POSTURAL BALANCE, ANXIETY AND MOTOR FUNCTION AFTER STROKE, AT VERY EARLY SUPPORTED DISCHARGE WITH CONTINUED REHABILITATION

LENA RAFSTEN

Department of Clinical Neuroscience
Institute of Neuroscience and Physiology
Sahlgrenska Academy, University of Gothenburg

Gothenburg, Sweden, 2020

UNIVERSITY OF GOTHENBURG

Cover illustration by Hanna Nilsson

Postural balance, anxiety and motor function after stroke, at very early supported discharge with continued rehabilitation

lena.rafsten@neuro.gu.se

ISBN 978-91-7833-968-6 (PRINT)
ISBN 978-91-7833-969-3 (PDF)

Printed in Gothenburg, Sweden 2020
Printed by Stema Specialtryck AB

”Vill du gå på lina så titta inte ner,
titta inte åt sidan. Blunda, ta ett steg”
Peter Lemarc

ABSTRACT

The overall aim of this thesis was to investigate postural balance, anxiety and motor function the first year after stroke and whether postural balance, anxiety and motor function was different at the intervention of Very Early Supported Discharge (VESD) compared to routine discharge during the first year post stroke.

Methods. In paper I a systematic review and a meta-analysis was performed in order to study presence of anxiety after stroke.
Papers II and IV included material from the GOTVED-study (Gothenburg Very Early Supported Discharge study), a randomised controlled study where 140 patients with stroke admitted to a stroke unit at Sahlgrenska University Hospital were consecutively included. Paper II investigated whether VESD affects the anxiety assessed with the Hospital Anxiety and Depression Scale (HADS) and the overall disability measured with the modified ranking scale (mRS) for the stroke patient compared with ordinary discharge routines.
In paper III data from two different data sources was merged to investigate if there was any association between function in the affected arm and postural balance. The dependent variables were Berg Balance Scale (BBS) and Timed Up and Go (TUG). As independent variable was Fugl-Meyer assessment-Upper extremity (FMA-UE) scale was used. In Paper IV the correlation between self-confidence in postural balance, observer assessed postural balance and anxiety during the first year after stroke was investigated. The impact of the intervention on the correlation was also examined. The self-confidence in postural balance was measured using the Fall Efficacy Scale (FES(S)). Postural balance was assessed with Berg Balance Scale (BBS) and Time Up and Go (TUG). Anxiety was assessed with HADS. Assessments were made 5 days after stroke onset, 1 day and 1 month after discharge, 3- and 12 months post stroke.

Main results. The systematic review showed that the overall pooled prevalence of anxiety after stroke was 29.3 %. There was no difference in anxiety if you received VESD or ordinary rehabilitation, but the VESD led to a faster improvement of overall disability

compared to ordinary rehabilitation. The motor function in the affected arm significantly correlated with the postural balance the first year post-stroke. There was a significant correlation between self-confidence in postural balance and observer assessed postural balance. Between anxiety and self-confidence in postural balance, there was only a small correlation.

Conclusions and clinical implications. Anxiety is common after stroke with about a third of patients experiencing it in the first year. Since anxiety influence quality of life and is a predictor of depression, routine screening would be worth considering in the stroke care. VESD did not show any harm or unintendent effects, but on the contrary led to a faster improvement in overall disability. We therefore suggest that coordinated VESD for patients with mild to moderate stroke should be considered as part of the service from a stroke unit. The result that motor function in the affected arm associated with the postural balance in a late stage after stroke can be of clinical importance to be aware of in assessment and planning the rehabilitation of postural balance. Patients with mild stroke seemed able to assess their confidence in postural balance, involved in daily activity performance, in line with observer assessed postural balance. Assessment of self-confidence can provide important information useful in rehabilitation planning and support patients regarding physically active after discharge.

Keywords: Stroke, Rehabilitation, Postural balance, Upper extremity, Motor function, Anxiety, Outcome, Physical therapy, Assessment

POPULÄRVETENSKAPLIG SAMMANFATTNING

Stroke orsakad av propp eller blödning i hjärnan, är idag den största orsaken till nedsatt funktion bland vuxna och den tredje största dödsorsaken efter hjärtinfarkt och cancer. Ca 30 miljoner får en strokediagnos årligen världen över och varje år avlider sex och en halvmiljon människor på grund av stroke. Årligen så insjuknar ca 25 000 personer av stroke i Sverige. En majoritet av de som överlever en stroke har en kombination av symptom som nedsatt funktion och känsel i ena kroppshalvan, nedsatt balans och påverkan på tal, minne och tankeförmåga. Detta kan leda till begränsningar i förmågan att utföra aktiviteter i det dagliga livet (ADL). Detta gör stroke till en av de vanligaste orsakerna till långvarigt nedsatt ADL-förmåga.

Det övergripandet syftet med denna avhandling var att studera balans, motorik och ångest under det första året efter stroke och att se om tidig understödd utskrivning med fortsatt rehabilitering i hemmet jämfört med ordinarie utskrivning och rehabilitering, påverkade balans, motorik och ångest. Avhandlingen omfattar fyra delstudier. Studie I är en artikelöversikt för att se hur vanligt det är med ångest efter stroke. I Studie II-IV ingår patienter från en stroke-enhet på Sahlgrenska Universitetssjukhuset.

I Studie I gjordes en kartläggning över förekomsten av ångest hos personer som insjuknat i stroke. Resultatet visade att 29.3 % drabbades av ångest någon gång under det första året efter stroke.

I Studie II undersöktes om det fanns någon skillnad i förekomsten av ångest och funktion beroende på om man fått tidig understödd utskrivning med fortsatt rehabilitering i hemmet eller om man fått sedvanlig rehabilitering efter stroke. Totalt ingick här 140 personer som hade insjuknat i stroke. Personerna blev slumpmässigt uppdelade i två grupper där den ena gruppen fick tidig understödd utskrivning med fortsatt rehabilitering i hemmet och den andra gruppen fick sedvanlig rehabilitering. Man kunde inte se någon

skillnad i förekomst av ångest beroende av vilken form av rehabilitering man fått. Efter tre månader så hade de som fått tidig understödd utskrivning med fortsatt rehabilitering i hemmet mindre funktionsbortfall än de som fått sedvanlig rehabilitering, men efter 1 år så var det ingen skillnad i funktion mellan de två grupperna.

I Studie III undersöktes det om funktionen i den arm som blivit påverkad av stroken påverkade balansen. Resultatet visade att det fanns ett samband mellan vilken funktion man hade i den arm som blivit påverkad av stroken och balansen.

I Studie IV undersöktes det om patienternas skattning av sin balans i olika aktiviteter överensstämde med den mätta balansen och/eller med ångesten under de första året efter stroke. Resultatet visade att det finns ett samband mellan hur patienten bedömer sin balans vid olika aktiviteter och den uppmätta balansen under det första året efter stroke. Sambandet var mindre precis efter insjuknandet och större ett år efter insjuknandet.

Sammanfattningsvis så är ångest vanligt under det första året efter stroke. Eftersom ångest påverkar livskvaliteten betydligt och kan vara ett tecken på ökad risk för depression, bör man överväga att undersöka ångest när en patient kommer in efter att ha insjuknat i en stroke. Ingen nackdel kunde ses med tidig understödd utskrivning med fortsatt rehabilitering i hemmet jämfört med vanlig rehabilitering efter stroke. Tidig understödd utskrivning med fortsatt rehabilitering i hemmet bör därför övervägas som ett alternativ vid rehabilitering efter stroke. Nedsatt funktion i armen kan vara förknippad med nedsatt balans i ett senare skede efter stroke. Detta kan vara av klinisk betydelse och ytterligare forskning bör göras för att undersöka förekomst i det akuta stadiet. Det finns ett samband mellan självskattad balans och observatör mätt balans, vilket tolkas som att majoriteten av patienter med stroke, verkar ha en realistisk insikt om sin balans.

LIST OF PAPERS

This thesis is based on the following Papers, referred to in the text by their Roman numerals.

I. Rafsten L, Danielsson A, Sunnerhagen KS. Anxiety after stroke: A systematic review and meta-analysis. J Rehabil Med. 2018:50(9):769-778

II. Rafsten L, Danielsson A, Nordin A, Björkdahl A, Lundgren-Nilsson A, Larsson MEH, Sunnerhagen KS. Gothenburg Very Early Supported Discharge study (GOTVED): a randomised controlled trial investigating anxiety and overall disability in the first year after stroke. BMC Neurol. 2019 Nov 9

III. Rafsten L, Meirelles C, Danielsson A, Sunnerhagen KS. Impaired Motor Function in the Affected Arm Predicts Impaired Postural Balance After Stroke: A Cross Sectional Study. Front Neurol. 2019 Aug 21;10:912

IV. Rafsten L, Danielsson A, Sunnerhagen KS. Self-perceived postural balance correlates with postural balance and anxiety during the first year after stroke: a part of the randomised controlled GOTVED study. *Submitted manuscript*

CONTENT

ABBREVIATIONS

ADL	Activity in Daily Life
AUC	Area Under Curve
BBS	Berg Balance Scale
BI	Barthel Index
BMC	BioMed Central
CBT	Cognitive Behaviour Therapy
CONSORT	Consolidated Standards of Reporting Trials
COPM	Canadian Occupational Performance Measure
DALYs	Disability Adjusted Life Years
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders
ESD	Early Supported Discharge
FES(S)	Fall Efficacy Scale (Swedish version)
FMA	Fugl Meyer Assessment
GAD	Generalized Anxiety Disorder
GOTVED	Gothenburg Very Early Supported Discharge
HADS	Hospital Anxiety and Depression Scale
HADS-A	Hospital Anxiety and Depression Scale-Anxiety subscale
HADS-D	Hospital Anxiety and Depression Scale-Depression sub scale
HRQL	Health-Related Quality of Life
ICC	Intraclass correlation
ICF	International Classification of Functioning, Disability and Health
ITT	Intention to treat
IQR	Inter Quartil Range
LOCF	Last Observation Carried Forward
mRS	Modified Rankin Scale
MoCA	Montreal Cognitive Assessment scale
MeSH	Medical Subject Headings
NCBI	National Center for Biotechnology Information

NIHSS	National Institutes of Health Stroke Scale
OCD	Obsessive Compulsive Disorder
OR	Odds Ratio
PTSD	Posttraumatic Stress Disorder
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
RCT	Randomised Controlled Trial
ROC	Receiver Operating Characteristic
SAD	Social Anxiety Disorder
SD	Standard Deviation
SPSS	Statistical Package for Social Science
SRRR	Stroke Recovery and Rehabilitation Roundtable
STROBE	STrengthening the Reporting of OBservational studies in Epidemiology
TUG	Times Up and Go
VESD	Very Early Supported Discharge
WCPT	World Physiotherapy
WHO	World Health Organisation

INTRODUCTION

The worldwide burden of stroke is growing and today one in four people will have a stroke in their lifetime (51). This makes stroke the second most common cause of death and the third most common cause of disability worldwide (52). Although the total incidence of stroke is decreasing in most parts of the world, the disability adjusted life years (DALYs) are increasing (53). Of those surviving a stroke a majority, experience a combination of loss of muscle strength, sensation, postural balance, cognition, and emotion, which may lead to restrictions in their ability to perform activities of daily living (ADL). The increased use of thrombolysis and thrombectomy together with increased primary and secondary prevention has led to fewer massive strokes and more mild to moderate strokes (54). This allows patients to be discharged earlier from the hospital, sometimes so quickly that neither the rehab staff nor the patient may be able to catch discrete symptoms.

Early initiation of rehabilitation according to specific rehabilitation programs are crucial for optimizing the outcome after stroke. The three major principles of recovery that are used in the rehabilitation process are adaptation, restitution, and neuroplasticity. Based on these principles, there are several different forms and methods of rehabilitation that improve the conditions for rehabilitation(55). There are different rehabilitation options after hospital, such as in hospital rehabilitation in a rehabilitation clinic, early supported discharge with continued rehabilitation from a multidisciplinary stroke team, rehabilitation in primary care and municipal rehabilitation. However, it is of utmost importance to start rehabilitation early in the stroke unit (56-58).

The discharge process following stroke has identified a need for new and more efficient services (59), and one service that is suggested to be more effective in the discharge following stroke is Early Supported Discharge (ESD) (60-62). Since stroke is complex, more knowledge is needed about factors that can affect rehabilitation. Such a factor may be time for discharge and the continued rehabilitation thereafter.

Stroke

According to the World Health Organization (WHO) stroke is defined as:
"Rapidly developing clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin" (63)
which originates from the 1976 publication by Hatano et al (64). However, over the years it has been noted that "silent" strokes are more common than clinically manifest strokes (65), and therefore it has been necessary to update the definition (66). In this thesis the WHO definition of stroke is used and will include ischemic and intra cerebral hemorrhage, but not subarachnoid hemorrhage.

Worldwide the estimated events of stroke incidence is about 14-15 million people every year (53, 67). In Sweden about 20-25 000 people are diagnosed with stroke every year (68). With almost a million hospital days per year, stroke is the somatic illness in need for most hospital days per year in Sweden (68, 69). About 100 000 people with residual symptoms after stroke live in Sweden and of these at least 20 000 require some assistance in their activities of daily living (70).
The stroke incidence in Sweden peaked in the late 90s and rates are now declining, particularly among the elderly. The main causes of increased numbers of stroke survivors are likely to be improved stroke care, aging, and growth of the population combined with the increased prevalence of many stroke risk factors that are modifiable (71).

The most important part after stroke, of course, is the recovery. The recovery process is complex including spontaneous, relearning and compensation processes (72, 73), which are dependent on many factors such as the size of the injury, the location, and the person affected (74). However, many other factors may influence the degree of recovery. The main part of recovery takes place early after stroke, but even if it slows down, functional recovery can be found several years after stroke (75, 76). Time to acute treatment such as thrombolysis and thrombectomy is an important factor, which determines the size of the damage and therefore also the condition for the recovery. For every minute of delay an average of two million neurons are lost (77). Generally, early start of rehabilitation is recommended to achieve better recovery after

stroke (58), but the optimal timing to begin rehabilitation is not yet known (78).

Organization of stroke care in Sweden

Since the end of the 20th century stroke units have been developed, recommended and built up in emergency stroke care (79, 80). In the acute phase the Swedish National Stroke Guidelines recommend care at a stroke unit for everyone suffering from a stroke (81). In recent decades, the number of stroke units in Sweden has increased continuously and today about 92% of persons with stroke receive care at a stroke unit in the acute stage (68). In Sweden, about 77% are discharged to their own accommodation, while 22 % are discharged to nursing homes (68). If you are in need of continued rehabilitation you can be referred to different kinds of rehabilitation. In Sweden about 60% of the patients who are discharged to their own accommodation are referred to continued rehabilitation such as early supported discharge, primary care, day rehabilitation or municipal rehabilitation (68).

Stroke rehabilitation

The aim with stroke rehabilitation is to reduce impairments, encourage and support activity, participation and independence. According to the WHO the definition of rehabilitation is: *A highly person-centred set of interventions needed when a person is experiencing or is likely to experience limitations in everyday functioning due to ageing or a health condition, including chronic diseases or disorders, injuries or traumas (82).* Even though we have an effective emergency medical stroke treatment, a large part of the post-stroke care is relying on rehabilitation interventions.

There are many different specific interventions in stroke rehabilitation. However, the organization of the stroke care seems to have the largest impact for the whole stroke population. The evidence supports rehabilitation in well-coordinated multidisciplinary stroke units or by providing early supported provision of multidisciplinary discharge teams (83). The International Classification of Functioning and Health (ICF) is paramount in these settings, giving the patient's condition a

broader context with the consequences for activity, participation, personal and contextual factors in addition to the consequences of the stroke itself (84).

The majority of the early rehabilitation often takes place in comprehensive stroke units or at stroke rehabilitation departments. A key component of those units seem to be the presence of a coordinated multidisciplinary stroke team, often comprising a medical nurse, physiotherapist, occupational therapist, speech therapist and sometimes a social worker and a neuropsychologist. Rehabilitation with a multidisciplinary team results in long-term reduction of death, length of hospital stay and dependency compared with conventional care (85). It has also been reported that more person-centered decisions are being made (86), and the staff experience increased work satisfaction (87).

Physiotherapy has a central role in rehabilitation (88). The definition of physiotherapy according to the World Physiotherapy (WCPT) is: "*To provide services to individuals and population that develop, maintain and restore peoples maximum movement and functional ability*" (89). Physiotherapy plays an important role in rehabilitation, as it can prevent a number of complications and reduce disability (90). Most of the ESD teams are multidisciplinary teams. In those teams, the physiotherapist plays an important role. The evidence for physiotherapeutic rehabilitation in the home setting, ESD, depends on the rehabilitation intervention (72, 91).

