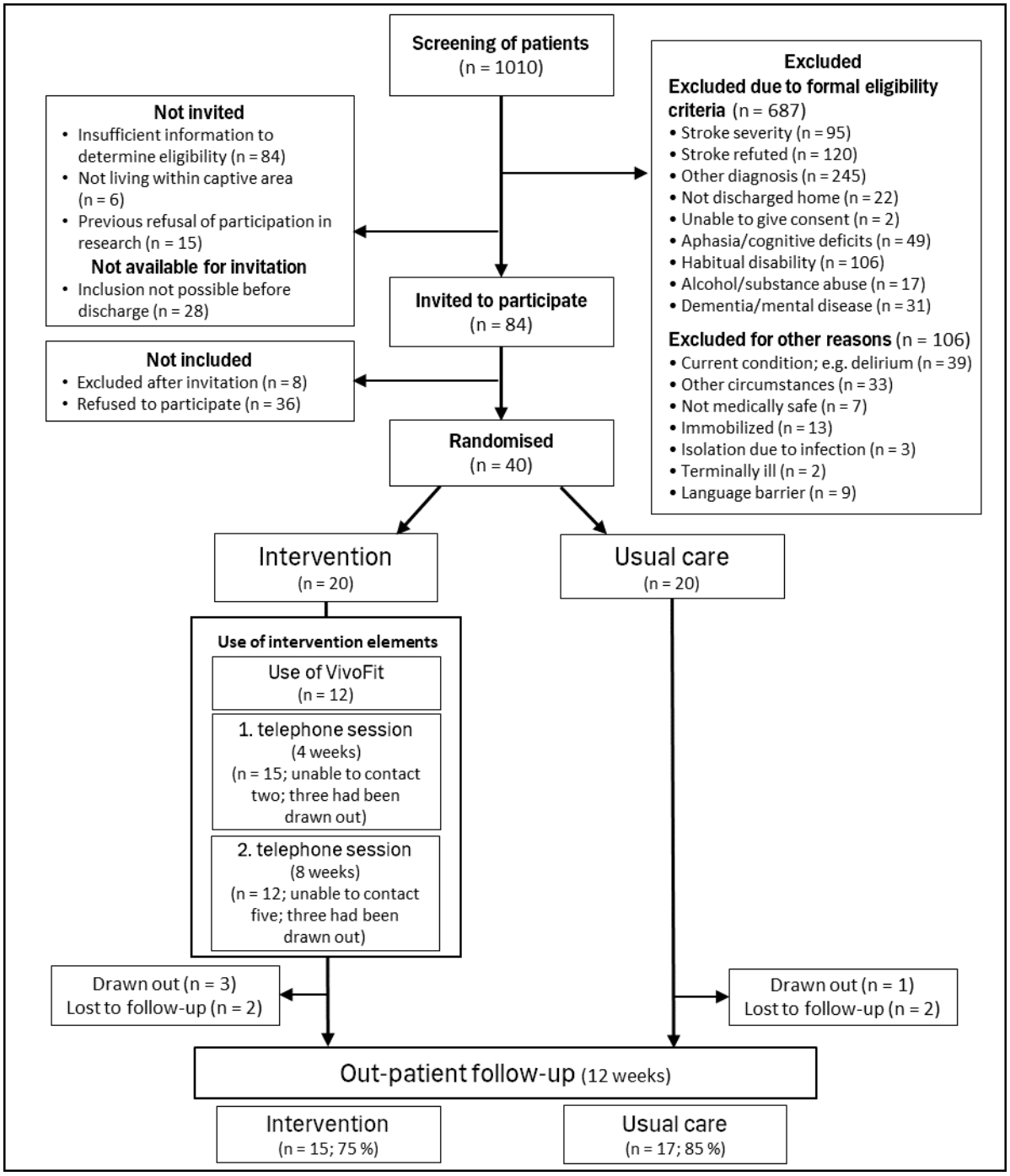

Figure 2 Patient flow from screening to final follow-up.