Person-centred care

A person-centred care is something that has been raised and researched during the last fifteen years and a shift to more person-centered care is taking place in Sweden. In an inquiry in 2013, the investigators state that the patient still has a weak position in the care system, and in 2018 the Swedish Agency for Health and Care Analysis published a report concluding that person-centred care and nursing can and must be developed in the Swedish health care context. The cornerstones of a person-centred approach is the patient story, the partnership and the documentation (92). There have been some studies on physiotherapy that explore concepts in person-centered care and suggest factors that may constitute barriers or facilitators in terms of its implementation in stroke care, for example the importance of goal setting, commitment

and self-management (93). Even though physiotherapists seem to be struggling with the incorporation of person-centred care principles (94), person-centred physiotherapy has successfully been used in studies that examined physical activity (95) and resistance exercise(96). In the rehabilitation process, goal formulation is important and clearly associated with person centering.

Early supported discharge

Conventionally stroke rehabilitation in recent decades has been provided in hospital. Often first in an acute ward followed by inpatient rehabilitation at a rehabilitation clinic, and finally rehabilitation in primary care or in the municipality. This care accounts for much of the substantial economic cost (97, 98). In Sweden readmission within first year post stroke around 6 % (99). Studies of home care visits carried out by a geriatric team have shown a significant reduction of readmission (100, 101). Reperfusion therapies have contributed to a change in the stroke population with fewer massive strokes and more mild-to-moderate strokes (54) resulting in a need for developing novel interventions that target specific patient subgroups. Early Supported Discharge (ESD) is a service that is suggested to be more effective after discharge following stroke giving a reduction in the length of hospital stay, an estimated lower cost, and increasing extended ADL scores (62). ESD suggested to improve the partnership between the patient and the therapist, getting a more motivated patient by focusing on more realistic rehabilitation goals, in a more relevant context where the patient should live and manage himself in the future. This makes ESD a more person-centered rehabilitation approach.

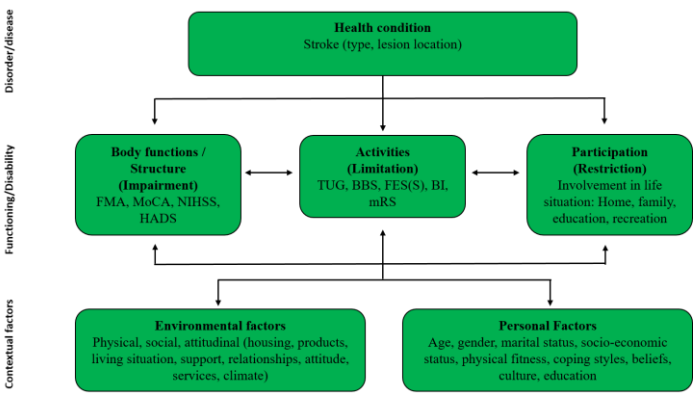
ESD was introduced in stroke rehabilitation between 1990-2000. The first study was conducted in London and published in 1997 (102). In this study, the authors concluded that ESD with a community rehabilitation team was feasible and as effective as conventional care and had a significant reduction in hospital bed usage. During the last decades several studies investigating ESD after stroke have been published. The results have been positive and encouraging. In 1998, a trial in Sweden was published (103) with follow-up evaluations after 3, 6 and 12 months (104, 105). They found no difference in patient outcome com-

pared to routine rehabilitation but the length of hospital stay was significantly reduced. In a systematic review in 2017 with 17 included studies the meta-analysis concluded that ESD for a group of selected patients with stroke reduced the length of hospital stay and was likely to make the patients more independent and living at home 6 months after discharge (62). No apparent adverse effects were seen and they concluded that ESD seems to be a good alternative as a part of the stroke care system.

Today ESD is recommended in the Swedish National Guidelines as a standard alternative rehabilitation option (70). Despite this, ESD is not fully implemented in the Swedish stroke care and it is unclear how many hospitals in Sweden can offer this form of rehabilitation.

ICF- Classification of functional states, disabilities and health

To make it possible to describe and classify a person's functional state, disability and health WHO adopted a bio-psycho-social model of ICF in 2001 (84) (Fig1). The ICF focuses on human functioning and provides a unified, standardized language and a framework to capture how people with a health condition function in their daily life. It can be used to indicate function or disability on three different domains.



Figur 1. *International Classification of Functioning Disability and Health (ICF) along with the assessment used in this thesis.*
Abbreviations: BI, Barthel Index; BBS, Berg Balance Scale; FES(S), Fall efficacy Scale-Swedish version; FMA, Fugl-Meyer Assessment scale; HADS, Hospital Anxiety and Depression Scale; MoCA, Montreal Cognitive Assessment scale; mRS, Modified Rankin Scale; TUG, Timed Up and GO

The non-hierarchical framework of the ICF can be used to decide appropriate assessment when planning treatment, for goal setting and evaluation of the treatment, in communication between healthcare professionals and for the persons self-evaluations (106). Since the different domain in ICF represent different aspects of functioning, assessments on each domain are recommended in order to fully understand the impact of disability.

Motor function

Motor control is defined as the ability to regulate or direct the mechanisms essential to movement (107), and is a prerequisite for motor function. Since movement is fundamental to ability to eat, walk and to communicate it is a critical aspect of life. Motor control is described as part of a conceptual model that through interaction with other components affects the postural balance (107). The control of the movements arise from interaction between the individual, the task and the environment and is dependent on several different factors such as the individual action, perception, cognition, the tasks mobility, stability and manipulation demands and the environment´s regulatory factors (e.g. size, shape, weight of the object) and non regulatory factors (background noise, other distractions) (107). There are several theories of motor control such as reflex, hierarchical theory and systems and many people have been working on developing an integrated theory of motor control. The most common used theory today is the systems theory. According to this theory, movement arises from the interaction of multiple processes. According to ICF motor control involves voluntary isolated or compound movements, coordination of voluntary movements, functions for loading arms or legs, right-left coordination, eye-hand coordination and eye-foot coordination (108).

Motor function after stroke

Motor impairment is one of the most common symptoms after stroke. It restricts functions in the patients muscle movement or mobility (73). The symptoms have increased severity in the first few days after the stroke, and most of the recovering occurs in the near future after the injury (109). The majority of the motor function improvement occurs within the first three month's post-stroke (110, 111). Several factors

can affect the outcomes of motor function after stroke, both endogenous and exogenous. In addition, preinjury and post injury influence the extent of the damage (107). The recovery of motor function, also mentioned as motor learning, refers to the ability to perform movements under voluntary control in the same way as before the stroke. It includes both previously learned and re-learning of movement (107). Traditional neurorehabilitation in physiotherapy focuses on recovery of motor function, and is a combination of recovery and compensation (112).

Observations in healthy individuals show that motor skills are largely dependent on intensity and quality of the training. Most patients experience some degree of spontaneous recovery, but it is often incomplete and is dependent of the combinations of the neurological functions (113). However, to achieve best possible function, active rehabilitation is also required. Preferably, it starts within a few days after stroke(58) .

Rehabilitation of motor function

Physiotherapy is considered to be an important discipline in stroke rehabilitation (72). It is considered to improve functional motor recovery at cellular and molecular levels (114), and improves the activation of affected muscles during exercise (114). Early and intensive intervention in not always the best (107, 115). It appears that if the intervention is to have a positive effect on recovery of motor function, the patient must actively participate (116). Recommendations are made to improve and restore motor function by focusing on high-intensity, repetitive task-specific practise with feedback on performance (73). Task-specific training is defined as training or therapy where the patients practise context-specific motor tasks and receive some form of feedback (117). It focuses on training of functional tasks rather than reducing impairment, such as with muscle strengthening (118). There is strong evidence that task-oriented rehabilitation results in better outcomes on functional abilities (76). In conclusion, several factors such as time of delivery, dosage, severity of baseline impairment and the patient's history are likely to influence the effects of the rehabilitation. Sensory input plays a crucial role in rehabilitation of motor function and should therefore be highlighted in the rehabilitation (119). The heterogeneity in stroke has led to development of many different forms of therapies

which are based on neuroplasticity, such as for example constraint-induced movement therapy, body weight-supported treadmill training and training with robot devices (120). However, it is difficult to come to any consensus that any method would be better than another, but there is an agreement that rehabilitation should be task oriented and repetitive (121).

Postural balance

There are several different synonyms for the term balance such as postural control, postural balance and vestibular functions, but there seems to be no consensus on what term to use.

Newton's First Law says that postural balance is the state of an object when the forces or movements acting upon it are zero (122). Shumway-Cook and Woollacott define postural balance as the ability to control the body position in space emerging from a complex interaction of musculoskeletal and neuronal systems (107). It is an interaction between the individual, the activity and the environment (107). There are many different aspects of postural balance such as for example steady state balance, formerly called static balance, reactive balance and proactive also called anticipatory balance. In the ICF browser (108) "vestibular functions" and " vestibular function of balance" shows up when searching for the term balance. When searching for postural balance the definition that appears is "involuntary movement reaction functions". When searching for the terms postural control and vestibular control there is no definition at all in the ICF browser.
Throughout this dissertation the term "postural balance" has been used according to the National Center for Biotechnology Information (NCBI) (123).

Postural balance after stroke

Impaired postural balance is one of the most common symptoms after stroke, a common cause of falling (124-126), and a limitation in the recovery of gait and independence (127, 128). In spite of the fact that the majority of the patients after stroke regain independent standing postural balance capacity (129), an asymmetry and increased postural

sway often remain, as well as a reduced ability to voluntarily hold position in external disorders (130). Seventy % of stroke survivors living at home reported having fallen within the first year after a stroke (131). Walking in one's home and community is a common training activity for people post stroke (132). Since postural balance plays an important role in community walking (133, 134), impairment can lead to a lower level of activity and participation (135, 136). It is recommended in the Swedish national guidelines that postural balance should be examined within the first 24 hours after the onset of stroke (81). As with other symptoms after stroke, some degree of recovery of the postural balance may occur spontaneously.

Rehabilitation of postural balance

Postural balance is an important determinant of activities of daily living and therefore a strong predictor of functional recovery and walking capacity (137, 138). There are many different rehabilitation methods, based on theories and knowledge of motor recovery and brain neuroplasticity (114), which are used to improve postural balance and walking ability after stroke. A systematic review from 2019 notes in their survey that mixed training by a physiotherapist shows a significant benefit when it comes to training of the postural balance (139). Training of postural balance and gait is recommended to avoid fall accidents at an early stage after stroke according to The Swedish National Board of Health and Welfares National Guidelines for Stroke (81). There are many causes of impaired postural balance after stroke. Many treatment strategies include postural balance training. The treatment strategy chosen depends on the symptoms after stroke and how these affect the postural balance. It is suggested that exercise therapy, repetitive task training, physical fitness training, virtual reality training and use of unstable support surface may be beneficial for people with impaired postural balance following a stroke, but the evidence is limited (139). Common physiotherapeutic exercises in postural balance impairment are dropout step on the floor and use of unstable support surface, gait practice, exercise training and repetitive task training. Several studies state that no evidence is available to prove the superiority of any approach in overall terms, but most of the physiotherapeutic training is repetitive and task-oriented in its nature, and can therefore lead to general improvement regardless of the type of training (140, 141).

Self-efficacy

Self-efficacy is defined as a person's perception of their ability to perform various activities (142). People with low self-efficacy for a particular activity will tend to avoid that activity, while those with high self-efficacy will approach the task with confidence (143). According to Bandura et al there are four main sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasions and psychological feedback (142). In the ICF model, self-efficacy is a personal factor that may have a positive or negative impact on the person's general health. It is therefore a strong reason for measuring and evaluating self-efficacy in stroke rehabilitation. In this thesis, self-efficacy is equal with one´s confidence in postural balance. Postural balance self-efficacy is linked to postural balance, motor function, physical function and perceived health status (144).

Self-efficacy after stroke

The belief in self-confidence can have a great impact on the patient's motivation after stroke. An accomplishment of a small goal can result in gained confidence in postural balance after stroke (145). Several studies has shown a relationship between self-confidence in postural balance, activity and participation after stroke (144, 146-148). Improvement has been shown in self-assessed postural balance, initially impaired after stroke, during rehabilitation in outpatient care (40, 149). The improvement has proven to be associated with improved postural balance, motor skills and walking ability (40, 149). Jones and Riazi conclude in their review (150) that there is some evidence that self-efficacy influences the outcome post stroke. However, most rehabilitation is carried out in hospitals where risks are understandably kept to a minimum, and this results in reduced opportunities for own exercise and experiments. At the same time, access to continued specialist rehabilitation in the community is severely limited, an environment that usually is more suitable for facilitating self-management strategies (150). Self-efficacy in postural balance has shown to be a predictor of ADL performance at least 10 months post stroke (149).

Rehabilitation of self-efficacy

Self-efficacy enhancing interventions may have a positive influence on the mobility, ADL, depression and health related quality of life (HRQL) for people post stroke. To improve self-efficacy, you must train the elements that are affected by the self-efficacy. If you want to improve the self-efficacy in postural balance, the intervention should be focused on the postural balance (151) and if you want to improve the ADL, you should focus the intervention on ADL. Self-efficacy has shown to be positively associated with a more frequent use of active coping strategies and positive reframing (144, 152), something that one should also focus on when rehabilitating after a stroke to obtain increased self-efficacy. In stroke rehabilitation, the physical therapist introduces the patient gradually towards more challenging activities. In addition, by empowering the patient in for example the goalsetting process and the activities the patient can achieve higher self-efficacy. Incorporation of assessment of self-efficacy can increase the evaluation of the physiotherapeutic rehabilitation.

Anxiety

Anxiety is one of the major groups of disorders seen in medicine (153), and one of the most common mental health problem worldwide (154). It was identified as a disorder even before Christ. In the late 19th and early 20th century, anxiety was a key component of various new diagnostic categories, from neurasthenia to neuroses. Many common symptoms were categorized under anxiety, ranging from general malaise, neuralgic pains, hysteria and hypochondriasis, to symptoms of anxiety and chronic depression (155). Today anxiety is classified as a disorder when the symptoms of anxiety are disproportionate and interfere with functioning. The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) classifies anxiety disorders as a collection of individual syndromes (156) .The original five anxiety disorders are well known: Phobic Disorder, Generalized Anxiety Disorder (GAD), Social Anxiety Disorder (SAD), Obsessive Compulsive Disorder (OCD), and Posttraumatic Stress Disorder (PTSD), but the most common diagnoses are phobic and generalized anxiety. Different anxiety disorders have shown different course trajectories (157, 158). Generally, anxiety disorders are regarded as "chronic" or as fluctuating disorders. Anxiety

disorders have a recovery rate and a relatively high recurrence probability (157, 159). At the different subtypes, the severity of symptoms or the appearance of a particular dimension of symptoms can provide important information about the prognosis. Patients with panic disorder without agoraphobia are more likely to recover than those with panic disorder with agoraphobia, generalized anxiety or social phobia (157).

Anxiety after stroke

Anxiety is a common symptom post stroke affecting every forth of the patients during the first year after stroke (160). This can affect stroke rehabilitation and prevent the patient from resuming normal activities. It seems as if the likelihood of developing anxiety after stroke increases in younger people, females and in those with a history of anxiety or depression (161, 162). Despite so, frequent anxiety receives less attention compared to other psychological symptoms after stroke (160, 163, 164). In this thesis, the purpose was not to diagnose anxiety but to map out the presence of anxiety disorders.

Rehabilitation of anxiety

Since there are different forms of anxiety, there is no definitive evidence for treatment approaches for anxiety after stroke. Different forms needs different treatments such as medications, Cognitive Behaviour Therapy (CBT) or other therapy techniques. Different physiotherapy treatments such as for example physical activity (165), have shown to have an impact on physical disorders such as anxiety (166, 167). Since anxiety can cause reduced quality of life, which can affect the rehabilitation process (168, 169), further trials are required to assess different interventions for anxiety treatment after stroke (170, 171)

Outcome measurements

The selection of appropriate outcome measures is a critical step in designing valid and useful clinical trials, as it has a big impact on the interpretation and conclusion of the study results. Different instruments

may capture different aspects and may not be equal for all people (172). Because of the heterogeneity of the patients, outcome measurement in stroke is difficult. If clinically meaningful interpretations are to be made from a study, it is very important that the scales used are reliable, valid, measure what they are intended to measure and responsive to be able to evaluate meaningful change over time (172). The feasibility is important, not at least in studies like this where most assessments are made in the participants' homes. Guidelines are proposed to select the best outcomes to evaluate the focus on the intervention of the study. The ICF is suggested to be such a guideline, that provide a multidimensional framework for health and disability suited to classify of outcome instruments (84, 173). For example, the Fugl-Meyer Assessment scale (FMA) is recommended as an instrument of body function that is widely used with good interpretability, acceptability and feasibility (174).