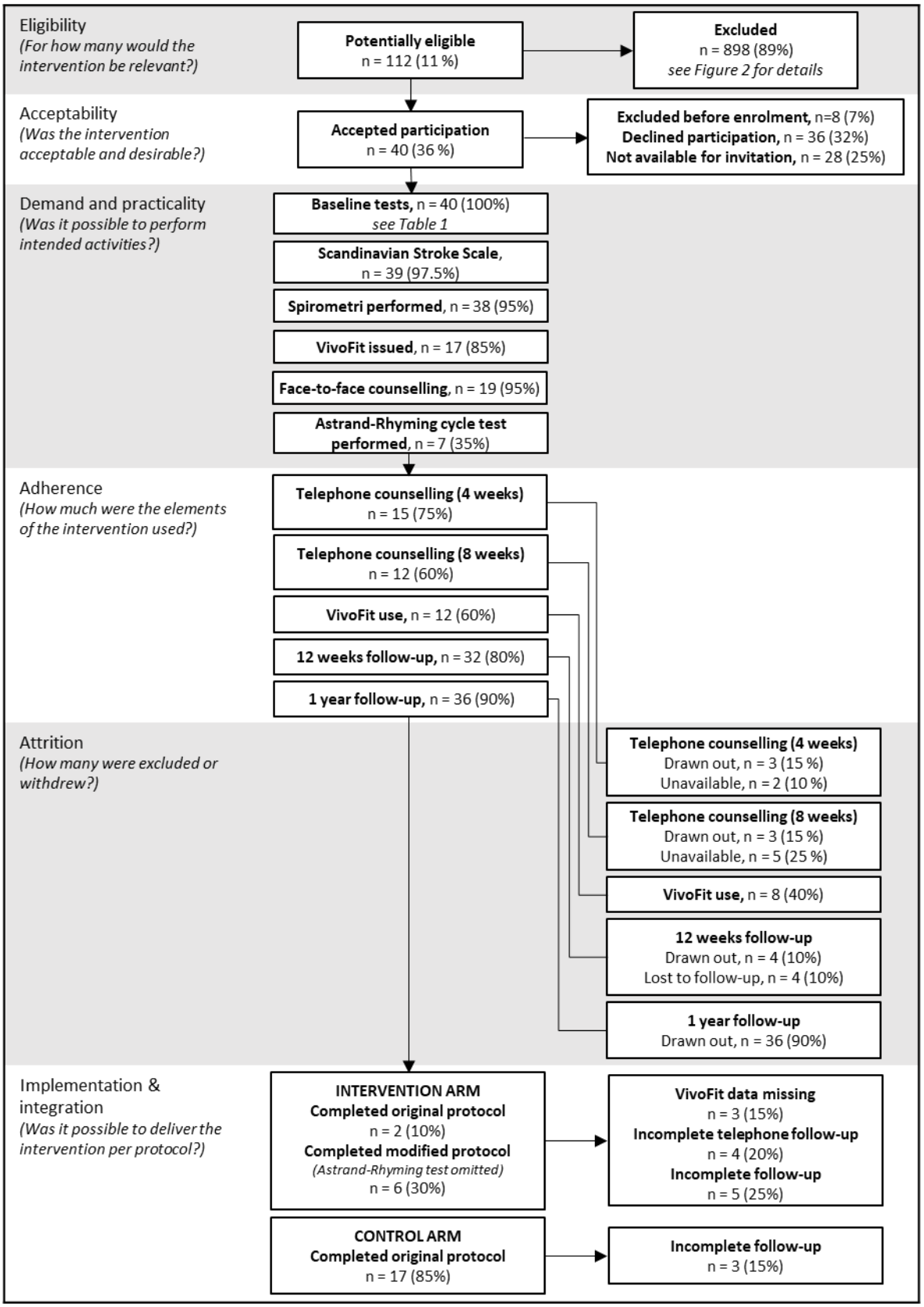

Figure 3 Evaluation of the feasibility

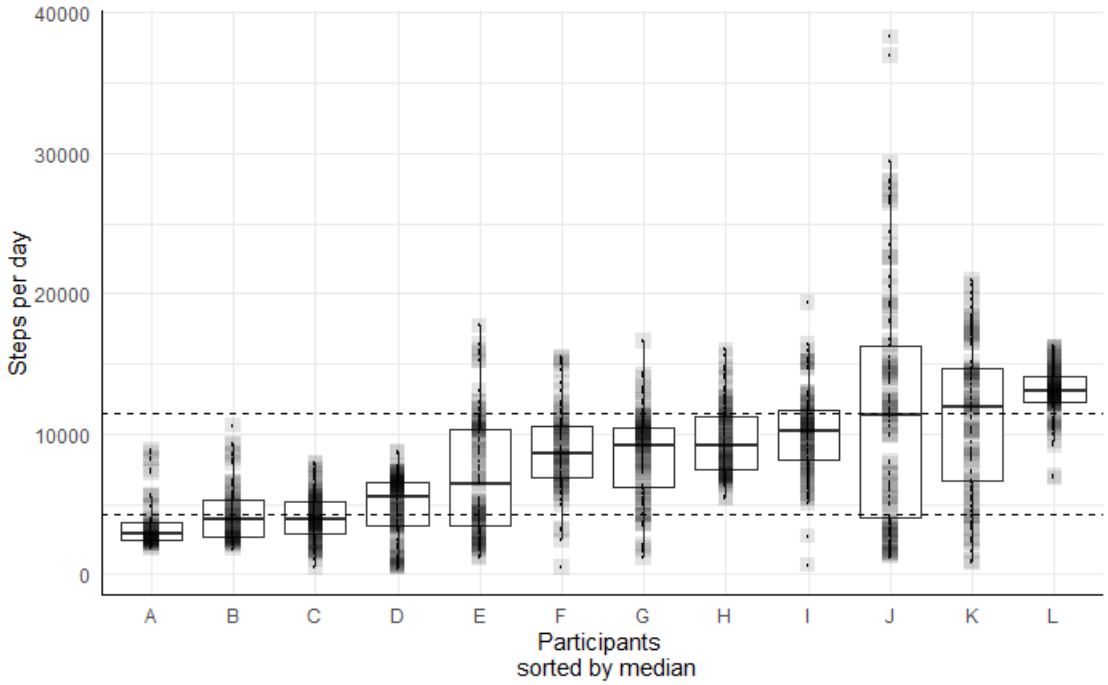

Figure 4 Boxplots of steps per day for each participant sorted by median. Each measurement is represented by an opaque grey square and darker colouring therefore signifies clustering of measurements. The dashed lines indicate the quartiles of all measurements.

Mastering health following minor stroke – a qualitative explorative study

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Short title: Mastering health after minor stroke

Keywords: Stroke, transient ischaemic attack, nursing, health behaviour

Abstract

Background:

Patients with minor stroke or transient ischemic attack are encouraged to adopt a healthy lifestyle to prevent recurrent stroke. After discharge health behaviour is performed in an individual everyday context and must be properly understood within this context, including which aspects act as facilitators or barriers for healthy behaviour.

Objectives:

To explore the experience of daily life in patients discharged home after minor stroke or transient ischemic attack, focusing on perceived health and reflection on health behaviour, and how this is associated with their overall experience of returning to their everyday context in relation to potential sequelae of stroke.

Methods:

Semi-structured qualitative interviews were conducted 3 - 13 months after discharge with sixteen patients discharged home after minor stroke or transient ischemic attack. Inductive thematic analysis was performed to analyse the interviews.

Results:

Participants associated their health and behaviour within a lens of worrying for future life prospect and triggered by perceived intrusive changes in their life condition. Even though some found it possible to resume participation in everyday life within weeks, they became increasingly aware that minor cognitive deficits, difficulties with planning, multi-tasking, memory, and fatigue influenced their health believes and behavioural patterns. The need for social and professional support had to be balanced against a wish for independence.

Conclusion:

Patients with minor stroke or transient ischemic attacks experience changes as both being concrete in the form of persisting symptoms and abstract in the form of worries and uncertainty about the future. Perceived health was associated with a new sense of vulnerability due to realisations about the risk of recurrent stroke. Worries were anchored within the individual to handle, but for some they serve as a motivator to regulate their behaviour in order to master health.

Introduction

Although strokes are often associated with severe disabilities, two thirds of stroke victims only experience minor or transient neurological deficits (Yaghi et al., 2016) and are usually discharged home without follow-up care. A cross-sectional study, however, showed that 48% of patients with minor stroke or transient ischemic attacks (TIA) experience cognitive difficulties (such as difficulties with impaired memory, concentrating, and multi-tasking), while 40% experienced problems with reading, writing, and communicating three months after the event (Fens et al., 2013).

Qualitative studies show that patients with minor stroke often experience being discharged home as a relief and as a way to regain independence (Connolly & Mahoney, 2018). Conversely, discharge may be associated with a changed perception of the home and their own abilities (Connolly & Mahoney, 2018; Wood et al., 2010). The stroke may limit both their physical and cognitive abilities with significant impact on how they interact with and participate in their social surroundings. These limitations are perceived as threats to their independence and previous social roles (Taule & Råheim, 2014; White et al., 2008; Wood et al., 2010).

Patients with stroke are encouraged to engage in healthy behaviour to reduce the risk of recurrent strokes, including physical activity, smoking cessation, eating a healthy diet, and taking preventive medication (Kernan et al., 2014). Evidence suggests that this type of encouragements do not necessarily implicate a high adherence and that the healthy behaviour may decrease over time (Bridgwood et al., 2018; Glader et al., 2010).

When patients are discharged home the health behaviour must be performed in an individual everyday context. Behaviour cannot be properly understood in isolation but has to be interpreted as part of the context it is performed within (McAuley, 2004). A deeper understanding is therefore needed about how patients with minor stroke and TIA experience returning to everyday life and how their perception of health and performance of health behaviour interact with the everyday context in relation to potential physical and cognitive effects of the stroke – including which aspects of the context that act as facilitators or barriers for healthy behaviour.

The objective of this study was to explore the experience of daily life in patients discharged home after minor stroke or TIA, with a focus on perceived health and reflection on their health behaviour, and how this is associated with their overall experience of returning to everyday life in relation to potential sequelae of stroke. This knowledge may contribute to identify more effective and supportive strategies for providing health behavioural counselling in the clinical setting and follow-up care.

Methods

Design

We conducted an explorative qualitative study of patients with minor stroke or TIA and based on 16 semi-structured interviews and a data-driven thematic analysis as suggested by Braun & Clark (Braun & Clarke, 2006, 2013). A hermeneutic approach was used for further interpretation of data (McAuley, 2004).

The qualitative study was performed along-side a randomised controlled pilot study designed to evaluate the feasibility of an early initiated, client-centred patient counselling intervention focusing on smoking cessation, physical activity, and adherence to preventive medication in patients with minor stroke or TIA (Liljehult, Molsted, et al., 2020). The study complied with the Consolidated Criteria for Reporting Qualitative Research (COREQ)(Tong et al., 2007).

Participants and procedures

Participants were recruited after the final follow-up (12 weeks) in an ongoing randomized controlled pilot study (Liljehult, Molsted, et al., 2020). All included participants had TIA or minor stroke, defined as an overall low burden of neurological deficits (Scandinavian Stroke Scale 45-58)(Lindenstrøm et al., 1991), and were discharged home. Participants from both allocation groups (intervention/usual care) were interviewed. Characteristics of the participants were continually evaluated to guide further recruitment and achieve maximal variation in terms of age, gender, and time since the discharge.

Based on empirical quantitative and qualitative literature, an interview guide containing both broad and specific questions (Table 1) was developed through discussions in the cross-disciplinary research team and anchored in the researchers' specialist clinical experience in stroke care and rehabilitation. The guide's main underlying assumptions were that social support (Lawrence et al., 2016), perception of behavioural control (Bandura, 2004), and self-rated health (Shields & Shooshtari, 2001) all positively affect health behaviour and sustainable behavioural change.

Participants were interviewed face to face in the same acute stroke ward where they had been hospitalised. They were invited to bring a relative to co-participate as support at their own discretion.

The three initial interviews, conducted jointly by JL and DO, were used to evaluate the usefulness of the interview guide and the setting. No changes were subsequently made to the interview guide. JL conducted succeeding interviews. All interviews were digitally recorded and transcribed verbatim. Field-notes were taken outlining tentative themes and the interviewer's reflections on the interview immediately afterward.

Insert Table 1 about here

Data analysis

The interviews were analysed using a six-step, data-driven thematic analysis (Braun & Clarke, 2006, 2013), consisting of the steps: 1) Familiarizing yourself with the data, 2) Generating initial codes, 3) Searching for themes, 4) Reviewing the themes, 5) Defining and naming the codes, and 6) Producing the report (Table 2).

Familiarisation with the data involved relistening to the recordings and thoroughly reading the transcripts while taking descriptive notes on the content. Transcripts were coded using open and descriptive codes. After fully coding half of the transcripts, we began categorising the codes into the following preliminary categories: explaining the stroke, pathway, coping with disease, medication, a new life, recurrence, social support, health, symptoms, and knowledge. When all codes were

categorised, we used concept maps to visually explore connections between codes and searched for potential themes. Memos were used to continually document observations and reflections. Preliminary themes were modelled by describing the patterns found in the concept maps. To review and qualify the themes all interview transcript text coded into the theme was reread. When necessary, bundles of text were recoded to construct new, more developed themes. General descriptions of each theme were written down to define more overall narratives in the content. The themes were further developed and refined through researcher triangulation. The six-step analysis were carried out by JL, while DO and TM contributed with triangulation and consensus on coding and themes in steps four to six (Table 2). NVivo version 12 (QSR International) (QRS international, 2018) was used to organise the data and support the analysis process.

Insert Table 2 about here

Ethical considerations

All participants provided written informed consent. Before the interview they were informed that the interview would be recorded and kept confidential, that participation was voluntary, and that they could withdraw their consent at any time. The study was approved by The Danish Data Protection Agency (file.no. VD-2018-306, I-6552.

Findings

A total of 16 stroke survivors took part in hospital-based, semi-structured interviews which lasted 30 to 68 minutes. On two occasions the spouses participated as co-participants. Table 3 summarises the characteristics of the stroke survivors. The time since the stroke event was 3 – 13 months (median 6.5 months).

Three participants lived alone, five were still working, and eleven were retired, seven of who still did volunteer work. Four were initially admitted with TIA, and the rest had minor ischemic stroke (Scandinavian Stroke Scale 58-56). Admission symptoms included motor deficits (n=10) and sensory deficits (n=6), mainly distributes to one arm (n=9), leg (n=4), and/or one side of the face (n=5) , or speech impairment (n=5). Two had been readmitted for suspected stroke and one had suffered a new ischemic stroke before discharge. At the time of the interview all participants were able to carry out the same activities as before the stroke, although half of them reported having remaining symptoms.

Insert Table 3 about here

Themes

An inductive analysis of the data that involved sorting themes hierarchically identified four overarching but interconnected themes*: 1) experiencing symptoms as intrusive in everyday life, 2) worrying – a new companion , 3) mastering health in a changed life situation,* and *4) family relationships – balancing support and independence*. Some common features were that the

participants wanted to return to the life they had had previously but found that their life situation had been disrupted by the consequences of the stroke with a new sense of vulnerability. This made them concerned about the future. To resolve their concerns, they adjusted their health behaviour. Both social support and a feeling of responsibility towards their family were associated with their worries and how they mastered their changed behaviour, which involved not only adjusting to the new situation but also modifying the conditions of the situation. Some of the factors that affected the way they mastered the situation were, e.g. risk awareness, social support, and what they thought caused the stroke.

Experiencing symptoms as intrusive in everyday life

The participants generally expressed a strong wish to return to their everyday life as it had been before the stroke. The perceived benefits of returning to everyday activities included a sense of structure and feeling less isolated. However, being faced with the reality following hospitalisation, several participants experienced more prolonged difficulties, which intruded on their ability to return to normality, even though some participants were able to resume their everyday activities within weeks. The evolving experience of changes was related to impaired function and symptoms associated with the stroke event and thus challenged their known normality. This implied that they had to find new ways to deal with their situation.

The evolving realisation that 'things are not as before' did not come right away but developed over time through experience with difficulties in everyday situations that faced the participants with changes in function and persistence of symptoms. Functional changes and symptoms included neurological deficits, cognitive deficits, and fatigue. The physical symptoms, such as problems with balance and sensory or motor deficits, had little effect on daily activities. On the contrary, cognitive deficits, such as difficulty planning and multi-tasking, decreased memory, and confusion seemed to affect the participants more than physical deficits. Fatigue and lack of energy were the most prevalent cognitive deficits.

> *It's the stubbornness that's the worst, and the realisation that you can't quite do the same as before, right, without getting tired at least. Yeah, that's [the biggest limitation], and it's really annoying.* (James)

Fatigue and problems with memory and planning were described as the most disruptive. To overcome the fatigue and lack of energy, the former described as fluctuating and sudden they had to rest more and give certain activities lower priority, especially social activities. They wanted to focus on close relationships at the expense of more proximal ones.

> *It improved step by step, like, finding yourself and getting things running but symptoms like a lot of people, loud noises, a lot of information, it can be difficult – sometimes I prefer going off to be by myself and relaxing for a bit. I think I get tired more easily.* (Gunnar)

Although the participants hoped to return to normality, several of them had to face the reality that the conditions for their life situation had changed and life was not as before. This realisation led to feeling a sense of vulnerability and an awareness of being at risk, which caused them to worry.

Worrying – a new companion

Returning to everyday life – and the realisation of everyday life difficulties – was associated with worrying about consequences of the present stroke and a new awareness of being at risk of having another stroke in the future. This raised a sense of vulnerability and caused them to worry, which would become a new companion in their daily life.