Lack of knowledge/research gap

Early Supported Discharge (ESD) has been studied and implemented over the last 10-15 years. The intervention of ESD has shown to have advantages compared with in-hospital rehabilitation. Complications of hospitalization are avoided, the patient is given a chance to focus on more realistic rehabilitation goals, and the rehabilitation is provided in a more relevant environment which can encourage a more focused self-directed recovery (175). The ESD also provides higher levels of therapy support over the whole patient journey among others. In general, it can be stated that ESD has a more person-centered rehabilitation approach, something that the Swedish healthcare today is required to work according to. A reduction of 8 days in the length of hospital stay was found for those patients who received ESD (175). The length of hospital stay has decreased among all patients with stroke and thereby the group receiving ESD today have an even shorter hospital stay, which make it important to study very early supported discharge (VESD). Knowledge regarding the patient's perspectives and performance needs to be updated. Is it possible to shorten the days of hospital stay even more and how does it affect the patients receiving ESD? Such a shortening of days of hospital stay can reduce and be a way to manage rising demands of number of hospital beds. If VESD shows to be a safe way of discharge it can have several advantages for both the patient and the hospital.

The fact that the motor function in the lower extremity affects the postural balance has been shown in several studies (176, 177) , but the upper extremities' impact on the postural balance after stroke has not been researched previously. Today's improvements in primary prevention and the increase in recanalizing therapy have led to fewer patients having severe strokes. Many are independent walkers with discreet symptoms. Perhaps they only have a discreetly impaired motor function in the arm, and how does that associate with the postural balance after stroke? When examining such a patient, it can be of great importance to be aware that impaired motor function in the arm can affect the postural balance. This knowledge can reduce the number of fall incidents after stroke.

That self-efficacy in postural balance is associated with observer assessed postural balance has been shown (148), but what happens with that association over time? Anxiety is a common symptom post stroke, but how anxiety relate to the self-perceived postural balance and the observer assessed postural balance has been studied very little. If there is an association between self-efficacy in postural balance, observer assessed postural balance and anxiety, it can be of great importance in the rehabilitation process after stroke. How VESD impacts the self-efficacy in postural balance is yet unknown. The assessment of self-efficacy in postural balance can perhaps guide the patient and the rehabilitation team in the formulation of goals and provide a safer rehabilitation.

AIM

The overall aim of this thesis was to analyse postural balance, anxiety and motor function the first year after stroke.

The specific aims were

I. To update evidence about the presence of anxiety during the first year after stroke. The second aim was to perform meta-analyses on those studies that have used HADS as assessment of anxiety after stroke during the first year after stroke.

II. To investigate whether very early supported discharge (VESD) with continued rehabilitation from a multiproffesional team affects the level of anxiety. A second aim was to evaluate whether VESD is useful for stroke patients in need of ongoing individualized rehabilitation at home due to motor and/or cognitive impairment

III. To explore if there is any association between arm motor function and postural balance in a late stage after stroke

IV. To investigate the association between patients self-rated postural balance, measured postural balance and anxiety during the first year after stroke. A second aim was to investigate if the intervention of very early supported discharge gives the stroke patient better insight into their capacity for postural balance compared to a control group.

METHODS

This thesis comprises four studies. Paper I is a systematic review with a meta-analysis. Papers II and IV are randomised controlled longitudinal studies and paper III is a cross sectional study. The three quantitative studies are all part of the Gothenburg Very Early Supported Discharge study (GOTVED).

Study population

The summary and clinical characteristics of the participants are presented in Table 1.

Table 1. Demographic data and clinical characteristics of the participants in all four papers.

Paper	I	II	III	IV
Patients, n	13756	140	121	140
Age, years, mean (SD)	52-79	74.1 (11.8)	70.4 (12.3)	74.1 (11.8)
Males, %	-	62	60	62
Female, %	-	38	40	38
Ischemic stroke, %	-	93	89.2	93
Hemorrhagic stroke, %		7	10.7	7
Stroke severity			-	
NIHSS, md (IQR)	-	3 (1-5)		3 (1-5(16))
BI, md (IQR)		80 (65-90)	-	80 (65-90)
mRs, md (IQR)	-	2 (2-3)	-	2 (2-3)
FMA-UE, md (IQR)	-		65 (58.5–66)	
FMA-LE, md (IQR)			34 (30-34)	
BBS, md (IQR)	-	49 (38-53)	52 (46-55)	49 (38-53)
TUG, sec, md (IQR)	-	14.6 (11.4–21.9)	11 (9-14.6)	14.6 (11.4–21.9)
FES(S), md (IQR)	-	-	-	97 (69.3–122.8)
HADS-A, md (IQR)	-	4 (1-8)	-	4 (1-8)

Abbreviations: BBS, Berg Balance Scale; BI, Barthel Index; FES(S), Fall Efficacy Scale-Swedish version; FMA-LE, Fugl-Meyer Assessment scale-Lower extremity; FMA-UE, Fugl-Meyer assessment scale Upper extremity; HADS-A, Hospital Anxiety and Depression Scale-Anxiety subscale; NIHSS, National Institute Health Stroke Scale; TUG, Timed Up and Go

The 37 included studies in the systematic review (Paper I) included together 13 756 patients with stroke. The subjects in Papers II and IV were the same and comprised 140 patients. All patients admitted to the stroke Unit at Sahlgrenska University Hospital were consecutively screened. The participants had a confirmed stroke according to the World Health Organization (WHO) criteria (63), were ≥18 years old and living within 30 min by car of the stroke unit. In Paper III data was retrieved from two different data sources, GOTVED and a project by Carvalho et al. (all of data has not been previously published), and merged into one dataset for analysis. In total data from 121 participants were included in this study, 89 from GOTVED and 32 from the study by Carvalho et al. The inclusion criteria in the project by Carvalho et al. were; community-dwelling, between 50-70 years of age, at least 6 months post-stroke and ability to walk in the community for at least 5 minutes without personal assistance.

Study designs and procedures

In Paper I a systematic review and several meta-analyses were conducted. Electronic searches were done in six databases in 2015 and repeated in 2016. A combination of MeSH terms and key words were used. To narrow the search some search limitations were used. A librarian independent of the study performed the electronic search. One reviewer screened and identified studies against the inclusion criteria. A second reviewer conducted a random check of titles and abstracts to check the reliability of the initial screening. The final inclusions were performed independently by the 2 reviewers.

The GOTVED study (Paper II) was a randomised controlled study where the participants were randomized to VESD or to ordinary discharge routines. The primary outcome was anxiety assessed with HADS-A. The secondary outcome was overall disability assessed with mRS. The assessments were performed by a blinded and trained researcher not working at the stroke unit at the time for the study. Assessments were made 5 days post-stroke (baseline), 3- and 12 months post-stroke (Fig. 2). Intention to treat analyses were used, and for missing observations, the "last value carried forward" was used. Occupational therapists working at the stroke unit performed the screening for inclusion. The randomization procedure was stratified with a 1:1 allocation. A block randomization model was applied. The allocation was

performed by a person not otherwise involved in the study. The research coordinator opened an envelope after inclusion, and then the blinded assessor and the nurse in the stroke team were informed of the inclusion. The patients in the intervention group underwent continued rehabilitation in their homes 1-4 times a week during up to 4 weeks with a multidisciplinary team from the stroke care unit. A person-centred intervention was approached, where a goal setting meeting was held before discharge and the patient was asked to formulate his or her goals based on the Canadian Occupational Performance Measure (COPM)(178). These goals guided the focus of the rehabilitation.

The patients randomised to the control group were discharged according to usual routines of the stroke unit. They had no goal setting meeting and they were not followed up by any multidisciplinary team. If they had a continuing rehabilitation need at discharge, they were referred to primary care rehab or municipal rehab. To investigate whether and what rehabilitation the control group received after discharge from the hospital, data from the Västra Götaland care database (VEGA) was used.

In paper III a cross sectional study was performed to examine if arm function was associated with observer assessed postural balance. In this study, data from two different sources were merged.

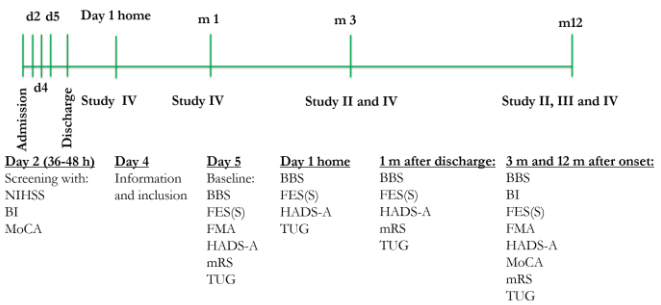


Figure 2. *Description of the assessment points in this thesis.*
Abbreviations: BBS, Berg Balance Scale; BI, Barthel Index; d, day; FES(S), Fall Efficacy Scale-Swedish version; FMA, Fugl-Meyer Assessment scale; FMA-UE, Fugl-Meyer assessment scale Upper extremity; HADS-A, Hospital Anxiety and Depression Scale-Anxiety subscale; MoCA, Montreal Cognetive Assessment scale; mRS, modified Rankin Scale; m, months; NIHSS, National Institute Health Stroke Scale; TUG, Timed Up and Go

In Paper IV, a longitudinal study, the GOTVED material was analysed to investigate if self-perceived postural balance was associated with observer assessed postural balance and anxiety during the first year efter stroke. Assessments were made 5 days post-stroke (baseline), first day at home, 1 month after discharge, 3- and 12 months post-stroke (Fig. 2). The study also examined whether the intervention of VESD affected any correlations between self-perceived postural balance, observer assessed postural balance and anxiety during the first year post-stroke. Table 2 gives a summary of the different study designs.

Table 2. An overview of the study designs and inclusion/exclusion criteria

Paper	I	II	III	IV
Design	Systematic review	Randomized controlled	Cross sectional	Longitudinal
Analysis	Descriptiv Review and metaanalysis	Non-parametric statistics	Non-parametric statistics Regression analysis	
Subjects	37 studies with 13 756 stroke patients	Stroke patients (n=140)	Stroke patients (n=121)	Stroke patients (n=140)
Datasource	A search was conducted in EMBASE, MEDLINE, PsycINFO, Cochrane Library, Amed and CINAHL	GOTVED –study (Consecutively screened sample from stroke unit 2 days post-stroke) VEGA database	GOTVED-data Study by Cavallio et al	GOTVED-data
Inclusion criteria	Clinical diagnosis of stroke and assessed for anxiety symptoms on a rating scale in the first year after stroke	Confirmed stroke according to World Health Organization (WHO) criteria age >18 years, residence within 30 min by car of the stroke unit, a National Institute of Health Stroke Scale (NIHSS) score of 0-16 points, Barthel Index (BI) score of 50 > points on day two Montreal Cognitive Assessment (MoCA) index < 26 if BI = 100	Confirmed stroke according to World Health Organization (WHO) criteria age ≥ 18 years, assessed with Berg Balance Scale (BBS), Time Up and Go (TUG) and Fugl-Meyer Assessment (FMA).	Confirmed stroke according to World Health Organization (WHO) criteria, age >18 years, residence within 30 min by car of the stroke unit, a National Institute of Health Stroke Scale (NIHSS) score of 0-16 points, Barthel Index (BI) score of 50 > points on day two Montreal Cognitive Assessment (MoCA) index < 26 if BI = 100
Exclusion criteria	Intervention studies Limited to selected groups Used assessment not specific to screen for anxiety Involved retrospective recruitment of reporting of mood Used convenience sampling Reported anxiety as a continuous outcome Measured anxiety by proxy	NIHSS score > 16 and BI score < 50. Patients with a life expectancy < 1 year (e.g. with severe malignancy) patient who were unable to speak or communicate in Swedish prior to stroke		NIHSS score > 16 and BI score < 50. Patients with a life expectancy < 1 year (e.g. with severe malignancy) patients unable to speak or communicate in Swedish prior to stroke

Abbreviations: BI, Barthel Index; BBS, Berg Balance Scale; CINAHL, Cumulative Index to Nursing and Allied Health Literature; Embase, Excerpta Medica database; Fugl-Meyer Assessment Scale; GOTVED, Gothenburg Very Early Supported Discharge; MEDLINE, Medical Literature Analysis and Retrieval System Online; MoCA, Montreal Cognetive Assessment Scale; NIHSS, National Institute of Health Stroke Scale; TUG, Timed Up and Go; VEGA, Västra Götaland care database.

Methodological quality, registration and protocol

The systematic review (Paper I) was conducted and reported following the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines(179). The study quality and potential risk for bias was assessed with the Swedish Agency for Health and Technology assessment of Social Service (SBU) checklist for assessment of study quality in observational studies (180).

The randomized controlled study was registered at Clinical Trials.gov (NCT01622205) and the study protocol was published in the BMC Neurology (181). A power calculation was performed based on the level of HADS-A. With a power of 80% and a p-value of 0.05 a sample size of at least 44 per group were needed to detect a 4-point difference (182, 183).

The CONSORT guidelines (184) were followed in the design of the randomized controlled study (Paper II) and in the longitudinal trial (Paper IV). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statements for observational studies was followed in the design of the cross sectional study (Paper III).

Outcome measures

The outcome measures used in this thesis are listed in Table 3. The outcomes are sorted according to ICF (84). A summary of the characteristics and properties of the measurements are provided in Table 4.

Body functions

Stroke severity

The stroke related neurological deficit was assessed with the National Institute of Health Stroke Scale (NIHSS) upon enrolment in the stroke unit. NIHSS is a widely used assessment tool used in many large clinical stroke trials to document baseline and outcome severity (8, 9, 26). The

score ranges from 0 to 42 with a lower score representing a better neurological function (185). The NIHSS is considered to be one of the most reliable and valid instruments of clinical measurement in stroke (9, 25, 27).

Table 3. An overview of outcomes used in this thesis, categorised according to ICF

Name	Description	Paper			
		I	II	III	IV
Body functions and structures					
FMA	Sensorimotor function			♦	
HADS-A	Anxiety symptoms	♦	♦		♦
MoCA	Cognitive function				
NIHSS	Neurological outcome		♦		♦
Activities					
BBS	Steady state postural balance			♦	♦
BI	Activity in daily life		♦		
FES(S)	Self-perceived postural balance				♦
TUG	Mobility and dynamic postural balance		♦	♦	♦
Personal factors					
Age		♦	♦	♦	♦
Gender		♦	♦	♦	♦

Abbreviations: BBS, Berg Balance Scale; BI, Barthel Index; FES(S), Fall Efficacy Scale(Swedish version); FMA, Fugle-Meyer Assessment scale; HADS-A, Hospital Anxiety and Depression Scale- Anxiety sub scale; MoCA, Montreal Cognition Assessment scale, NIHSS, National Institute Health Stroke Scale; TUG, Timed Up and Go

Cognitive function

Cognitive function was assessed with the Montreal Cognitive Assessment (MoCA) scale (5). MoCA is a screening tool developed to assess mild cognitive impairments. It can be divided into 6 different domains, and it ranges from 0 to 30 where a higher score represents a better

cognitive function. MoCA has demonstrated a good reliability and validity for those with mild to moderate stroke (24). A cut-off of ≥ 26 was used to indicate normal cognitive functioning (47).

Motor function

Sensorimotor function in the upper and lower limbs was assessed with the Fugl-Meyer Assessment Scale (FMA) (1, 2, 35, 174). The FMA is a widely used assessment for quantitative measurement of motor impairment after stroke. It has demonstrated excellent reliability and validity (1, 2, 20), and is recommended for use in clinical trials of stroke rehabilitation and recovery (35). The FMA includes two parts, upper extremity (UE) and lower extremity (LE). Each part is divided into four subscales: motor function, sensory function, joint range of motion and joint pain, which consist of multiple items, each scored on a 3- point ordinal scale (0=cannot perform. 1=performs partially, 2=performs fully). The total score for FMA-UE is 66 and for FMA-LE it is 34 and corresponds to unimpaired motor function.

Self-perceived anxiety and depression

To detect possible anxiety disorders, the Hospital Anxiety and Depression Scale (HADS) was used. HADS was developed to identify cases (possible and probable) of anxiety disorders and depression (3). HADS is a reliable and valid instrument for screening for clinically significant anxiety and depression after stroke (3, 23). The scale is a self-assessment scale that is divided into two subscales, Anxiety (HADS-A) and Depression (HADS-D). Each subscale contains seven items rated on a 4-point ordinal scale. The maximal total score for HADS-A is 21 and for HADS-D it is also 21, with a higher score indicating more symptoms of anxiety or depression. For this thesis a cut-off of ≤ 7 was used corresponding to no anxiety.

Activities

Activities of daily living and degree of independence

Patients' degree of overall disability was assessed with the modified Rankin Scale (mRS) (186). The mRS has a 7 grade ordinal scale where 0 means perfect health with no symptoms and 6 means death (186, 187). The mRS has been shown to be a valid and reliable instrument for assessing overall disability and recovery after stroke (16). A score of ≤ 2 indicates functional independence (48).

The activity in daily life performance for patients with neuromuscular or musculoskeletal disorders were assessed with the Barthel Index (BI). The BI was developed for patients with neuromuscular and musculoskeletal disorders, and by applying the test at different occasions, an improvement could be identified (188). The scale is an ordinal scale comprising ten activities of daily living. Each activity is scored in steps of five points and the total score ranges from 0 to 100. A higher score indicate higher grade of ADL independence. In clinical settings, the administration of BI can occur in several ways. In this thesis, BI was collected by observation of the patient and by interview. The scale has proved to be reliable and valid when assessing patients with stroke (12, 13, 30, 189-191). A cut-off score of ≥ 50 was used for inclusion in the GOTVED study.