The degree of risk awareness and concern varied, the latter described as fluctuating and coming in waves. The participants tried to manage their worry to prevent it from taking over and limit their behaviour.

> *In some way, you could say, yeah, I'm worried about having another stroke, but I don't think about it all the time; I'm trying to get my everyday life going and to hold on to that.* (Gunnar)

Worrying occurred among both patients and relatives, although they described worrying differently. The patients were mostly worried about becoming disabled and how close family members would carry on if they died. The relatives were mainly worried about the prospect of losing their loved one.

> *It was more me, I think, who was scared if you went anywhere and I couldn't get hold of you, or you had been out for a long time, then I had to go out and look, if he was lying out there, for the first six months at least. I didn't feel very good.* [Wife of Oscar]

Worrying was experienced as reasonable in concern of the seriousness of the illness. Some of the participants talked about finding a balance between worrying and complaining excessively.

> *It's like trying to keep the balance between, on one hand, not being a wuss, who needs help all the time, I have to do the things, I can and believe that I can do them myself, and then at the same time being a little careful.* (Kenneth)

Participants worried both about their current situation and the future, including the long-term prospect of becoming disabled by a new stroke and the more imminent concern of being unable to get help in the event of another stroke. They were also concerned about the future of their family whether they would be able to fulfil their role and responsibilities in the family. This was most prominent in participants who had young children or who took care of family members.

> *We've talked about it sometimes. It might happen; I might die from it, and those thoughts are new, like, life doesn't last forever. I think about that when I sing at funerals, then I think, 'Oh, that could be me one day', but hopefully not anytime soon, hopefully it can wait 10, 15, 20 years.* (Carl)

Some were able to regulate the worrying to prevent it from disrupting their everyday life. Strategies for downplaying worrying included taking an action-oriented approach, such as taking the prescribed medication and staying active, but also various cognitive strategies, such as rationalisation.

Mastering health in a changed life situation

The changes to the participants life conditions brought about by the stroke entailed various degrees of modification to their behaviour. Although a few participants expressed that no changes in their life were necessary, others found that adapting to functional limitations, living healthily, taking the prescribed medication, and taking proper safety measures were warranted in order to master their new situation.

Mastering situational challenges partly involved behavioural strategies to compensate for functional limitations. Participation in community rehabilitation or self-training helped patients master the physical symptoms, while cognitive deficits were mastered by prioritising activities, slowing down, lowering expectations, and writing things down to better remember them.

> *I actually don't feel that things are different than before – small things are not as they should be, you compensate in all sorts of ways.* (Otto)

> *Things like cleaning, I've never been good at that. It's never really interested me, not that our house is a mess. I prioritise going for a walk; exercise is a big thing, you see.* (Elisabeth)

Mastering problems with planning and memory often included writing notes and lists.

> *I open the refrigerator and say: 'We have to buy milk and yoghurt today', but if I don't write it down immediately, then maybe an hour later I can't remember.* (Frederik)

The stroke, in itself, had a minor impact on how the participants rated their own health, though it did serve as a wake-up call that their health needed more attention. Most participants thought that it was possible for them to affect their own health, though other aspect, both physical, psychological, and social, were also highlighted as important for health behavioural change.

> *You feel that you've got a bit of a wake-up call, in the way that you can't just do as you like. If I can do something, then I have to do it.* (Gunnar)

When rating their own health, the participants often compared it to that of friends or their own previous level of activity. The evaluation was not based on the presence of medical diagnoses, but rather their perception of their physical function and level of energy.

> [My health] *is not what it was 20 years ago, you know. Physically it's not good, but mentally I guess that my mind can't understand that there should be anything wrong, but it has nothing to do with the stroke. It's psychological; it's because I have all these pains. I have osteoporosis and arthritis. I have had them for a while.* (Patrick)

Being healthy was associated with keeping active – both physically and socially – avoiding negative thoughts, eating healthily – especially eating more vegetables and less meat – maintaining a normal weight, being aware of alcohol intake, and making healthy behaviour into a habit.

> *I walk a lot more, because, I didn't go for walks before, not as often, no, but now I have made the decision that now is the time, and because, if you skip one day, then you might also skip tomorrow – you have to commit to it, and I also enjoy it. And when you wear this watch* [VivoFit]*, so I never cheat.* (Oliver)

Only few participants could point to a specific cause for their stroke, most of them were aware that there was an increased risk of a recurrent stroke. Health behaviours, including taking the prescribed medication, physical activity, eating a healthy diet, and drinking less alcohol, were perceived as means to reduce the risk and staying alive.

> *It can hit all of us, indeed. So if you take the medication you're supposed to, you can't do much else,* [...]*, and I keep active and walk. I don't sit around feeling sorry for myself, you see. That's what it's all about.* (David)

Health promoting behaviour was reported as being motivated by social support in the form of encouragement from their family or having people to exercise with, an experience of being responsible for their own health, a new focus on health, monitoring their health (activity trackers, body weight, blood pressure), and being active, all of which gave them a sense of satisfaction. Barriers to physical activity included musculoskeletal pain and lack of time due to work or family obligations.

Not all participants had taken medication before the stroke and for some this signified a considerable change to their self-image (*"I'm not the type who takes pills, not even when I have a headache."*) and meant that they had to adapt new daily routines, such as incorporating medication into existing regular activities – e.g. meals or morning habit.

> *It's best when it's in the morning, then it's part of my toothbrush-routine. When I forget, it means something distracted me from it. Some I have to take once a week, and I have to take it half an hour before breakfast and the rest of the pills. If I go downstairs and up again, then I simply forget.* (Patrick)

Side-effects were a significant barrier for taking medication, urging them to change or discontinue medication. Most participants consulted their physician before deviating from prescriptions, although some stopped medication or changed the dosage on their own.

Another aspect of mastering involved awareness of perceived risk. Several participants took measures to be able to get help if they fell ill again, such as carrying their mobile phone or making sure that there were people nearby. More long-term strategies involved formally ensuring their family by making a will and talking with family about their wishes in terms of treatment if they became incapacitated.

> *I was told that I should get out and get some fresh air and exercise half an hour every day or something, and I did that, but like short walks. I would go for a walk and always bring my mobile phone with me. That's something that I didn't do before. I don't like going out alone or where there are no people around without my mobile phone along.* (Kenneth)

Family relationships – balancing support and independence

The consequences of the stroke affected not only the participants but also their families in the informer's point of view. Family relationships were described as a significant factor in the participants mastering their new life situation, and inversely, family relationships were also affected by the way the participants mastered the situation.

Close family members provided most of the social support, which was also the most persistent form of support. Spousal relationships were of chief importance to most participants – although for widowed participants, it was with their adult children. When extended family, friends, neighbours, and colleagues gave support, it was frequently of a more practical nature.

> *My wife is good at – if we're working hard in the garden, she'll says, 'Know what, I'll get you a cold beer, go and sit down and relax.' It's more like that. I do more or less the same, but she's good at putting the brakes on me.* (James)

Support was expressed as being more considerate of each other's needs, e.g. accepting that the participant needed to rest more and encouraging them to take it easier. Occasionally, participants found it necessary to negotiate a balance between relatives being supportive and being overprotective, as they wanted to be as independent as possible.

> *I don't even get to [help out], I can't keep away; then they* [adult children] *send me away and that bothers me a little. I'm not totally crippled yet, but yeah, they're observant about that. I do feel that.* (Patrick)

Consideration was expressed by the participants by adapting to the new situation in a manner that acknowledged their spouse's situation, such as the spouse being ill or still working. Both felt an obligation towards mutual relationships that affected their behaviour, exhibited by, e.g. prioritising time with close family instead of other activities and acknowledging their financial responsibilities towards the family.

> *I have to take care of my wife. She can't take care of herself, so my time is occupied. That's why it isn't possible for me to go to anything. I'd like to play football or something but that won't do. We can't make that work, no, but that's how things are when you get older.* (Oliver)

Concerns for the future affected relationships in several ways. Some participants wanted to spare the family from worrying, either by talking about the disease or by not talking about it. Generally, they found it difficult to talk about the disease with their family.

> *No, not spare them, but it's difficult to talk about [worries], and it's also difficult for him to help, you see, because then he goes and says something wrong and then I get all mad [laughs], 'Jeez, you're useless!'.* (Elisabeth)

The changes and concerns might be the subject of conflicts, which often arose from the participants not feeling understood by others, e.g. when relatives would become impatient when the participant did things slower than normal or struggled to find the right words.

Yeah, it's actually going slowly, I'm slower than I used to be, and then she doesn't want to wait, like, then she takes over instead. It actually irritates me a little, and I tell her 'I can do it, it just takes longer'. (Carl)

Discussion

The present study suggests that participants who experienced a minor stroke associated their health and behaviour within a lens of worrying for future life prospect and triggered by perceived changes in their life condition. Even though some found it possible to resume participation in everyday life within weeks, they became increasingly aware that minor cognitive deficits, difficulties in planning and multi-tasking, decreased memory and fatigue influenced their health believes and behavioural patterns.

The experienced changes were both concrete in the form of persisting symptoms and abstract in the form of worries and uncertainty about the future. Wood et al. (Wood et al., 2010) described the process of returning to normality in patients discharged home after stroke rehabilitation as a non-linear process which involved finding a balance between their capacity and personal expectations. The wish to return to a normal life was found in other studies to be connected to regaining independence and autonomy (Nordin et al., 2015; Wood et al., 2010; Wray et al., 2019). Returning to previous activities was a way of establishing structure and a feeling of connection to society. Wood et al. (2010) found that limitations in the ability to participate in everyday life made the participants feel useless. Returning to their previously familiar everyday life is not just a matter of wanting to carry on like before, but also about regaining a sense of independence and belonging in the world.

The new sense of vulnerability found in the present study and the feeling of being at risk, was the predominant cause of worrying in both patients and relatives. Facing worries was an experience anchored within the individual to handle and keep it bay to maintain their everyday life. Connolly and Mahoney (2018) found that worries and uncertainty were always in the back of the mind of the stroke victims, but they mastered it by trying to understand the cause of their stroke and by integrating it into their self-image. Hillsdon et al. (2013) also found participants with minor stroke who felt ashamed about using health care resources because they were not ill enough, while Taule and Råheim (2014) had similar participants who felt ashamed of finding it difficult to return to everyday life because they knew others were worse off. Our informants mainly reported seeking professional support related to health problems and medication. Inviting stroke survivors to talk about their worries at follow-ups with a health professional might relieve some of their concerns and enhance their quality of life. The general practitioners were the primary source of professional support, although they in some informants' experience lacked specialised knowledge about stroke care. A more cooperative model for stroke follow-up might be able to narrow this gap.

Social support, especially spousal, was emphasised by the participants as important in mastering their illness, but simultaneously, they expressed a need for maintaining independence and for others to acknowledge the changed nature of their life situation. The independence aspect was not just a matter of functional independence, but also regarded an acknowledgement of mutual obligations and not being a burden on the relatives. Other studies have emphasised how social support may

protect against negative emotions and increase resilience (White et al., 2008), while Wood et al. (Wood et al., 2010) found that interaction with relatives and health professionals provided hope and motivation. Gaps in the support were experienced in situations where the participants did not feel acknowledged, e.g. relatives being overprotective or impatient with them. Similar experiences of not being understood (Taule & Råheim, 2014) or relatives being overprotective (Hillsdon et al., 2013; Wood et al., 2010; Wray et al., 2019) have been expressed in previous studies as factors that made patients feel unimportant and unheard.

In the present study stroke risk was attributed to a range of potential causes, such as an active lifestyle, positive and negative thoughts, or mere coincidence. Different narratives about the cause and urgency of the stroke seem to affect patients' willingness to engage in or change health behaviour. On one hand, some stroke victims perceive an association between their own health behaviour and the stroke – which might urge some to engage in or change behaviour – but might also cause some patients to blame themselves for the stroke (Taule & Råheim, 2014). On the contrary, some patients do not perceive any connection between their own behaviour and the stroke or perceive the stroke as a lesser threat, making them more reluctant to change behaviour (Hillsdon et al., 2013).

The impact of health behaviour on the risk of stroke is well-established and patients find it meaningful and helpful to receive counselling from a health professional (Lawrence et al., 2016). There is low to moderate evidence that health behavioural interventions have a beneficial effect in secondary prevention of stroke, although we still lack evidence on what might be the best approach (Liljehult, Christensen, et al., 2020). Patients with minor stroke have difficulties receiving information (Hillsdon et al., 2013; Reed et al., 2010). We found that several informants had difficulties recalling details about their hospital stay and the information they had been given. This means that generic encouragement of behavioural change might be insufficient. To be useful to patients, we need to provide specific and relevant counselling that is individualised in a manner that, acknowledges the life situation of the patients, including their physical and cognitive limitations and their access to social support.

Strengths and limitations

The exploratory qualitative design of this study allowed us to gain insight into novel aspects of patient experiences and a more nuanced depiction of their thoughts and experiences. The selection of participants might constitute a limitation to this study since we only included informants who participated in an interventional study. This means that the perspectives represented by patients who were either excluded or refused to participate are not included. Ten of the participants had further education, compared to only 32 percent of the general population above 55 years (Statistics Denmark, 2021), making them more well-educated than expected. None of the informants were currently smoking, but it is uncertain whether other aspects of the informants' health behaviour might have influenced our findings. Although it was beyond the scope of this study, we cannot rule out that including patients with more severe deficits, especially more severe aphasia and cognitive deficits, would have had an impact on the results.

Most participants in this study either lived with a partner (n = 13) or had close contact with their adult children (n = 2). This obviously influenced the theme related to social support in which the participants pointed to social support as important for how they mastered their life situation and

health behaviour. In contrast, the perspective of patients with a limited social network has not been fully investigated. Future studies should look further into how patient living alone or with a limited social network seek support and how this affect their health behaviour.

Trustworthiness

The primary investigator had throughout the interventional study a *prolonged engagement* with participants and had therefore already established a relation with them before the interviews and had a prior knowledge of their health and living situation. The credibility was further developed by using a well-recognised qualitative methodology and involved multiple investigators in steps of interpretation.

Determining an appropriate sample can be challenging in qualitative research and exploring a broad aim across multiple case, as we have, might require a broad variation over demographics and medical characteristics to obtain greater information power (Malterud et al., 2016). Had it been possible, we would have liked to have more female informants and more informants living on their own. It is likely that patients' experience and mastering of stroke related difficulties change over time. The choice of interviewing participants at variable times after the initial stroke events allowed us to gain insight into the experiences at different time points.