Postural balance and mobility

The postural balance was assessed with the Berg Balance Scale (BBS). The scale was developed to evaluate postural balance performance and fall risk in elderly (192). BBS is an ordinal scale consisting of 14-items scored from 0 to 4 according to the patient´s ability to maintain position and complete moving tasks of varying difficulty. Maximum score is 56 and a higher score represents higher grade of postural balance and lower fall risk. The scale has proved to be reliable and valid when assessing patients with acute and chronic stroke (10, 29). BBS is generally sensitive to change over time after a stroke (193). A cut-off score of ≤ 45 was used to identify patients with impaired postural balance.

Table 4. Measurement characteristics and properties of the assessments used in this thesis

Outcome	FMA	HADS	MoCA	NIHSS	BBS	BI	FES(S)	mRS	TUG
Type	Observational rating scale	Self-reported questionnaire	Cognitive screening test	Observational rating scale	Observational rating scale	Observational rating scale	Self-reported questionnaire	Observational rating scale	Observational
Scale level	Ordinal	Ordinal	Ordinal	Ordinal	Ordinal	Ordinal	Ordinal	Ordinal	Quota scale
Range sum score	0-66	0-21	0-30	0-46	0-56	0-100	0-	0-6	-
Number of items	33	14	6	13	14	10	13	1	-
Item range	0-2	0-3	-	Varies, 0-2, 3 or 4	0-4	Varies, 0-5, 10 or 15	0-10	0-6	-
Reliability	High[1, 2]	High[3, 4]	High[5-7]	Moderate to high [8, 9]	High[10]	High[11-13]	High[14, 15]	Moderate to high[13, 16]	Moderate to high(17-19)
Validity	High[1, 20, 21]	High[22, 23]	Moderate to high[5, 24]	Moderate to high [25-28]	High[21, 29]	High[30, 31]	Moderate[32]	Low to moderate[16, 33]	High[17-19]
Responsiveness	Moderate to large[34-36]	-	Moderate[37]	Large[38]	Moderate to large[21]	Moderat to large[31, 39]	High[40]	Small to moderate[41]	Large[17, 42]
MCID	10 points [43]	1,7 points[44]	1.22 points[37]	2 points[34, 38]	Varies between 4-5 points[45]	1.85 points[46]	-	-	2.9 s[17]
Cut-off	-	≤7	≥26[47]	<16	≤45[29]	<50		≤2(48)	>15[49, 50]

Abbreviations: BI, Barthel Index; BBS, Berg Balance Scale; FES(S), Fall Efficacy Scale (Swedish version); FMA, Fugle-Meyer Assessment Scale; HADS, Hospital Anxiety and Depression Scale;MCID, Minimal Clinically Important Difference; mRS, Modified Rankin Scale; MoCA, Montreal Cognitive Assessment scale; NIHSS, National Institute of Health Stroke Scale; TUG, Timed Up and Go

High/Large: ICC or kappa value ≥0.75; Cronbach´s α>0.8; Correlation coefficient >0.60; Area under the curve (AUC)>0.9; Effect size >0.8

Moderate: ICC or kappa value 0.4-0.74; Cronbach´s α>0.70-0.79; Correlation coefficient 0.30-0.60; Area under the curve (AUC) 0.7-0.9; Effect size 0.5-0.8

Low/Small: ICC or kappa value <0.40; Cronbach´s α<0.7; Correlation´s coefficient <0.3; Area under the curve (AUC) >0.7; Effect size <0.5

To assess postural balance in basic mobility the Timed Up and Go (TUG) was used. TUG is a modified version of the "Get Up and Go Test"(194), and it is primarily developed to evaluate basic functional mobility, reflecting postural balance and gait manoeuvres used in daily life(195). Time is taken when a patient rises from an armchair, walks a distance of 3m in a comfortable and safe pace, crosses a line on the floor, turns, walks back to the chair and sits down again. For the patient to be familiar with the test TUG was performed twice and the second value was used. The scale has proved to be reliable and valid when assessing patients with acute and chronic stroke (18, 19). A cut–off score of >15 s was adopted to identify impaired postural balance (49, 50).

Self-perceived postural balance in daily activities

The persons perceived confidence in postural balance in this thesis was assessed with the Swedish version of the Falls Efficacy Scale FES(S) (149). The FES-S is a modified version of the Falls Efficacy Scale (196) and has been developed for use in the stroke population. The FES is a self-report questionnaire, providing information on a persons fear of falling during different daily activities. The original questionnaire contains 10 items scored on a ten point Likert Scale. The FES-S is an extended version where the ten original items were utilized and three additional items were incorporated (14). The patients are asked to rate the confidence in completing each activity without falling along a visual digital scale ranging from 0 (not at all confident) to 10 (completely confident). The maximum total score is 130. The patients are asked to rate each activity regardless of whether they actually perform it. The FES-S has proved to be reliable and valid in patients with stroke (14, 32).

Statistical methods

The statistical analyses in the systematic review (Paper I) were made using Review Manager 5:3. The descriptive analysis in Paper I and all other analyses in Papers II-IV were performed using Statistical Package for Social Science (SPSS©) (Version 24 SPCC Inc., Chicago, IL, USA). All the tests were two-tailed and a significance level of 0.05 was used in the analysis. The statistical tests used in this thesis are presented in Table 5.

Descriptive statistics were used to describe clinical characteristics and demographic data for the study population. They were presented with mean, standard deviation and range for continuous variables and as percent for categorical variables.

Table 5. An overview of the statistical methods used in this thesis

Statistics	Paper I	Paper II	Paper III	Paper IV
Descriptive				
Mean (SD)	✓	✓	✓	✓
Median (IQR)	✓	✓	✓	✓
Number (n) and percent (%)	✓	✓	✓	✓
Differences between groups				
Mann-Whitney *U*-test		✓	✓	✓
Pearson´s Chi-square test		✓	✓	✓
Independent samples t-test		✓		✓
Within group comparison for change				
Paired t-test		✓		✓
Change over time				
Post.hoc Wilcoxon signed rank test		✓		✓
Analysis of relationship				
Spearman´s rank correlation test			✓	✓
Kendall´s rank correlation test			✓	✓
Single sided test (Eid, Gollwitzer and Schmidt)			✓	✓
Test for heterogeneity				
Cochran´s Q	✓			
Eggers regression test	✓			
Prediction analysis				
Logistic regression (including Spearman´s correlation test, Hosmer Lemeshow test, ROC curves			✓	

Abbreviation: SD, Standard deviation; IQR, Inter Quartile Range; ROC, Receiver Operating Characteristic curve

In Paper I the Cochran´s Q test was used to test the heterogeneity among the studies and the I^2 statistic was used to interpret the heterogeneity. The Eggers regression test was used to confirm any heterogeneity.

To analyse differences between groups with continuous variables not normally distributed the Mann-Whitney U test was used. To analyse differences when data were categorical the Pearson´s Chi^2 test was used. In papers II and IV the independent t-test was used to test the difference of the mean between the groups. To test the change in correlation over time between the groups a single test according to Eid, Gollwitzer, and Schmidt was used (197). A paired t-test was used to analyse the difference in mean between the groups over time.

The post hoc Wilcoxon signed rank test was used in papers II and IV to analyse the change over time in the different groups. The Bonferroni correlation of the p-value was used to correct testing between the points (198). The effect size was used to interpret the strength of the difference and Cohen´s guidelines were used to interpret the effect sizes(199). Effect size values of <0.3 indicated small effects, 0.30–0.49 medium effects and ≤0.50 large effects (198). In paper II shifts in the proportions of anxiety disorders were analysed for the intervention group and the control group and reported using bar graphs.

Correlation analyses were used in papers III and IV. In paper III a logistic regression was used to investigate if motor function in the affected arm could predict impaired postural balance during the first year after stroke. In paper IV the correlation between self-perceived postural balance, observer assessed postural balance and anxiety was investigated. The independent variables were chosen based on clinical and theoretical relevance. The result of the correlation analysis was presented with odds ratio (OR), 95% confidence interval and p-values. Spearman´s rank correlation test was used to test potential multi-collinearity. The correlation values were interpreted as small (r<±0.29), medium (r=±0.30 to ±0.49) and large (r=±0.50 to ±1.09)(199). The limit for multicollinearity was set at >0.7 (200). To test the correlation between dichotomised and independent variables the Kendall´s rank test was used. A correlation coefficient of >0.3 was required for inclusion in the regression analysis (200). To test the goodness of fit of the different regression models the Hosmer and Lemeshow test,

Nagelkerke R^2 and the area under the curve (AUC) using Receiver Operating Characteristics Curves (ROC-curves) were performed. The results of the Hosmer and Lemeshow and Nagelkerke R^2 were interpreted as poor fit ($p < 0.05$) or good fit ($p > 0.05$), and the results of the AUC were classified as acceptable (AUC ≥ 0.7), splendid (AUC ≥ 0.8) or excellent (AUC ≥ 0.9).

Ethical considerations

The GOTVED study was approved by the Regional Ethical Review board in Gothenburg in February 2011 (reference number 042-11). In October 2018, a complement was approved (reference number T904-18). In Paper III, the GOTVED data was merged with data from another study, which was approved in September 2005 (reference number 4265-05). Written informed consent was obtained from the participants or from their closest relative prior to participation in the studies. The participants were informed that they could without explanation withdraw from the study.

RESULTS

Participants' characteristics

The characteristics of the participants in all four studies are presented in Table 1.

A summary of the results of Papers I-IV is presented in the following section.

Anxiety prevalence after stroke (Paper I)

The search produced 2612 references. The majority of the studies (65%) were of medium quality, of which 19 publications met the inclusion criteria. In an updated search, we found 1841 new studies, of which 18 publications met the inclusion criteria. This resulted in a total of 37 studies and 13 756 unique patients with stroke included in this study. A Prisma flowchart can be seen in paper I that shows the search process and reason of exclusion of the full text articles.

The prevalence of anxiety disorders in stroke survivors was 29.3 % at any time during the first year after stroke. HADS-A was the most common assessment tool, used in 31 of the included articles, and the meta-analysis showed a prevalence of anxiety of 27.4%. There was a statistical high heterogeneity in both those estimates (I^2= 97 %, p<0.00001) which was confirmed by the Eggers regression asymmetry test (b_1 = 1.4), but it was not significant (p = 0.2). The reported cut-off for HADS-A ranged from > 6 to ≥11 in those studies.

The majority of the studies, 27, took place in an acute hospital setting and accounted for 78 % of the stroke participants (169, 201-226). Of the remaining studies, 6 were conducted in the community (227-232), 3 in a rehabilitation setting (233-235) and 1 in a population setting (236). When pooling the data depending on the setting, the highest prevalence of anxiety disorders was estimated in population-based settings (37%) and the lowest in the rehabilitation- and community based settings with 18.4% and 18.9% presenting with anxiety disorders, respectively.

Overall anxiety and disability after stroke. VESD compared to routine discharge (Paper II)

Overall anxiety

There was no difference in anxiety between the groups at baseline, but after 3 months, the control group had significant higher levels of anxiety compared to the VESD group. After 1 year post-stroke, there was no significant difference between the groups. The shift in the proportions of HADS only showed a small effect size both in the VESD group and in the control group in al analyses. Figure 3 presents the change in anxiety in the VESD group and the control group.

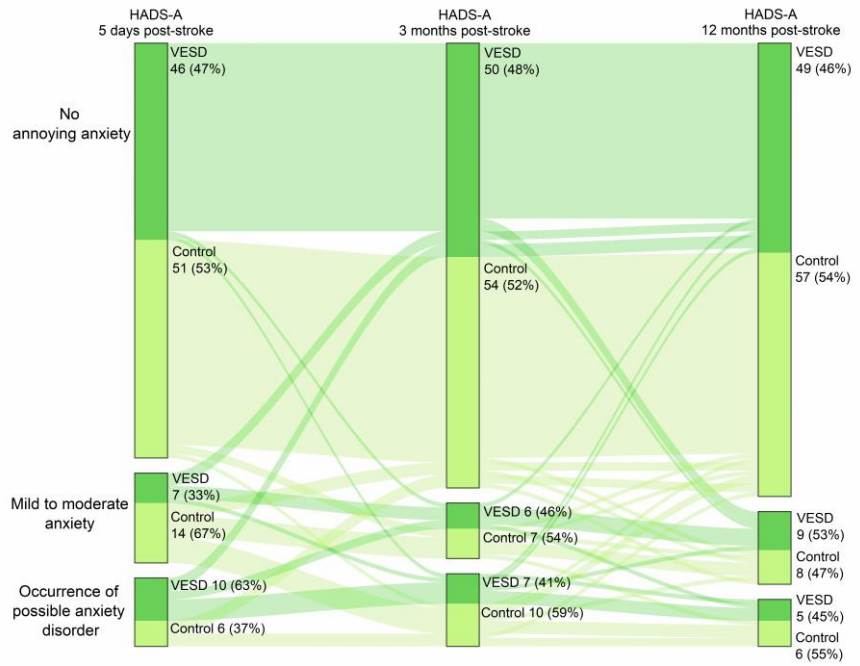


Figure 3. *Change in anxiety in the VESD group and in the control group.*
Abbreviations: HADS-A, Hospital Anxiety and Depression Scale-Anxiety subscale; VESD, Very Early Supported Discharge.

Overall disability

At baseline, there was no significant difference of overall disability assessed with mRS, however after 3 months the VESD group had a significantly lower grade of overall disability compared to the control group. One year after the stroke there was no difference in overall disability between the groups. In the proportion of mRS there was a clear change in the VESD group with a large effect size between admittance and 3 months post-stroke, and between admittance and 12 months post-stroke, compared to the control group where there only was a small effect size in the shift of proportions in all analyses. Fig 4 presents the change in overall disability in the VESD group and the control group.

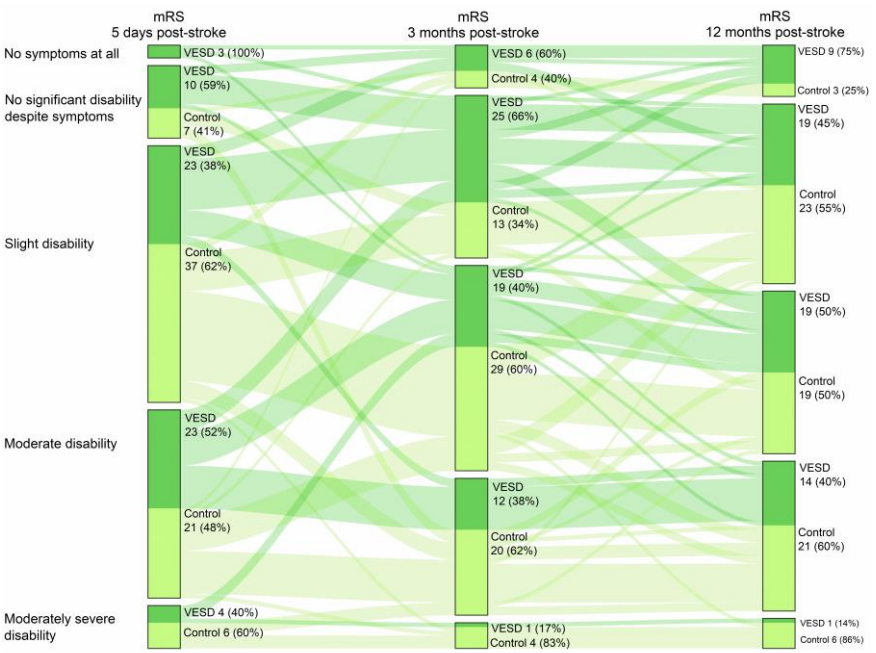


Figure 4. *Change in over all disability in the VESD group and in the control group. Abbreviations: mRS, modified Rankin Scale; VESD, Very Early Supported Discharge.*

Correlation between upper extremity motor function and postural balance (Paper III).

The correlation between postural balance and motor function of the affected arm was low although statistically significant during the first year post stroke. The results were the same whether the postural balance was assessed with BBS or TUG. The regression analysis showed that impaired motor function in the affected arm was significantly associated with impaired postural balance and explained 49% of the variance of the postural balance with BBS as the depending variable, and 54% with TUG as the depending variable. This shows that motor function in the affected arm works well to identify patients with impaired postural balance. A summary of the regression models can be found in Figure 5.