In the attempt to further enhancing the information power of the study we used established theories to inform the interview guide and chose to recruit participants from the interventional study, which had the advantage of specifying the sample to patients with minor stroke who were discharged home and who had shown an interest in health behaviour, and further enhanced the quality of the dialogue in the interviews because they were conducted by an investigator whom the participants already knew from the interventional study.

Conclusion

Patients with minor stroke and TIA experience changes as both being concrete in the form of persisting symptoms and abstract in the form of worries and uncertainty about the future. Perceived health was associated with a new sense of vulnerability due to realisations about the risk of recurrent stroke. Worries were anchored within the individual to handle. For some this serves as a motivator to regulate their behaviour in order to master health. The support from relatives' is highly pronounced even that this study does not cover its significance in detail and the fact that the vast majority were having marital partner.

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Table 1 Interview guide

Domain	Subdomain	Main questions	Supporting theory
Discharge and coming home	Discharge	Do the patients feel prepared to go home? Do you remember being told what had happened? Was there anything that made you feel worried or unsafe?	(Connolly & Mahoney, 2018; Fens et al., 2013; Nordin et al., 2015)
	Being at home	How did you experience being home in the first weeks/months after the stroke? Did you have any symptoms or difficulties after the stroke? (We specifically ask about: motor/sensory deficits, speaking impairments, trouble reading, writing, watching television, fatigue, concentration, planning, and social interaction) Did the remaining symptoms affect your everyday life?	
Health	Self-perceived health	How do you perceive your own health? Has your perception of your health changed after the stroke? Why do you think you had the stroke? Are you worried about your health? Do you do anything in particular to be healthy?	(Shields & Shooshtari, 2001)
	Perceived barriers and facilitators	What motivates you to participate in healthy activities? Are there any barriers/facilitators for participating in healthy activities?	(Fishbein & Ajzen, 2009)
	Perceived control	Do you feel that you can have an impact on your own health? Do you feel that your health behaviour is important?	(Bandura, 2004; Fishbein & Ajzen, 2009)
Medication	Importance of medication	How do you feel about taking medication? Have you experienced any side-effects?	(DiMatteo et al., 2012; Glader et al., 2010)
	Medication adherence	How good are you at remembering to take your medication? Have you ever forgot to take the medication? Has your medication been changed after the discharge? (Why? By whom?)	
Physical activity		Do you engage in any physical activity? (Which type? How often?)	
Tobacco use (if relevant)		Do you intend to stop smoking? Have you tried to stop smoking?	
Social support		In whom do you find your primary social support? Have you sought support anywhere else? Have you lacked any kind of support (relatives, family, professional)?	(Lawrence et al., 2016)

Table 2 Thematic analysis process (example)
Interviews were analysed using a six step data-driven thematic analysis (Braun & Clarke, 2006, 2013). The process consists of the steps: 1) Familiarizing yourself with the data, 2) Generating initial codes, 3) Searching for themes, 4) Reviewing the themes, 5) Defining and naming the codes, and 6) Producing the report. The process is exemplified below.

Quote	Note	Code	Potential theme	Final theme
"I have sort of pushed a lot of those thoughts away, that there should be somethings that I am scared about – and my wife too – but we have talked about it, I might have thought that it rather not happen again, but it might happen, but then at least that it rather not be serious, because it might be fatal – and those are some new thoughts to me, that life is not eternal, at some point it is 'goodbye and farewell', and I do think about it when I sing at funerals, I think: 'That could be me some day', but hopefully not any time soon, hopefully it can wait 10, 15, 20 years"	The stroke has been a reminder of his own mortality	Knows that it can happen again; and that it can be severe or fatal	Worries	Worrying – a new companion
"But I think, of cause I think, okay, you have to hold on 6-7-8 years, and after that you probably want to take five more years – But then it will be something else, because it's an important phase in their lives right now, because you have children of that age, family and all. It's better if you are both there."	He does not want to leave the children – It is an important time in their life right now	Wants to stay healthy because of the children	Social support	Family relationships

Table 3 Characteristics of stroke survivors in the qualitative interview study

							At RCT baseline						
Pseudonym	**Days since stroke**	**Age**	**Sex**	**Habitation**	**Occupational status**	**Education**	**Self-rated health**	**CCI**	**Smoking**	**Alcohol** (units per week)	**NIHSS / SSS**	**Allocation**	**mRS**
Neal	88	78	Male	Living with a partner	Retired, volunteer	College degree	Good	0	Previous smoker	10	1 / 58	Intervention	0
Karen	89	72	Female	Living with a partner	Retired, volunteer	College degree	Good	1	Never smoked	5	0 / 58	Control	0
Otto	92	77	Male	Living with a partner	Retired, volunteer	Master' s degree	Pretty good	1	Previous smoker	10	2 / 58	Control	1
Lisa	105	73	Female	Living alone	Retired, volunteer	Vocational	Good	1	Previous smoker	0	0 / 58	Control	0
Oliver	138	72	Male	Living with a partner	Working part-time	College degree	Good	0	Never smoked	3	0 / 58	Intervention	0
David	148	72	Male	Living with a partner	Retired	Vocational	Pretty good	0	Previous smoker	2	2 / 57	Intervention	1
Gunnar	156	68	Male	Living with a partner	Retired, volunteer	College degree	Pretty good	1	Never smoked	2	0 / 58	Control	1
Frederik	195	52	Male	Living with family	Working full-time	Master' s degree	Pretty good	0	Previous smoker	1	0 / 58	Control	1
Kenneth	197	64	Male	Living alone	Working full-time	Master' s degree	Good	1	Never smoked	7	0 / 58	Control	0
Carl	232	73	Male	Living with a partner	Retired, volunteer	College degree	Good	1	Previous smoker	5	0 / 58	Intervention	1
Elisabeth	233	73	Female	Living with a partner	Retired	College degree	Pretty good	2	Previous smoker	7	0 / 58	Intervention	1
Julia	240	74	Female	Living alone	Working part-time	Vocational	Pretty good	0	Previous smoker	7	4 / 56	Control	1
James	286	69	Male	Living with a partner	Retired	Vocational	Pretty good	0	Previous smoker	0	2 / 56	Control	2
Paul	287	67	Male	Living with a partner	Working full-time	College degree	Pretty good	1	Never smoked	21	1 / 58	Intervention	0
Patrick	331	77	Male	Living with a partner	Retired, volunteer	Vocational	Good	4	Previous smoker	1	0 / 58	Intervention	0
Oscar	399	76	Male	Living with a partner	Retired	Vocational	Good	0	Previous smoker	30	1 / 57	Intervention	0

CCI Carlson Comorbidity Index, **NIHSS** National Institute of Health Stroke Score, **mRS** modified Rankin Scale at the time of the interview, **SSS** Scandinavian Stroke Scale

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	4
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	Title page
Occupation	3	What was their occupation at the time of the study?	Title page
Gender	4	Was the researcher male or female?	Title page
Experience and training	5	What experience or training did the researcher have?	Title page
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	4+13
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	4
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	4
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	3
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	3-4
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	3-4
Sample size	12	How many participants were in the study?	5
Non-participation	13	How many people refused to participate or dropped out? Reasons?	13
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	5
Presence of nonparticipants	15	Was anyone else present besides the participants and researchers?	5
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	Table 3
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	3 + Table 1

Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	No
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	4
Field notes	20	Were field notes made during and/or after the interview or focus group?	4
Duration	21	What was the duration of the interviews or focus group?	5
Data saturation	22	Was data saturation discussed?	13
Transcripts returned	23	Were transcripts returned to participants for comment and/or	No
Topic	**Item No.**	**Guide Questions/Description**	**Reported on Page No.**
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	4
Description of the coding tree	25	Did authors provide a description of the coding tree?	5 + Table 2
Derivation of themes	26	Were themes identified in advance or derived from the data?	4-5
Software	27	What software, if applicable, was used to manage the data?	5
Participant checking	28	Did participants provide feedback on the findings?	No
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	5-9
Data and findings consistent	30	Was there consistency between the data presented and the findings?	5-9 + Table 2
Clarity of major themes	31	Were major themes clearly presented in the findings?	5-9
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	5-9

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

DECLARATION OF CO-AUTHORSHIP

The declaration is for PhD students and must be completed for each conjointly authored article. Please note that if a manuscript or published paper has ten or less co-authors, all co-authors must sign the declaration of co-authorship. If it has more than ten co-authors, declarations of co-authorship from the corresponding author(s), the senior author and the principal supervisor (if relevant) are a minimum requirement.

1. Declaration by	
Name of PhD student	Jacob Mesot Liljehult
E-mail	Jacob.mesot.liljehult@regionh.dk
Name of principal supervisor	Thomas Christensen
Title of the PhD thesis	Health behaviour in patients with minor stroke and transient ischemic attacks

2. The declaration applies to the following article	
Title of article	Effect and efficacy of lifestyle interventions as secondary prevention
Article status	
Published ☒ Date: 06-04-2020	Accepted for publication ☐ Date:
Manuscript submitted ☐ Date:	Manuscript not submitted ☐
If the article is published or accepted for publication, please state the name of journal, year, volume, page and DOI (if you have the information).	Acta Neurol Scand. 2020 Oct; 142(4): 299-313. Doi: 10.1111/ane.13308. PMID 32620044.

3. The PhD student's contribution to the article ***(please use the scale A-F as benchmark)*** Benchmark scale of the PhD-student's contribution to the article **A**. Has essentially done all the work (> 90 %) **B**. Has done most of the work (60-90 %) **C**. Has contributed considerably (30-60 %) **D.** Has contributed (10-30 %) **E.** No or little contribution (<10 %) **F.** Not relevant	**A, B, C, D, E, F**
1. Formulation/identification of the scientific problem	A
2. Development of the key methods	B
3. Planning of the experiments and methodology design and development	A
4. Conducting the experimental work/clinical studies/data collection/obtaining access to data	B
5. Conducting the analysis of data	A

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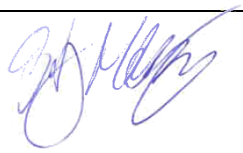
6. Interpretation of the results	B
7. Writing of the first draft of the manuscript	A
8. Finalisation of the manuscript and submission	A
Provide a short description of the PhD student´s specific contribution to the article.[i] Jacob Mesot Liljehult has conceived the principle idea of the study and planned and developed the design in collaboration with the co-authors, and has further lead and participated in the data collection, analysis, and interpretations of the results. JML has made first draft of the publication and managed further revisions and submission of the manuscript.	

4. Material from another thesis / dissertation[ii]	
Does the article contain work which has also formed part of another thesis, e.g. master's thesis, PhD thesis or doctoral dissertation (the PhD student's or another person's)?	Yes: ☐ No: ☒
If yes, please state name of the author and title of thesis / dissertation.	NA
If the article is part of another author's academic degree, please describe the PhD student´s and the author´s contributions to the article so that the individual contributions are clearly distinguishable from one another.	NA

5. Signatures of the co-authors[iii]

	Date	**Name**	**Title**	**Signature**
1.	23-02-2021	Thomas Christensen	MD, DMSc	
2.	23-02-2021	Stig Mølsted	PT, PhD	
3.	23-02-2021	Dorthe Overgaard	RN, PhD	

5. Signatures of the co-authors[iii]				
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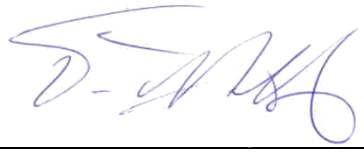
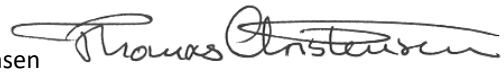
5.	23-02-2021	Tom Møller	RN, PhD	

6. Signature of the principal supervisor

I solemnly declare that the information provided in this declaration is accurate to the best of my knowledge.

Date: 23-02-2021
Principal supervisor: Thomas Christensen 

7. Signature of the PhD student

I solemnly declare that the information provided in this declaration is accurate to the best of my knowledge.

Date: 22-02-2021
PhD student: Jacob Mesot Liljehult 

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[i] This can be supplemented with an additional letter if needed.
[ii] Please see Ministerial Order on the PhD Programme at the Universities and Certain Higher Artistic Educational Institutions (PhD Order) § 12 (4):
"Any articles included in the thesis may be written in cooperation with others, provided that each of the co-authors submits a written declaration stating the PhD student's or the author's contribution to the work."
[iii] If more signatures are needed please add an extra sheet.

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1. Declaration by	
Name of PhD student	Jacob Mesot Liljehult
E-mail	Jacob.mesot.liljehult@regionh.dk
Name of principal supervisor	Thomas Christensen
Title of the PhD thesis	Health behaviour in patients with minor stroke and transient ischemic attacks

2. The declaration applies to the following article	
Title of article	Lifestyle counselling as secondary prevention in patients with minor stroke and transient ischemic attack: study protocol for a randomized controlled pilot study
Article status	
Published ☒ Date: 25-03-2020	Accepted for publication ☐ Date:
Manuscript submitted ☐ Date:	Manuscript not submitted ☐
If the article is published or accepted for publication, please state the name of journal, year, volume, page and DOI (if you have the information).	Pilot Feasibility Stud. 2020 Mar 25;6: 40. doi: 10.1186/s40814-020-00583-4. PMID 32226634

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2. Development of the key methods	B
3. Planning of the experiments and methodology design and development	B
4. Conducting the experimental work/clinical studies/data collection/obtaining access to data	A

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5. Conducting the analysis of data	A
6. Interpretation of the results	B
7. Writing of the first draft of the manuscript	A
8. Finalisation of the manuscript and submission	A
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If the article is part of another author's academic degree, please describe the PhD student´s and the author´s contributions to the article so that the individual contributions are clearly distinguishable from one another.	NA

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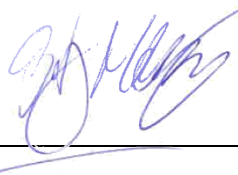
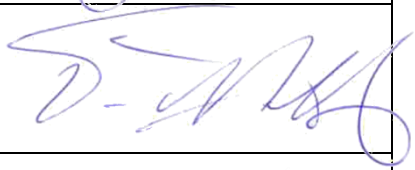
1.	23-02-2021	Stig Mølsted	PT, PhD	
2.	23-02-2021	Tom Møller	RN, PhD	
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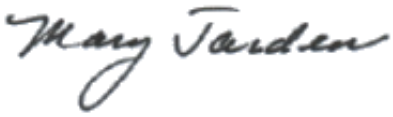
4.	23-02-2021	Mary Jarden	RN, PhD	
5.	23-02-2021	Lis Adamsen	RN, PhD	
6.	23-02-2021	Thomas Christensen	MD, DMSc	

6. Signature of the principal supervisor

I solemnly declare that the information provided in this declaration is accurate to the best of my knowledge.