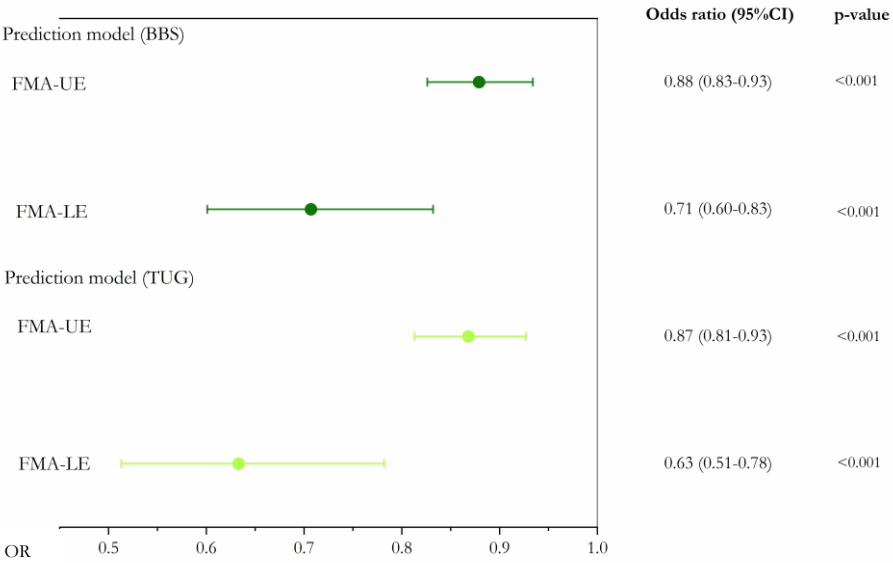


Figure 5. *Logistic regression models of factors associated with impaired postural balance assessed with BBS or TUG.*
Abbreviations: BBS, Berg Balance Scale; CL, confidence interval; FMA-UE, Fugl-Meyer Assessment Upper extremity; FMA-LE, Fugl-Meyer Assessment Lower extremity; OR, odds ratio; TUG, Timed Up and Go.

Correlation between self-efficacy in postural balance and observer assessed postural balance and anxiety (Paper IV).

Self-efficacy in postural balance associated significantly with observer assessed postural balance at first day after discharge, 1 month after discharge, 3- and 12 months post stroke. When analysing depending on group affiliation, the VESD group or the control group, there was a significant difference between the VESD group and the control group one month after discharge with the VESD group having a higher correlation between FES-S and TUG. The analysis of the correlation between self-efficacy in postural balance and anxiety showed no significant difference between the two groups. Between postural balance and anxiety there was no significant correlation except three months post stroke when there was a low but significant correlation between BBS and HADS-A. A summary of the correlations between FES(S), BBS, TUG and HADS-A can be found in Figure 6.

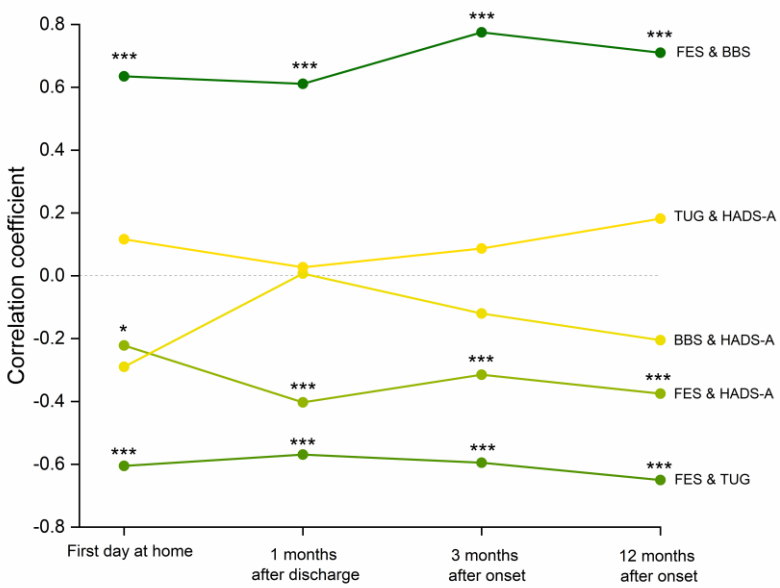


Figure 6. *The Spearmans correlation between FES(S)/BBS, FES(S)/TUG, FES(S)/HADS-A, BBS/HADS-A and TUG/HADS-A during the first year post-stroke. Abbreviations: BBS, Berg Balance Scale; FES, Fall Efficacy Scale; HADS-A, Hospital Anxiety and Depression Scale-Anxiety subscale; TUG, Timed Up and Go.*

Summary of results

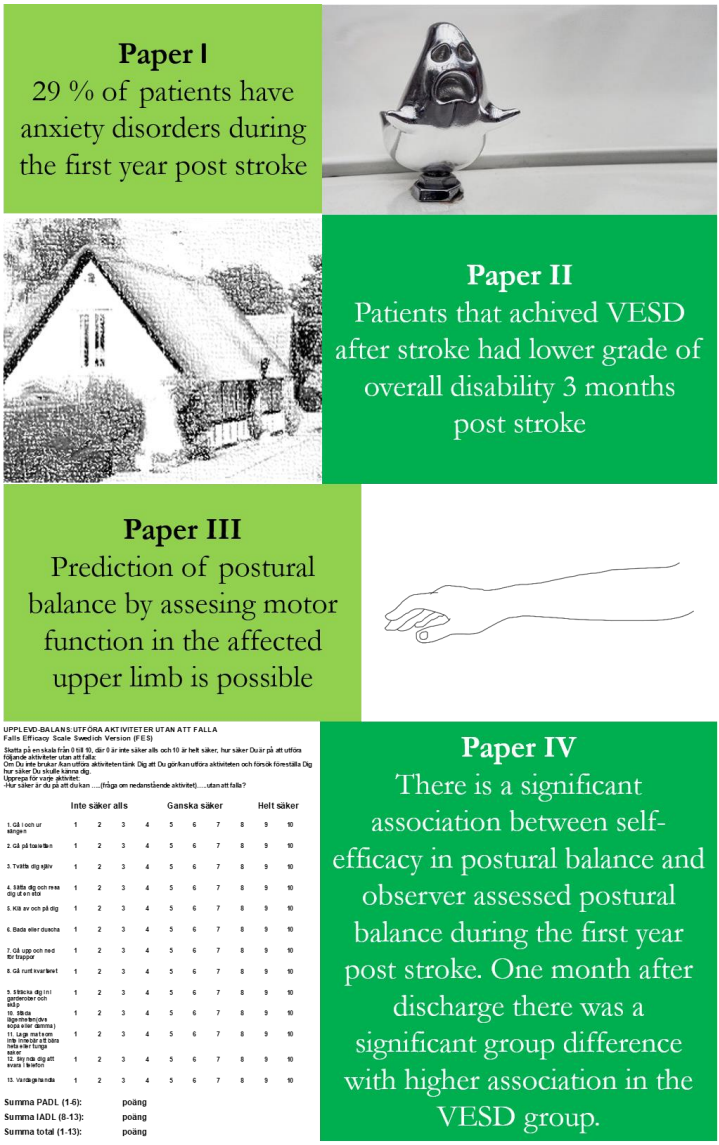


Figure 7. *A summary of the main results in papers I-IV*

DISCUSSION

In this thesis the focus was to investigate postural balance, anxiety, and motor function in patients during the first year after stroke. A systematic review was conducted as a first step to study the current occurrence of anxiety in the stroke population. Early supported discharge is a recommended alternative of stroke rehabilitation, and the purpose of this thesis was to investigate how anxiety, postural balance and motor function was affected by VESD compared to ordinary discharge routines.

Summary of the key results

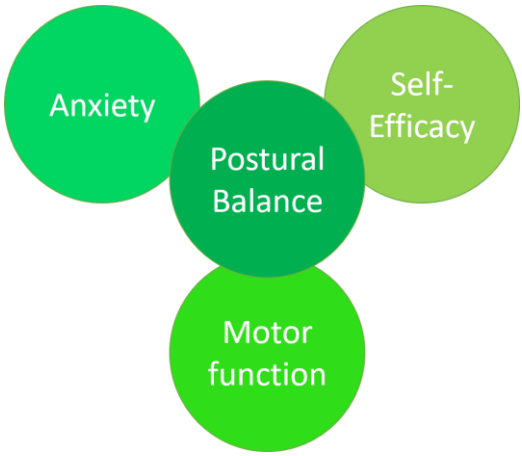
Anxiety is common after stroke, with 20-30% of the stroke population experiencing anxiety during the first year after onset. A rather high prevalence of a symptom that is not usually screened for in Swedish stroke care. The overall disability was significantly lower in the VESD group compared with the control group three months post-stroke. VESD did not affect the level of anxiety compared to ordinary rehabilitation during the first year post stroke. Motor function in the affected arm was significantly associated with postural balance. No difference in postural balance, anxiety or motor function was seen during the first year post stroke whether the patients received VESD or was discharged according to usual routines. There was a significant association between self-efficacy in postural balance and observer assessed postural balance during the first year post stroke. Figure 7 shows a summary of the main results in Papers I-IV.

Postural balance after stroke

The term *postural balance* was introduced as a MeSH term in 2009. Several similar terms exist such as, for example, *postural control* and *balance*. In everyday speech in Sweden the term balance is the most common when talking about the ability to maintain a given posture and ensure equilibrium in changes of position. Since postural control is not defined at all in the ICF we decided to use the term "postural balance" in this thesis. Impaired postural balance is a common symptom after stroke. Since impaired postural balance is a common reason for falls, which in

turn can led to minor injuries, and more serious consequences such as fractures, depression and restriction of activities (237), it is important to assess postural balance in the acute stage but also later after stroke to make patients aware of their limitations but also about their opportunities and conditions for various activities. To capture both steady state postural balance and basic functional mobility and dynamic postural balance we used two difference assessment scales, BBS and TUG (195, 238). Paper IV concluded that a quarter of the patients had impaired postural balance according to BBS and about a third according to TUG at baseline, with the majority having discretely impaired postural balance. In total there were 10 persons that had full score, 56/56, in BBS at baseline.

In this thesis we wanted to investigate how different symptoms were associated with each other. We assumed that postural balance would be associated to anxiety, motor function and self-efficacy post stroke. In paper III the motor disorder in the affected arm was significantly associated with impaired postural balance during the first year after stroke. Approximately one fifth of those with intact motor function in the lower extremities and impaired motor function in an affected arm had impaired postural balance. For natural reasons, impaired postural balance is often linked to impaired motor function in the lower extremities, but our results suggest that reduced motor function in an upper extremity also needs to be taken into account when assessing postural balance. This result is in line with earlier studies which have found that the upper extremities plays an important role in postural balance recovery during perturbed stance or perturbed gait (239-241).

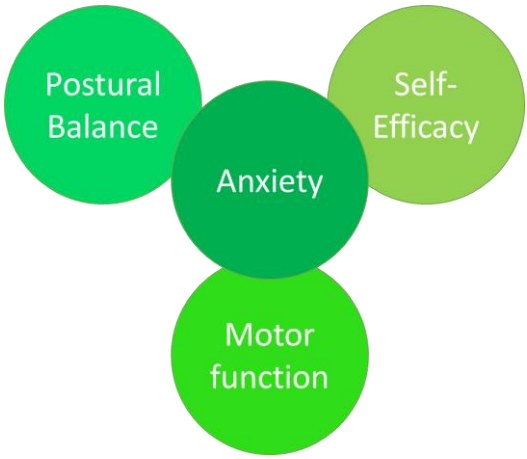


In paper IV there was a significant association between postural balance and self-efficacy during the first year post stroke, which is in line with a previous study (242). A small to medium significant correlation was seen between self-efficacy in postural balance and anxiety. The correlation was strongest at the follow-up one month after discharge. That was the time when the intervention group was discharged from the VESD team and one can assume that the fact that they suddenly were on their own with no support and supposed to take more responsibility for their training and rehabilitation could have impacted the correlation. However, no group difference in the correlation was seen. The correlation between postural balance and anxiety was low at all assessment occasions and only significant at the follow up three months post-stroke.

Anxiety after stroke

The finding that 30% of the patients in the included studies in the review (Paper I) had anxiety disorders, was a bit increased compared to earlier studies. When pooling the studies that used HADS-A as a screening instrument 27% had anxiety disorders. In many of the studies, HADS was used to screen for depression and anxiety and was presented as descriptive data. Considering that 1/3 of the stroke patients reported some form of anxiety disorders in the first year after stroke, it is strange that anxiety does not receive more attention. It has been highlighted earlier that anxiety gets significantly less attention compared to depression after stroke (160), which is in line with our conclusion. It is reported that there is a dissatisfaction with the way physical services are provided after stroke. Because anxiety is a predictor of impaired quality of life (224, 243) and since it also is associated to and can lead to impaired depression prognosis (244) it is of great importance to assess anxiety both in the acute and in the chronic phase after stroke. It is however reasonable to believe that with the shortened days of hospital stay for the patients with stroke there is less time for such assessment and no time to take care of any anxiety symptoms that emerge during such an investigation. However, perhaps assessing and treating anxiety would shorten the hospital stay for some patients and prevent re-admission, and therefore pay off socio-economically.

In paper IV there is an association between anxiety and self-efficacy in postural balance. Since there is also a relationship between self-efficacy in postural balance and observer assessed postural balance, one can assume that there exists a relationship between postural balance and anxiety. However in this thesis we only saw a small correlation. Earlier studies have emphasized that vestibular information and other information on balance control exercise a significant impact on anxiety (245, 246). Therefore, routine assessment of postural balance in patients



with anxiety is recommended (247). Even though we only found a small correlation the correlation, it is still a reason to assess anxiety in the acute phase after stroke. In order for this to be justified, it is of course also necessary to consider interventions for anxiety disorders after a stroke, which becomes even more important if it can also affect postural balance and the risk of falling.

The effect of VESD

The model of ESD for rehabilitation after stroke has been around since the late 1990s. ESD accelerates the discharge from hospital, reduces long-term dependency and admission to institutional care (61, 248). The ESD services is suggested to provide a better partnership between the patient and the therapist, helping patient motivation by focusing on

more realistic rehabilitation goals and providing rehabilitation in a more relevant context in the patients home (175). This suggests that ESD is a more person-centered form of rehabilitation. It seems to be most effective for those with mild to moderate stroke (62, 248). Most of the randomized controlled trials on ESD services were published more than 10 years ago, and since then the conditions for this form of rehabilitation have changed. Despite that ESD is recommended in the Swedish National Guidelines for stroke (81) and should be offered as an alternative for rehabilitation after stroke, ESD is far from being an alternative at all hospitals in Sweden today (249). Since the introduction of ESD in Sweden the duration of hospital stay has shortened and the severity of the stroke has changed. Consequently, patients are now discharged from the hospital earlier than what was considered "early" when the studies on ESD were published. Against this background, we chose to investigate how VESD affects patients.

The VESD comprised up to four rehab sessions a week with a physiotherapist and/or an occupational therapist with a median of 11 visits from the team over the 4 weeks. This is in line with the procedure described in some earlier ESD studies (104, 250). In the Cochrane reviews regarding ESD, the length of receiving care and rehabilitation from the ESD teams was reported as approximately three months (62, 248). In the light of the Cochrane review our VESD team worked with short lengths of stay but also with large variations in frequency of the visits and lengths of stay. Since the patients in the VESD group had a shortened average length of hospital stay of 2 days compared to the control group, the patients in the control group received more inpatient rehab sessions compared to the VESD group before discharge. Six patients in the control group were referred to continued inpatient rehabilitation in a rehabilitation clinic after being discharged from the stroke unit. During the first year after stroke, 70% in the control group continued their outpatient rehabilitation, compared to 58% in the VESD group after the VESD period. This can have affected the differences between the groups which diminished one year after stroke onset.

This thesis shows that VESD is just as good as, and sometimes better, than standard care and rehabilitation after stroke. Since there were no reports of harm or unintended effects of VESD, and since it has a per-

son-centred approach, one can state that VESD should exist as an alternative to other rehabilitations and that it is the best form for some patients but not suitable for others. In paper II the main outcomes, HADS-A and mRS, differed significantly at 3 months after stroke onset. The VESD group reported decreased level of anxiety and a lower mRS compared to the control group. These findings are in line with previous results for ESD (62). The group difference did not persist at the one year follow up. One can only guess what this is due to, but it is reasonable to believe that the training and the care that VESD entails is "perishable", and after a year some effects have diminished. In paper IV, unlike the control group, at one month after discharge the VESD group estimated their postural balance in line with observer assessed postural balance. At the other survey dates, we found no differences between the two groups. Our findings on VESD are in line with most of the studies being conducted, i.e. you can see some significant difference 1-3 months after discharge but in the later stage after stroke you see no significant difference between the ESD group and the control group regarding parameters such as overall disability.