Date: 23-02-2021
Principal supervisor: Thomas Christensen 

7. Signature of the PhD student

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PhD student: Jacob Mesot Liljehult 

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2. Development of the key methods	B
3. Planning of the experiments and methodology design and development	A
4. Conducting the experimental work/clinical studies/data collection/obtaining access to data	B

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5. Conducting the analysis of data	A
6. Interpretation of the results	B
7. Writing of the first draft of the manuscript	A
8. Finalisation of the manuscript and submission	F
Provide a short description of the PhD student´s specific contribution to the article.[i] Jacob Mesot Liljehult has conceived the principle idea of the study and planned and developed the design in collaboration with the co-authors, and has further lead and participated in the data collection, analysis, and interpretations of the results. JML has made first draft of the publication and managed further revisions and submission of the manuscript.	

4. Material from another thesis / dissertation[ii]	
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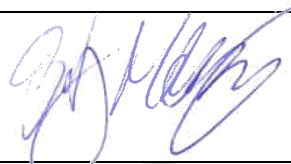
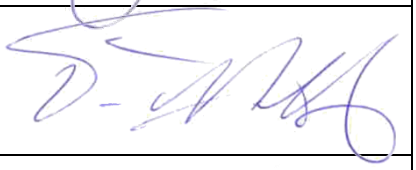
If yes, please state name of the author and title of thesis / dissertation.	NA
If the article is part of another author's academic degree, please describe the PhD student´s and the author´s contributions to the article so that the individual contributions are clearly distinguishable from one another.	NA

5. Signatures of the co-authors[iii]

	Date	Name	Title	Signature
1.	23-02-2021	Stig Mølsted	PT, PhD	
2.	23-02-2021	Tom Møller	RN, PhD	
3.	23-02-2021	Dorthe Overgaard	RN, PhD	

5. Signatures of the co-authors[iii]				
4.	23-02-2021	Thomas Christensen	MD, DMSc	

6. Signature of the principal supervisor

I solemnly declare that the information provided in this declaration is accurate to the best of my knowledge.

Date: 23-02-2021
Principal supervisor: Thomas Christensen 

7. Signature of the PhD student

I solemnly declare that the information provided in this declaration is accurate to the best of my knowledge.

Date: 22-02-2021
PhD student: Jacob Mesot Liljehult 

Please learn more about responsible conduct of research on the Faculty of Health and Medical Sciences' website.

[i] This can be supplemented with an additional letter if needed.
[ii] Please see Ministerial Order on the PhD Programme at the Universities and Certain Higher Artistic Educational Institutions (PhD Order) § 12 (4):
"Any articles included in the thesis may be written in cooperation with others, provided that each of the co-authors submits a written declaration stating the PhD student's or the author's contribution to the work."
[iii] If more signatures are needed please add an extra sheet.

DECLARATION OF CO-AUTHORSHIP

The declaration is for PhD students and must be completed for each conjointly authored article. Please note that if a manuscript or published paper has ten or less co-authors, all co-authors must sign the declaration of co-authorship. If it has more than ten co-authors, declarations of co-authorship from the corresponding author(s), the senior author and the principal supervisor (if relevant) are a minimum requirement.

1. Declaration by	
Name of PhD student	Jacob Mesot Liljehult
E-mail	Jacob.mesot.liljehult@regionh.dk
Name of principal supervisor	Thomas Christensen
Title of the PhD thesis	Health behaviour in patients with minor stroke and transient ischemic attacks

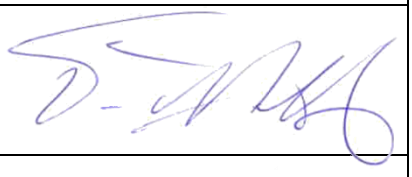
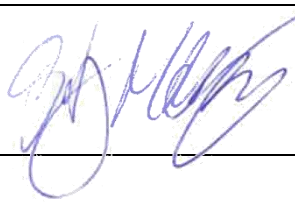
2. The declaration applies to the following article	
Title of article	Mastering health, safety, and worries after minor stroke: a qualitative study
Article status	
Published ☐ Date:	Accepted for publication ☐ Date:
Manuscript submitted ☒ Date: 18-12-2020	Manuscript not submitted ☐
If the article is published or accepted for publication, please state the name of journal, year, volume, page and DOI (if you have the information).	

3. The PhD student's contribution to the article ***(please use the scale A-F as benchmark)*** Benchmark scale of the PhD-student's contribution to the article **A**. Has essentially done all the work (> 90 %) **B**. Has done most of the work (60-90 %) **C**. Has contributed considerably (30-60 %) **D.** Has contributed (10-30 %) **E.** No or little contribution (<10 %) **F.** Not relevant	**A, B, C, D, E, F**
1. Formulation/identification of the scientific problem	A
2. Development of the key methods	B
3. Planning of the experiments and methodology design and development	A
4. Conducting the experimental work/clinical studies/data collection/obtaining access to data	A
5. Conducting the analysis of data	A

3. The PhD student's contribution to the article ***(please use the scale A-F as benchmark)*** Benchmark scale of the PhD-student's contribution to the article **A**. Has essentially done all the work (> 90 %) **B**. Has done most of the work (60-90 %) **C**. Has contributed considerably (30-60 %) **D.** Has contributed (10-30 %) **E.** No or little contribution (<10 %) **F.** Not relevant	**A, B, C, D, E, F**
6. Interpretation of the results	B
7. Writing of the first draft of the manuscript	A
8. Finalisation of the manuscript and submission	A
Provide a short description of the PhD student´s specific contribution to the article.[i] Jacob Mesot Liljehult has conceived the principle idea of the study and planned and developed the design in collaboration with the co-authors, and has further lead and participated in the data collection, analysis, and interpretations of the results. JML has made first draft of the publication and managed further revisions and submission of the manuscript.	

4. Material from another thesis / dissertation[ii]	
Does the article contain work which has also formed part of another thesis, e.g. master's thesis, PhD thesis or doctoral dissertation (the PhD student's or another person's)?	Yes: ☐ No: ☒
If yes, please state name of the author and title of thesis / dissertation.	NA
If the article is part of another author's academic degree, please describe the PhD student´s and the author´s contributions to the article so that the individual contributions are clearly distinguishable from one another.	NA

5. Signatures of the co-authors[iii]

	Date	**Name**	**Title**	**Signature**
1.	23-02-2021	Tom Møller	RN, PhD	
2.	23-02-2021	Thomas Christensen	MD, DMSc	
3.	23-02-2021	Stig Mølsted	PT, PhD	

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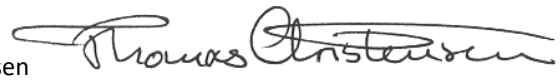
I solemnly declare that the information provided in this declaration is accurate to the best of my knowledge. Date: 23-02-2021 Principal supervisor: Thomas Christensen 

7. Signature of the PhD student
I solemnly declare that the information provided in this declaration is accurate to the best of my knowledge. Date: 22-02-2021 PhD student: Jacob Mesot Liljehult 

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