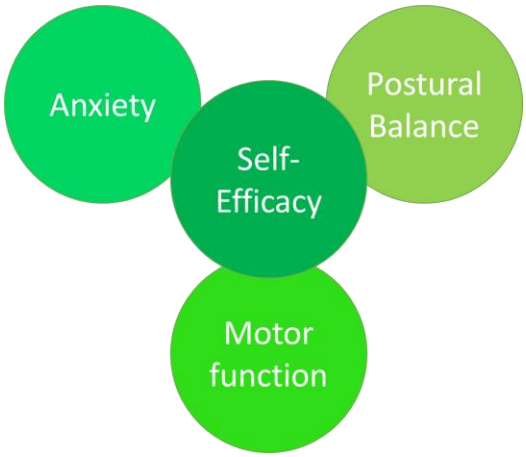
The relationship between arm function and postural balance

In paper III a significant association between the function in the affected arm and impaired postural balance was found. It is of great interest and importance when planning for the rehabilitation to take into account that the rehabilitation of the upper extremity is not only important for improving the function of the arm but also to improve the postural balance. It is also of great interest that even though the motor function in the leg, which of course is of great importance for the postural balance, is not affected their postural balance may still be affected by impaired arm function. Postural balance was assessed with two different outcomes, BBS and TUG, both valid and reliable measures in the stroke population. Both showed a significant association with motor function, although the correlation with BBS was slightly higher. At the same time, the Holmer and Lemeshow test showed that TUG was a little better to catch those with impaired postural balance, even though the RUC curve supports both models being able to detect those patients with impaired postural balance. So maybe it is not important which of these two instruments you choose, but only that you really

assess the postural balance. This is in line with the Stroke Evidence Database to Guide Effectiveness (Stroke EDGE) recommendation, which is that both BBS and TUG are highly recommended for assessing postural balance both in inpatient and outpatient rehabilitation (251, 252). The assessment of motor function and postural balance in our study was made between one and thirteen years post stroke, when, according to The Stroke Recovery and Rehabilitation Roundtable (SRRR) (253), the patient is in the chronic phase after stroke. This means that the result is primarily transferable to patients in a late stage after stroke

The relationship between self-reported and observer assessed postural balance

Paper IV showed a significant association between self-reported and observer assessed postural balance. This shows that patients who have developed mild to moderate stroke can estimate their postural balance and risk of falling correctly. This is in line with earlier studies, which also concluded that patients with stroke were significantly more likely to experience recurrent falls and fear of falls compared with persons without a stroke (254). Falling is the most common complication after stroke with a reported incidence of 73% in the first year after stroke (255). That fact together with the result in this thesis showing that the patients seem aware of their impaired postural balance, can be of great importance and very useful to examine patients' self-experienced postural balance during the first year after stroke, to try to prevent fall incidents. Maybe by performing the self-assessment test, patients are made aware of their risk of falling. Further studies comparing the incidence of falls in those who performed a self-efficacy test compared with those who did not would be interesting. At the one month follow up a significant group difference in the correlation between FES(S) and TUG in favour for the VESD group was seen. At the other assessment occasions, no significant group difference in the correlation between how the patient estimated their postural balance, whether they received VESD or were discharged according to the department's usual routine was seen. Perhaps the intervention during the first month, with daily training in their home environment and support from the physiotherapist,



occupational therapist or from the nurse gave them better insight in their postural balance, which was shown in the one-month assessment. At the 3- and 12 months follow up the VESD group had no longer support from the VESD team which may have affected their self-esteem.

Methodological considerations

General experience from the GOTVED study

To conduct the present randomised controlled trial, which is sub-study II of this thesis and forms the basis of studies III and IV, has been challenging and periodically demanding. When we planned the study in 2010, the intervention of early supported discharge from the stroke unit at Sahlgrenska University Hospital was only part of an intervention in our study. During the autumn of 2011, ESD became part of the routines at the stroke unit at Sahlgrenska University Hospital. This meant that all patients were entitled to ESD and inclusion in a randomized study was made more difficult and therefore took longer than planned.

Another problem was the inclusion criteria to be assessed 36-48 h after enrolment in the department. The staff who performed the assessments of BI and MoCA worked only weekdays and therefore the inclusion stopped during the weekends. Halfway into the study, the weekend service began on Saturdays and therefore also the inclusion, but still there was no inclusion on Sundays.

The participants were recruited in the acute phase when their focus probably is towards their clinical situation with a lot of worry concerning what is going to happen and how it will go. Enrolment in several different studies at the stroke unit is common because there is so much research in a university hospital and the same goes for Sahlgrenska. For a patient in the acute phase it is not easy to take a stand on the various requests for different studies and it can be expected that they are not fully aware of the decision to accept or not to accept to participate. Sometimes it was even necessary for next-of-kin to receive the information and decide on participation or not. This may be one reason why there were so many that withdrew, 14%, before discharge or the first follow-up at home.

Measurements

Specific guidelines were followed to improve the quality in the different studies. In the systematic review (Paper I), the design was made in accordance with the PRISMA Guidelines (179). The randomised controlled trial (Papers II and IV) was made in accordance with the CONSORT guidelines (256), and in the cross sectional study (Paper III) the STROBE statements were followed (257).

In the systematic review (Paper I) some limitations were made in the search, but to receive as many studies as possible the search was not restricted to include first ever stroke. It can be a limitation not knowing if the occurrence of anxiety depends on the current stroke or an earlier stroke. Another weakness is that the majority of the included studies did not investigate the incidence of anxiety prior to stroke. However, the occurrence of anxiety and how it affects the patient is most important and was the main aim to investigate. Despite the significant heterogeneity in methodology between the included studies, a meta-analysis was conducted for the studies using HADS-A as assessment

of anxiety. An important part of a systematic review is the assessment of the study quality. Although there are many different templates for quality assessment to choose from, it is hard to find a template possible to use if studies include different study methods. Even when using a template it can only guide and thereby increase the objectivity, but it is never possible to completely ensure that subjective assessments are not included, which can limit the generalizability of the result. A way to try to reduce the risk is to have several researchers evaluate the articles individually, then compare, and agree on a result, which was the case in the review in this thesis.

In papers II and IV, HADS-A was used to assess anxiety. The HADS is known to be a reliable and valid scale that is sensitive to change (3, 23, 258). We chose the HADS because it is a common and widely used instrument to screen for anxiety and depression disorder in clinical populations with symptoms of somatic diseases, and one of the most commonly used measures of psychiatric morbidity after stroke. Something that was confirmed in paper I where the majority of the eligible studies had used HADS as a screening for anxiety and depression. The HADS is known to be easy to administrate and well accepted, which is important when conducting a study with several outcomes and measurement occasions as with GOTVED. Herrmann et al (258) conclude that for scientific purposes, the scale is able to differentiate groups with different prevalences or intensities of anxiety and depression, and that it is sensitive to changes in patient's emotional state in longitudinal assessments. The HADS is not intended to be used to diagnose but only to screen for clinical anxiety symptoms (3), which was also the aim of using the instrument in this thesis.

In papers III and IV, BBS and TUG were used as assessment scales for postural balance. They are both valid, reliable and responsive to change in elderly after stroke (10, 18, 29, 259, 260).They are also recommended for detecting impaired postural balance, change over time and risk of falling in the elderly after stroke. Additionally, the BBS is also recommended as a standardized tool and valid to examine post-stroke recovery. BBS and TUG are commonly used in post-stroke assessments and are often used in studies investigating postural balance after stroke. It was also important to choose an assessment that was appropriate and possible to perform in the participants' homes as the majority of the assessments were made there. Therefore the BBS and

TUG were chosen to assess the outcome postural balance. Like most assessment instruments, they have limitations. Primarily the BBS has shown to have a floor and ceiling effect (261). It would have been possible to use another instrument in participants that scored maximum points on the BBS at baseline to distinguish between the participants. However, since the TUG also was used, it was probable that potential differences were to be captured there. Characteristics of reactive stepping has been shown to relate to increased falls in individuals with stroke (262). A limitation with the assessment tools used in this thesis is that none of them take reactive postural balance into account, which could affect the generalizability of the results.

The FES(S) was used in paper IV to examine how the patients experienced and estimated their own postural balance. It has shown to be a reliable instrument in patients with stroke and valid against observer assessment of postural balance and motor function (14, 32). The trend in physiotherapy has gone from a function-oriented strategy to a more task-oriented strategy. By adopting rehabilitation interventions where functional tasks can be performed in different environments, one retrains and improves the postural balance. With this strategy it can be of great importance to be aware of the patient's self-perceived postural balance. Since GOTVED has a person-centred approach, it also feels important to take into account the participants own experience of their postural balance. Perhaps the use of such an assessment will make the participant more aware of their postural balance.

Dichotomization (paper IV) and trichotomization (paper II) of ordinal sum scores were used, for different purposes. In paper II the trichotomization of HADS-A was made to do the shift analyses and show the shift of proportions of anxiety. The three different levels of anxiety chosen were the scale scores suggested in the assessment instrument (3). The dichotomization of BBS and TUG in paper III was made to be able to use it in the logistic regression. The levels were chosen according to an original article where it is stated that ≥7 corresponds to no anxiety. The purpose of dichotomizing or trichotomizing is to make the material more transparent. Another advantage is that the difficulties with ordinal scales and any unequal distances between score levels and items can be less of a problem if the sum is dichotomized (34). The disadvantage of dichotomization is that you lose information. The dichotomization should be made on the basis of reasonable motives or

statistical methods. Note that dichotomization strongly affects the relationships between variables.

Data collection and statistical handling of data

The GOTVED study was designed to consecutively include patients with stroke from the stroke unit at Sahlgrenska University Hospital in Gothenburg, Sweden. Only around 5% of the patients with stroke admitted to the stroke unit during 2011-2015 were recruited to GOTVED and half were offered VESD. Compared to the Cochrane review from 2017, reporting that the number of patients that were offered ESD differed a lot with a medium of 33% and a range of 13-70% (62) in different ESD teams, our inclusion is very low. Soon after the start of GOTVED, it was decided that ESD would become part of the operation of the stroke unit at the Sahlgrenska University Hospital. This was a fact that hampered the inclusion of patients into our study when some patients declined the study because they knew they could get the intervention anyway. This may be one of the reasons why recruiting the estimated number of patients took such a long time.

A power calculation was performed prior to starting and showed that at least 44 patients needed to be included for a power of 80%. The GOTVED ended up with 140 participants, to cover any deaths, dropouts etc. To reduce the risk of non-response, an intention to treat (ITT) analysis was performed. This is a statistical concept used as a solution of the problems with dropouts and non-compliance (263, 264). ITT is proposed to be a valid measure and the CONSORT recommend ITT analysis to improve the quality of an RCT (265, 266). The missing data was handled by using the last observation carried forward (LOCF) method, which is common for this procedure. The screening was made the second day after admission and the Barthel Index and MoCA were used as inclusion assessments. Except for the inclusion assessment all the assessments were administered by the same physiotherapist.

Generalisability

Most of the participants in this thesis come from a University Hospital, where thrombectomy and thrombolysis are available, which can affect the stroke outcomes, a fact that affects the generalisability. Another

fact is that the participants come from a high-income country where the care is tax-financed and accessible to everyone. This raises the generalisability in those countries but reduces it in low-income countries and parts of the world. This may influence the results and must be considered when generalising the findings from the study. The GOTVED study aimed to capture patients with mild and moderate stroke but the majority captured had mild stroke, which also influences the generalisability of the results. The mean age of the incident stroke in studies II and IV was 74 years, which is in line with the mean age of the Swedish incident and also in line with stroke incident in high-income countries. This make the result generalisable for that part of the world. In low-income countries the mean age of stroke incident is a bit lower which limits the generalisability of the results to this part of the world.

Strengths and limitations

One of the main strengths in this thesis is the relatively large and unselected study sample in studies II-IV. Early inclusion of both ischemic and hemorrhagic stroke and the long-term follow-up with up to 5 assessment occasions where the participants were assessed from day 5 after admission to the stroke unit until 12 months after the stroke must also be considered as a strength.

That the samples were consecutively included and randomized is also a strength worth mentioning. The groups are well defined and detailed information is presented for the included patients and the drop-outs.

The same experienced researcher, who was familiar with the assessment instruments and used to using the majority of them, made all the assessments, except those for the inclusion. This is a strength in this thesis but can of course be a weakness if you have an unexperienced assessor who does not have much routine with the assessment instruments.

This thesis includes clinical outcomes that cover assessment of body function and activities according to ICF. There is however a lack of assessment on the level of participation. Some assessments are made

on that level in the GOTVED study and will be analysed in future studies.

The economic aspect of VESD has not been analysed and taken into account in this thesis. This is something that is interesting and of great importance when analysing and implementing a new form of rehabilitation. The data has been collected and analyses will be conduted in future studies.

Clinical implications and further considerations

Findings from this thesis shows that anxiety is common after stroke and should be taken into account since it significantly influences quality of life and is a predictor for depression. The findings indicate that routine screening for anxiety post stroke would be worth considering in the acute stroke settings prior to the planning of rehabilitation and discharge.

This thesis showed that the degree of anxiety was not affected by what form of rehabilitation the patient received. Those receiving VESD did not estimate higher degree of anxiety than those receiving ordinary rehabilitation. Another finding was that VESD led to faster improvement of overall disability. These findings are in line with previous studies that in various ways have shown that VESD is a good alternative for rehabilitation after a stroke. Therefore it should be coordinated to offer VESD to patients with mild to moderate stroke. It should be implemented more largely than it is today to give the patient an alternative to inpatient rehabilitation as part of the service from a stroke-unit.

The finding that the motor function in the arm, affected by the stroke, correlates with the postural balance after stroke could be useful in the assessment of the patient. It could be useful both to the rehab staff and to the patient to be aware that even if the patient has unimpaired motor control in the leg, impaired function in the arm can lead to impaired postural balance and risk of falling. This can be of importance when planning the rehabilitation and discharge.

The finding that patients with stroke seem to be aware of their capacity of postural balance can be of use not only when planning the rehabilitation but also to support the patients to dare to be active and strengthen their self-confidence in activities post-stroke. To be physically active is important preventively in order not to get stroke again, and to assess self-efficacy in postural balance prior to discharge can perhaps help the patients to dare to be more physically active. To be able to further support and motivate patients with stroke it would be of interest to investigate if there is any correlation between reactive postural balance and falling.

CONCLUSION

- This thesis shows that anxiety is common during the first year post-stroke, with 1 in 3 subjects experiencing it.
- Very early supported discharge after stroke does not affect the level of anxiety at any point compared to ordinary rehabilitation.
- Very early supported discharge leads to a faster recovery of independence after discharge.
- Impaired arm function is associated with problems with postural balance in a late stage after stroke
- Patients with mild stroke seem to be able to assess their ability to perform activities in daily life without fear of falling.

FUTURE PERSPECTIVE

- Further routine for screening anxiety post-stroke needs to be implemented.

- Interventions for anxiety after stroke needs to be explored and implemented.

- VESD needs to be implemented to a greater extent in addition to ordinary rehabilitation, as a part of the service from a stroke unit.

- The results from the GOTVED project is probably transferable to other patient groups in need of rehabilitation and should be explored in further research.

- Further research ought to be undertaken to investigate the association between arm function and postural balance in the acute stage.

- The patient's self-confidence in postural balance should be assessed when planning rehabilitation to support patients in daring to be physically active after discharge from the hospital.

ACKNOWLEDGEMENT

Först ett varmt tack till **alla patienter** som deltagit i studierna. Ni har med gott mod och intresse tagit emot mig i era hem och utfört de tester och frågeformulär som jag bett om. Utan er hade jag inte fått ihop datan som till slut lett till denna avhandling.

Ett stort tack **Katharina Stibrant Sunnerhagen**, min huvudhandledare. Tack för att du delat med dig av din enorma kunskap och ditt stora nätverk. När du blev inbjuden till ett första möte för att lyssna på våra idéer om att starta ett projekt för att utvärdera tidig utskrivning med fortsatt rehabilitering i hemmet, efter stroke, så var du intresserad och hoppade på tåget direkt. Utan din kunskap och kapacitet så hade GOTVED projektet aldrig blivit av. Tack också för att du stöttat mig och trott på mig, utan det så hade jag aldrig hamnat där jag är idag. Att få vara del av din forskar grupp är inspirerande, utvecklande och så kul.

Tack också **Anna Danielsson**, min bihandledare, för allt stöd och vägledning. Att få bolla tankar och idéer med dig har varit till så stor hjälp. Ditt lugn och din eftertänksamhet har varit bra för mig som gärna har lite bråttom och är snabb i tanken. Kombinationen av handledare har passat mig perfekt. Tack också för att du kämpat med att förbättra min skriftliga engelska, det är inte lätt att lära gamla hundar sitta.

Tack till **Ann Björklund, Maria EH Larsson, Åsa Lundgren Nilsson** och **Åsa Nordin** mina medförfattare i GOTVED studien. Tack för hjälp och uppmuntran vid bearbetning och skrivande av manuset. Med hjälp av er blev den mycket bättre. Tack också till medförfattare **Christiane Meirelles** för samarbete i studie III.

Ett stort tack till alla kolleger vid Forskargruppen vid Rehabiliteringsmedicin. Tillsammans blir vi bättre och starkare. Vi har i forskargruppen ett öppet klimat där man alltid har någon att fråga och dela sina funderingar med. Tack **Emma Westerlind, Dongni Buvarp, Netha Hussein** och **Tamar Abzhandadze** för att ni stått ut med mina frågor och hjälpt mig med min statistik. Tack **Emma Kjörk, Malin Reinholdsson, Annie Palstam** för att ni hjälpt mig att förbättra mitt engelska språk och uttryckssätt i skrift. Ett stort tack till **Hanna Persson**

och **Margit Alt Murphy** som jag kunnat bolla tankar och idéer med och som varit mina trogna rese- och löpkompisar på kongresserna. Tack **Sofie Andersson, Ann Björklund, Elisabeth Brodin, Eva-Lena Bustrén, Ulrica Jonsson, Charlotta Josefsson, David Krabbe, Åsa Lundgren Nilsson, Lamprini Lili, Åsa Nordin, Carina Persson, Helena Selander, Adam Viktorisson, Elisabeth Åkerlund** och alla övriga kolleger som kommit och gått i forskagruppen och som hjälpt mig med mina texter vid våra återkommande peer-reviewer.

Tack **Berit Bjerlemo, Christina vom Hofe Jensen, Lisbeth Eriksson, Therese Kristersson, Anneli Pennbrant, Ulrika Påhlman** och **Karin Svensson** mina kära fysioterapikollegor i Strokegruppen Fysioterapin Sahlgrenska, Sahlgrenska Universitetssjukhuset som stöttat mig och stått ut med att jag kommit och gått i kliniken under de här åren, ni är bäst. Tack också ni fysioterapikollegor som kommit och gått i Strokegruppen Sahlgrenska under de här åren.

Tack till alla fysioterapi kollegor i Neurogruppen på Fysioterapi Sahlgrenska, Sahlgrenska Universitetssjukhuset för att jag fick komma och arbeta i er grupp under tiden som jag som blindad testare samlade in materialet på strokenheten och då inte kunde arbeta där. Det var en kul tid hos er och era fester går inte av för hackor.

Tack till alla kollegor på Fysioterapin Sahlgrenska, Sahlgrenska Universitetssjukhuset som alltid hejar glatt när jag dyker upp och som med intresse frågar hur det går för mig. Ert bemötande gör att det alltid känns kul att komma upp till fysioterapin även om det inte blir så ofta, jag känner mig alltid välkommen.

Tack till **Julia Philip Wigh** och **Maria Edvinsson**, enhetschefer på Fysioterapi Sahlgrenska, Sahlgrenska Universitetssjukhuset för att ni genom er flexibilitet ger oss som vill forska möjlighet att kombinera forskning med arbete i klinik. Tack också tidigare enhetschefer, **Sara Lilliehöök** och **Harriet Englund** för att ni trodde på mig och gav mig möjlighet att påbörja denna forskningsresa.

Tack **Gunilla Kjellby Wendt** verksamhetschef för Arbetsterapi och Fysioterapi Sahlgrenska Universitetssjukhuset för ditt intresse av de olika forskningsprojekten som pågår inom verksamheten och för att

du precis som tidigare enhetschefer stöttar och uppmuntrar till utvecklingsarbete och forskning.

Tack **Monika Fagervik Olsén** för att jag kunnat komma och bolla frågor och tankar kring min forskning med dig, du har alltid kloka tankar och svar.

Tack till alla arbetsterapi kollegerna på Strokenheten Sahlgrenska, Sahlgrenska Universitetssjukhuset som hjälpt till med datainsamlingen. Tack för att ni höll ut trots att inkluderingen tog mycket längre tid än beräknat. Utan er hade studien blivit mycket svårare att genomföra.

Tack till **Mare Teinlum-Kruse** sjuksköterska och samordnare i stroke hemteamet på strokenheten Sahlgrenska, Sahlgrenska Universitetssjukhuset, för att du på ett intresserat och fint sätt varit behjälplig när det är några data som saknats eller blivit fel. Tack även arbetsterapi- och fysioterapikolleger som arbetat i teamet under de år studien pågick för att ni var flexibla och tog hänsyn till mina inbokade tider hos studiedeltagarna.

Tack **Karin Fröjd**, överläkare och klinikchef på strokenheten Sahlgrenska, Sahlgrenska Universitetssjukhuset vid studiens start. Utan din idé om att starta upp understödd hemgång som ett projekt så hade jag troligtvis inte stått där jag står idag.

Tack till språkgranskare **Kate Bramly-Moore** och **Judith Klecki** som hjälpt mig att korrigera och förbättra min engelska i skrift. Ni har varit snabba och flexibla vilket underlättar och betyder mycket när man ska ha in sina manus.

Tack till bibliotekarie **Ann Liljegren** för hjälp med sökning i samband med Review artikeln. Ditt intresse, snabbhet och flexibilitet underlättade mycket.

Tack släkt och vänner som med intresse följt min forskarresa och stöttat och uppmuntrat mig. Att få umgås och skratta med er är guld värt.

Till sist tack till min familj, min man **Fredrik** och mina barn **Maja** och **Max** för att ni finns i mitt liv, jag älskar er.

Projekten i denna avhandling har delvis finansierats av: Lokala FoU-rådet för Västra Götaland och södra Bohuslän, Regionala FoU-rådet för Västra Götalandsregionen, STROKE Riksförbundet, Svenska Vetenskapsrådet (VR 2012-3523), Kung Gustav V:s och Drottning Victorias Frimurarestiftelse, Agneta Prytz-Folke´s och Gösta Folke´s stiftelse, Wilhelm och Martina Lundgrens stiftelse, Felix Neubergs stiftelse, Stiftelsen Handlanden Hjalmar Svenssons forskningsfond, Renée Enanders fond, Rune och Ulla Almlövs stiftelse för neurologisk forskning, John och Brit Wennerströms stiftelse för neurologisk forskning, Svenska Hjärt-Lungfonden, Centrum för personcentrerad vård (GPCC) vid Sahlgrenska Universitetssjukhuset, Sahlgrenska Universitetssjukhusets stiftelser, Norrbacka-Eugeniastiftelsen, Stroke Centrum Väst Sahlgrenska Universitetssjukhuset.

REFERENCES

1. Fugl-Meyer AR, Jaasko L, Leyman I, Olsson S, Steglind S. The post-stroke hemiplegic patient. 1. a method for evaluation of physical performance. Scand J Rehabil Med. 1975;7(1):13-31.
2. Duncan PW, Propst M, Nelson SG. Reliability of the Fugl-Meyer assessment of sensorimotor recovery following cerebrovascular accident. Phys Ther. 1983;63(10):1606-10.
3. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361-70.
4. Johnston M, Pollard B, Hennessey P. Construct validation of the hospital anxiety and depression scale with clinical populations. J Psychosom Res. 2000;48(6):579-84.
5. Nasreddine ZS, Phillips NA, Bedirian V, Charbonneau S, Whitehead V, Collin I, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. J Am Geriatr Soc. 2005;53(4):695-9.
6. Toglia J, Fitzgerald KA, O'Dell MW, Mastrogiovanni AR, Lin CD. The Mini-Mental State Examination and Montreal Cognitive Assessment in persons with mild subacute stroke: relationship to functional outcome. Arch Phys Med Rehabil. 2011;92(5):792-8.
7. Cumming TB, Lowe D, Linden T, Bernhardt J. The AVERT MoCA Data: Scoring Reliability in a Large Multicenter Trial. Assessment. 2018;27(5):976-81.
8. Goldstein LB, Bertels C, Davis JN. Interrater reliability of the NIH stroke scale. Arch Neurol. 1989;46(6):660-2.
9. Goldstein LB, Samsa GP. Reliability of the National Institutes of Health Stroke Scale. Extension to non-neurologists in the context of a clinical trial. Stroke. 1997;28(2):307-10.

10. Berg K, Wood-Dauphinee S, Williams JI. The Balance Scale: reliability assessment with elderly residents and patients with an acute stroke. Scand J Rehabil Med. 1995;27(1):27-36.
11. Quinn TJ, Langhorne P, Stott DJ. Barthel index for stroke trials: development, properties, and application. Stroke. 2011;42(4):1146-51.
12. Duffy L, Gajree S, Langhorne P, Stott DJ, Quinn TJ. Reliability (inter-rater agreement) of the Barthel Index for assessment of stroke survivors: systematic review and meta-analysis. Stroke. 2013;44(2):462-8.
13. Wolfe CD, Taub NA, Woodrow EJ, Burney PG. Assessment of scales of disability and handicap for stroke patients. Stroke. 1991;22(10):1242-4.
14. Hellstrom K, Lindmark B. Fear of falling in patients with stroke: a reliability study. Clin Rehabil. 1999;13(6):509-17.
15. Nordell E, Andreasson M, Gall K, Thorngren K-G. Evaluating the Swedish version of the Falls Efficacy Scale-International (FES-I). Adv Physiother. 2009;11(2):81-7.
16. Banks JL, Marotta CA. Outcomes validity and reliability of the modified Rankin scale: implications for stroke clinical trials: a literature review and synthesis. Stroke. 2007;38(3):1091-6.
17. Flansbjer U-B, Holmbäck AM, Downham D, Patten C, Lexell J. Reliability of gait performance tests in men and women with hemiparesis after stroke. J Rehabil Med. 2005;37(2):75-82.
18. Alghadir AH, Al-Eisa ES, Anwer S, Sarkar B. Reliability, validity, and responsiveness of three scales for measuring balance in patients with chronic stroke. BMC Neurol. 2018;18(1):141-.
19. Chan PP, Si Tou JI, Tse MM, Ng SS. Reliability and Validity of the Timed Up and Go Test With a Motor Task in People With Chronic Stroke. Arch Phys Med Rehabil. 2017;98(11):2213-20.

20. van Wijck FM, Pandyan AD, Johnson GR, Barnes MP. Assessing motor deficits in neurological rehabilitation: patterns of instrument usage. Neurorehabil Neural Repair. 2001;15(1):23-30.
21. Mao HF, Hsueh IP, Tang PF, Sheu CF, Hsieh CL. Analysis and comparison of the psychometric properties of three balance measures for stroke patients. Stroke. 2002;33(4):1022-7.
22. Aben I, Verhey F, Lousberg R, Lodder J, Honig A. Validity of the beck depression inventory, hospital anxiety and depression scale, SCL-90, and hamilton depression rating scale as screening instruments for depression in stroke patients. Psychosomatics. 2002;43(5):386-93.
23. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. J Psychosom Res. 2002;52(2):69-77.
24. Burton L, Tyson SF. Screening for cognitive impairment after stroke: A systematic review of psychometric properties and clinical utility. J Rehabil Med. 2015;47(3):193-203.
25. Muir KW, Weir CJ, Murray GD, Povey C, Lees KR. Comparison of neurological scales and scoring systems for acute stroke prognosis. Stroke. 1996;27(10):1817-20.
26. Lyden P, Lu M, Jackson C, Marler J, Kothari R, Brott T, et al. Underlying structure of the National Institutes of Health Stroke Scale: results of a factor analysis. NINDS tPA Stroke Trial Investigators. Stroke. 1999;30(11):2347-54.
27. D'Olhaberriague L, Litvan I, Mitsias P, Mansbach HH. A reappraisal of reliability and validity studies in stroke. Stroke. 1996;27(12):2331-6.
28. Bohannon RW, Lee N, Maljanian R. Postadmission function best predicts acute hospital outcomes after stroke. Am J Phys Med Rehabil. 2002;81(10):726-30.

29. Berg KO, Wood-Dauphinee SL, Williams JI, Maki B. Measuring balance in the elderly: validation of an instrument. Can J Public Health. 1992;83 Suppl 2:S7-11.
30. Wade DT, Hewer RL. Functional abilities after stroke: measurement, natural history and prognosis. Journal of Neurology, Neurosurgery & Psychiatry. 1987;50(2):177.
31. Hsueh IP, Lin JH, Jeng JS, Hsieh CL. Comparison of the psychometric characteristics of the functional independence measure, 5 item Barthel index, and 10 item Barthel index in patients with stroke. J Neurol Neurosurg Psychiatry. 2002;73(2):188-90.
32. Hellström K, Nilsson L, Fugl-Meyer AR. Relationship of confidence in task performance with balance and motor function after stroke. Physiother Theory Pract. 2001;17(2):55-65.
33. Weimar C, Kurth T, Kraywinkel K, Wagner M, Busse O, Haberl RL, et al. Assessment of functioning and disability after ischemic stroke. Stroke. 2002;33(8):2053-9.
34. Duncan PW, Jorgensen HS, Wade DT. Outcome measures in acute stroke trials: a systematic review and some recommendations to improve practice. Stroke. 2000;31(6):1429-38.
35. Gladstone DJ, Danells CJ, Black SE. The fugl-meyer assessment of motor recovery after stroke: a critical review of its measurement properties. Neurorehabil Neural Repair. 2002;16(3):232-40.
36. Hsieh YW, Wu CY, Lin KC, Chang YF, Chen CL, Liu JS. Responsiveness and validity of three outcome measures of motor function after stroke rehabilitation. Stroke. 2009;40(4):1386-91.
37. Wu C-Y, Hung S-J, Lin K-c, Chen K-H, Chen P, Tsay P-K. Responsiveness, Minimal Clinically Important Difference, and Validity of the MoCA in Stroke Rehabilitation. Occup Ther Int. 2019;2019:2517658.

38. Brott T, Adams HP, Jr., Olinger CP, Marler JR, Barsan WG, Biller J, et al. Measurements of acute cerebral infarction: a clinical examination scale. Stroke. 1989;20(7):864-70.
39. Salbach NM, Mayo NE, Higgins J, Ahmed S, Finch LE, Richards CL. Responsiveness and predictability of gait speed and other disability measures in acute stroke. Arch Phys Med Rehabil. 2001;82(9):1204-12.
40. Hellström K, Lindmark B, Fugl-Meyer A. The Falls-Efficacy Scale, Swedish version: does it reflect clinically meaningful changes after stroke? Disabil Rehabil. 2002;24(9):471-81.
41. Dromerick AW, Edwards DF, Diringer MN. Sensitivity to changes in disability after stroke: a comparison of four scales useful in clinical trials. J Rehabil Res Dev. 2003;40(1):1-8.
42. Brooks D, Davis AM, Naglie G. Validity of 3 physical performance measures in inpatient geriatric rehabilitation. Arch Phys Med Rehabil. 2006;87(1):105-10.
43. Shelton FD, Volpe BT, Reding M. Motor impairment as a predictor of functional recovery and guide to rehabilitation treatment after stroke. Neurorehabil Neural Repair. 2001;15(3):229-37.
44. Lemay KR, Tulloch HE, Pipe AL, Reed JL. Establishing the Minimal Clinically Important Difference for the Hospital Anxiety and Depression Scale in Patients With Cardiovascular Disease. J Cardiopulm Rehabil Prev. 2019;39(6):E6-e11.
45. Donoghue D, Stokes EK. How much change is true change? The minimum detectable change of the Berg Balance Scale in elderly people. J Rehabil Med. 2009;41(5):343-6.
46. Hsieh YW, Wang CH, Wu SC, Chen PC, Sheu CF, Hsieh CL. Establishing the minimal clinically important difference of the Barthel Index in stroke patients. Neurorehabil Neural Repair. 2007;21(3):233-8.

47. Lees R, Selvarajah J, Fenton C, Pendlebury ST, Langhorne P, Stott DJ, et al. Test accuracy of cognitive screening tests for diagnosis of dementia and multidomain cognitive impairment in stroke. Stroke. 2014;45(10):3008-18.
48. Broderick JP, Adeoye O, Elm J. Evolution of the Modified Rankin Scale and Its Use in Future Stroke Trials. Stroke. 2017;48(7):2007-12.
49. Alzayer L, Beninato M, Portney LG. The accuracy of individual Berg Balance Scale items compared with the total Berg score for classifying people with chronic stroke according to fall history. J Neurol Phys Ther. 2009;33(3):136-43.
50. Persson CU, Hansson PO, Sunnerhagen KS. Clinical tests performed in acute stroke identify the risk of falling during the first year: postural stroke study in Gothenburg (POSTGOT). J Rehabil Med. 2011;43(4):348-53.
51. Feigin VL, Nguyen G, Cercy K, Johnson CO, Alam T, Parmar PG, et al. Global, Regional, and Country-Specific Lifetime Risks of Stroke, 1990 and 2016. N Engl J Med. 2018;379(25):2429-37.
52. Feigin VL, Norrving B, Mensah GA. Global Burden of Stroke. Circ Res. 2017;120(3):439-48.
53. Collaborators GBDS. Global, regional, and national burden of stroke, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet Neurology. 2019;18(5):439-58.
54. Donnan GA, Fisher M, Macleod M, Davis SM. Stroke. Lancet. 2008;371(9624):1612-23.
55. Belagaje SR. Stroke Rehabilitation. Continuum (Minneap Minn). 2017;23(1, Cerebrovascular Disease):238-53.
56. Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. Lancet. 2015;386(9988):46-55.
57. Fure B, Holte HH, Hov L, Vist GE, Kateraas LH, Indredavik B. [Very early mobilisation in cases of acute stroke]. Tidsskr Nor Laegeforen. 2018;138(17).

58. Bernhardt J, English C, Johnson L, Cumming TB. Early mobilization after stroke: early adoption but limited evidence. Stroke. 2015;46(4):1141-6.
59. Torp CR, Vinkler S, Pedersen KD, Hansen FR, Jorgensen T, Willaing I, et al. Model of hospital-supported discharge after stroke. Stroke. 2006;37(6):1514-20.
60. Brandal A, Eriksson M, Glader EL, Wester P. Effect of early supported discharge after stroke on patient reported outcome based on the Swedish Riksstroke registry. BMC Neurol. 2019;19(1):40.
61. Fjærtoft H, Rohweder G, Indredavik B. Stroke unit care combined with early supported discharge improves 5-year outcome: a randomized controlled trial. Stroke. 2011;42(6):1707-11.
62. Langhorne P, Baylan S. Early supported discharge services for people with acute stroke. The Cochrane database of systematic reviews. 2017;7:Cd000443.
63. Stroke--1989. Recommendations on stroke prevention, diagnosis, and therapy. Report of the WHO Task Force on Stroke and other Cerebrovascular Disorders. Stroke. 1989;20(10):1407-31.
64. Hatano S. Experience from a multicentre stroke register: a preliminary report. Bull World Health Organ. 1976;54(5):541-53.
65. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Blaha MJ, et al. Heart disease and stroke statistics--2014 update: a report from the American Heart Association. Circulation. 2014;129(3):e28-e292.
66. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJB, Culebras A, et al. An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(7):2064-89.
67. Krishnamurthi RV, Feigin VL, Forouzanfar MH, Mensah GA, Connor M, Bennett DA, et al. Global and regional burden of first-ever ischaemic and haemorrhagic stroke

during 1990-2010: findings from the Global Burden of Disease Study 2010. Lancet Glob Health. 2013;1(5):e259-81.
68. Register TSS. Riksstroke, Quality of the Swedish Stroke Care 2018, A Brief Summary Of The Data For The Full Year 2018 Umeå: Riksstroke; 2018 [Available from: http://www.riksstroke.org/wp-content/uploads/2019/09/%C3%85rsrapport-2018-engelsk-sammanfattning.pdf.
69. Ghatnekar O, Persson U, Glader EL, Terent A. Cost of stroke in Sweden: an incidence estimate. Int J Technol Assess Health Care. 2004;20(3):375-80.
70. Welfare SNBoHa. National Guidlines: Swedish National Board of Health and Welfare 2019 [Available from: https://www.socialstyrelsen.se/regler-och-riktlinjer/nationella-riktlinjer/slutliga-riktlinjer/stroke/
71. Feigin VL, Roth GA, Naghavi M, Parmar P, Krishnamurthi R, Chugh S, et al. Global burden of stroke and risk factors in 188 countries, during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet Neurology. 2016;15(9):913-24.
72. Langhorne P, Bernhardt J, Kwakkel G. Stroke rehabilitation. Lancet. 2011;377(9778):1693-702.
73. Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: a systematic review. Lancet Neurol. 2009;8(8):741-54.
74. Nakayama H, Jorgensen HS, Raaschou HO, Olsen TS. Recovery of upper extremity function in stroke patients: the Copenhagen Stroke Study. Arch Phys Med Rehabil. 1994;75(4):394-8.
75. Enderby P, Pandyan A, Bowen A, Hearnden D, Ashburn A, Conroy P, et al. Accessing rehabilitation after stroke - a guessing game? Disabil Rehabil. 2017;39(7):709-13.
76. Kwakkel G, Kollen B, Lindeman E. Understanding the pattern of functional recovery after stroke: facts and theories. Restor Neurol Neurosci. 2004;22(3-5):281-99.

77. Saver JL. Time is brain--quantified. Stroke. 2006;37(1):263-6.
78. Coleman ER, Moudgal R, Lang K, Hyacinth HI, Awosika OO, Kissela BM, et al. Early Rehabilitation After Stroke: a Narrative Review. Current atherosclerosis reports. 2017;19(12):59.
79. Adams HP, Jr., Brott TG, Crowell RM, Furlan AJ, Gomez CR, Grotta J, et al. Guidelines for the management of patients with acute ischemic stroke. A statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. Stroke. 1994;25(9):1901-14.
80. Díez-Tejedor E, Fuentes B. Acute Care in Stroke: Do Stroke Units Make the Difference? Cerebrovasc Dis. 2001;11(suppl 1)(Suppl. 1):31-9.
81. Sweden SNW. National Guidlines for stroke care. 2020.
82. (WHO) WHO. Rehabilitation https://www.who.int/news-room/fact-sheets/detail/rehabilitation [
83. Organised inpatient (stroke unit) care for stroke. The Cochrane database of systematic reviews. 2013;2013(9):Cd000197.
84. World Health O. International classification of functioning, disability and health (ICF): Geneva : World Health Organization; 2001.
85. Clarke DJ. The role of multidisciplinary team care in stroke rehabilitation. Prog Neurol Psychiatry. 2013;17(4):5-8.
86. McCallin A, BA R. Factors influencing team working and strategies to facilitate successful collborative teamwork. NZ Journal of Physiotherapy. 2009;37(2):62.
87. Clarke DJ. Achieving teamwork in stroke units: the contribution of opportunistic dialogue. Journal of interprofessional care. 2010;24(3):285-97.
88. Veerbeek JM, van Wegen E, van Peppen R, van der Wees PJ, Hendriks E, Rietberg M, et al. What is the evidence for

physical therapy poststroke? A systematic review and meta-analysis. PLoS One. 2014;9(2):e87987.
89. Therapy WCfP. https://www.wcpt.org/what-is-physical-therapy [
90. Kuliński W, Bębenek O. Evaluation of the effects of physical therapy on everyday functioning in stroke patients. Wiad Lek. 2018;71(8):1497-503.
91. Hale LA, Piggot J. Exploring the content of physiotherapeutic home-based stroke rehabilitation in New Zealand. Arch Phys Med Rehabil. 2005;86(10):1933-40.
92. Ekman I. Personcentrering inom hälso- och sjukvård : från filosofi till praktik. 1. uppl. ed: Stockholm : Liber; 2014.
93. MacDonald GA, Kayes NM, Bright F. Barriers and facilitators to engagement in rehabilitation for people with stroke: a review of the literature. New Zealand Journal of Physiotherapy. 2013;41(3):112-21.
94. Mudge S, Stretton C, Kayes N. Are physiotherapists comfortable with person-centred practice? An autoethnographic insight. Disabil Rehabil. 2014;36(6):457-63.
95. Feldthusen C, Dean E, Forsblad-d'Elia H, Mannerkorpi K. Effects of Person-Centered Physical Therapy on Fatigue-Related Variables in Persons With Rheumatoid Arthritis: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2016;97(1):26-36.
96. Larsson A, Palstam A, Löfgren M, Ernberg M, Bjersing J, Bileviciute-Ljungar I, et al. Resistance exercise improves muscle strength, health status and pain intensity in fibromyalgia—a randomized controlled trial. Arthritis Res Ther. 2015;17(1):161.
97. Warlow CP, Van Gijn J, Dennis MS, Wardlaw JM, Bamford JM, Hankey GJ, et al. Stroke: practical management: John Wiley & Sons; 2011.
98. MacDonald GA, Kayes NM, Bright F. Barriers and facilitators to engagement in rehabilitation for people

with stroke: a review of the literature. New Zealand Journal of Physiotherapy. 2013;41(3).
99. SVEUS. Värdebaserad uppföljning av strokevård-analys från framtagande av nya uppföljningssystem http://analys.vgregion.se/siteassets/sveus-vardebaserad-uppfoljning-av-strokevard-2015-05.pdf2015 [
100. Naylor MD, Brooten D, Campbell R, Jacobsen BS, Mezey MD, Pauly MV, et al. Comprehensive discharge planning and home follow-up of hospitalized elders: a randomized clinical trial. JAMA. 1999;281(7):613-20.
101. Rich MW, Beckham V, Wittenberg C, Leven CL, Freedland KE, Carney RM. A multidisciplinary intervention to prevent the readmission of elderly patients with congestive heart failure. N Engl J Med. 1995;333(18):1190-5.
102. Rudd AG, Wolfe CD, Tilling K, Beech R. Randomised controlled trial to evaluate early discharge scheme for patients with stroke. BMJ. 1997;315(7115):1039-44.
103. Widen Holmqvist L, von Koch L, Kostulas V, Holm M, Widsell G, Tegler H, et al. A randomized controlled trial of rehabilitation at home after stroke in southwest Stockholm. Stroke. 1998;29(3):591-7.
104. von Koch L, Widén Holmqvist L, Kostulas V, Almazán J, de Pedro-Cuesta J. A randomized controlled trial of rehabilitation at home after stroke in Southwest Stockholm: outcome at six months. Scand J Rehabil Med. 2000;32(2):80-6.
105. von Koch L, de Pedro-Cuesta J, Kostulas V, Almazan J, Widen Holmqvist L. Randomized controlled trial of rehabilitation at home after stroke: one-year follow-up of patient outcome, resource use and cost. Cerebrovasc Dis. 2001;12(2):131-8.
106. (WHO) WHO. Towards a Common Language for Functioning, Disability and Health ICF 2002 [Available from:

https://www.who.int/classifications/icf/icfbeginnersguide.pdf?ua=1.
107. Shumway-Cook A. Motor control : translating research into clinical practice. Fifth edition. ed. Woollacott MH, editor: Philadelphia : Wolters Kluwer; 2016.
108. (WHO) WHO. ICF Browser 2011 [Available from: http://apps.who.int/classifications/icfbrowser/.
109. Nudo RJ, McNeal D. Plasticity of cerebral functions. Handb Clin Neurol. 2013;110:13-21.
110. Jørgensen HS, Nakayama H, Raaschou HO, Olsen TS. Recovery of walking function in stroke patients: the Copenhagen Stroke Study. Arch Phys Med Rehabil. 1995;76(1):27-32.
111. Kwakkel G, Kollen BJ. Predicting activities after stroke: what is clinically relevant? Int J Stroke. 2013;8(1):25-32.
112. Levin MF, Kleim JA, Wolf SL. What do motor "recovery" and "compensation" mean in patients following stroke? Neurorehabil Neural Repair. 2009;23(4):313-9.
113. Cassidy JM, Cramer SC. Spontaneous and Therapeutic-Induced Mechanisms of Functional Recovery After Stroke. Translational stroke research. 2017;8(1):33-46.
114. Pin-Barre C, Laurin J. Physical Exercise as a Diagnostic, Rehabilitation, and Preventive Tool: Influence on Neuroplasticity and Motor Recovery after Stroke. Neural Plast. 2015;2015:608581.
115. Bernhardt J, Godecke E, Johnson L, Langhorne P. Early rehabilitation after stroke. Curr Opin Neurol. 2017;30(1):48-54.
116. Stein DG, Brailowsky S, Will B. Brain repair: Oxford University Press, USA; 1997.
117. Teasell RW, Foley NC, Salter KL, Jutai JW. A blueprint for transforming stroke rehabilitation care in Canada: the case for change. Arch Phys Med Rehabil. 2008;89(3):575-8.
118. Hubbard IJ, Parsons MW, Neilson C, Carey LM. Task-specific training: evidence for and translation to clinical practice. Occup Ther Int. 2009;16(3-4):175-89.

119. Chen X, Liu F, Yan Z, Cheng S, Liu X, Li H, et al. Therapeutic effects of sensory input training on motor function rehabilitation after stroke. Medicine (Baltimore). 2018;97(48):e13387.
120. Cramer SC, Sur M, Dobkin BH, O'Brien C, Sanger TD, Trojanowski JQ, et al. Harnessing neuroplasticity for clinical applications. Brain. 2011;134(Pt 6):1591-609.
121. French B, Thomas LH, Coupe J, McMahon NE, Connell L, Harrison J, et al. Repetitive task training for improving functional ability after stroke. The Cochrane database of systematic reviews. 2016;11(11):Cd006073.
122. Bell F. Principles of mechanics and biomechanics. Cheltenham: Stanley Thornes; 1998.
123. NCBI. MeSH [Available from: https://www.ncbi.nlm.nih.gov/mesh/?term=postural+balance.
124. Lord SR, Menz HB, Sherrington C. Home environment risk factors for falls in older people and the efficacy of home modifications. Age Ageing. 2006;35 Suppl 2:ii55-ii9.
125. Xu T, Clemson L, O'Loughlin K, Lannin NA, Dean C, Koh G. Risk Factors for Falls in Community Stroke Survivors: A Systematic Review and Meta-Analysis. Arch Phys Med Rehabil. 2018;99(3):563-73.e5.
126. Persson CU, Kjellberg S, Lernfelt B, Westerlind E, Cruce M, Hansson PO. Risk of falling in a stroke unit after acute stroke: The Fall Study of Gothenburg (FallsGOT). Clin Rehabil. 2018;32(3):398-409.
127. Veerbeek JM, Van Wegen EE, Harmeling-Van der Wel BC, Kwakkel G. Is accurate prediction of gait in nonambulatory stroke patients possible within 72 hours poststroke? The EPOS study. Neurorehabil Neural Repair. 2011;25(3):268-74.
128. Tsang YL, Mak MK. Sit-and-reach test can predict mobility of patients recovering from acute stroke. Arch Phys Med Rehabil. 2004;85(1):94-8.

129. Smith MT, Baer GD. Achievement of simple mobility milestones after stroke. Arch Phys Med Rehabil. 1999;80(4):442-7.
130. Geurts AC, de Haart M, van Nes IJ, Duysens J. A review of standing balance recovery from stroke. Gait Posture. 2005;22(3):267-81.
131. Beyaert C, Vasa R, Frykberg GE. Gait post-stroke: Pathophysiology and rehabilitation strategies. Neurophysiol Clin. 2015;45(4-5):335-55.
132. Lord SE, McPherson K, McNaughton HK, Rochester L, Weatherall M. Community ambulation after stroke: how important and obtainable is it and what measures appear predictive? Arch Phys Med Rehabil. 2004;85(2):234-9.
133. Fulk GD, He Y, Boyne P, Dunning K. Predicting Home and Community Walking Activity Poststroke. Stroke. 2017;48(2):406-11.
134. Lee KB, Lim SH, Ko EH, Kim YS, Lee KS, Hwang BY. Factors related to community ambulation in patients with chronic stroke. Top Stroke Rehabil. 2015;22(1):63-71.
135. Schmid AA, Van Puymbroeck M, Altenburger PA, Dierks TA, Miller KK, Damush TM, et al. Balance and balance self-efficacy are associated with activity and participation after stroke: a cross-sectional study in people with chronic stroke. Arch Phys Med Rehabil. 2012;93(6):1101-7.
136. van der Kooi E, Schiemanck SK, Nollet F, Kwakkel G, Meijer JW, van de Port I. Falls Are Associated With Lower Self-Reported Functional Status in Patients After Stroke. Arch Phys Med Rehabil. 2017;98(12):2393-8.
137. Tyson SF, Hanley M, Chillala J, Selley AB, Tallis RC. The relationship between balance, disability, and recovery after stroke: predictive validity of the Brunel Balance Assessment. Neurorehabil Neural Repair. 2007;21(4):341-6.
138. Dobkin BH, Nadeau SE, Behrman AL, Wu SS, Rose DK, Bowden M, et al. Prediction of responders for outcome

measures of locomotor Experience Applied Post Stroke trial. J Rehabil Res Dev. 2014;51(1):39-50.
139. Arienti C, Lazzarini SG, Pollock A, Negrini S. Rehabilitation interventions for improving balance following stroke: An overview of systematic reviews. PLoS One. 2019;14(7):e0219781.
140. Pollock A, Baer G, Pomeroy V, Langhorne P. Physiotherapy treatment approaches for the recovery of postural control and lower limb function following stroke. The Cochrane database of systematic reviews. 2007(1):Cd001920.
141. Kollen BJ, Lennon S, Lyons B, Wheatley-Smith L, Scheper M, Buurke JH, et al. The effectiveness of the Bobath concept in stroke rehabilitation: what is the evidence? Stroke. 2009;40(4):e89-97.
142. Bandura A. Self-efficacy : the exercise of control. Basingstoke: Basingstoke : W. H. Freeman; 1997.
143. Bandura A. Self-efficacy mechanism in human agency. Am Psychol. 1982;37(2):122.
144. Salbach NM, Mayo NE, Robichaud-Ekstrand S, Hanley JA, Richards CL, Wood-Dauphinee S. Balance self-efficacy and its relevance to physical function and perceived health status after stroke. Arch Phys Med Rehabil. 2006;87(3):364-70.
145. Jones F, Mandy A, Partridge C. Reasons for recovery after stroke: a perspective based on personal experience. Disabil Rehabil. 2008;30(7):507-16.
146. Engberg W, Lind A, Linder A, Nilsson L, Sernert N. Balance-related efficacy compared with balance function in patients with acute stroke. Physiother Theory Pract. 2008;24(2):105-11.
147. Ng SS. Contribution of subjective balance confidence on functional mobility in subjects with chronic stroke. Disabil Rehabil. 2011;33(23-24):2291-8.
148. Rosen E, Sunnerhagen KS, Kreuter M. Fear of falling, balance, and gait velocity in patients with stroke. Physiother Theory Pract. 2005;21(2):113-20.

149. Hellstrom K, Lindmark B, Wahlberg B, Fugl-Meyer AR. Self-efficacy in relation to impairments and activities of daily living disability in elderly patients with stroke: a prospective investigation. J Rehabil Med. 2003;35(5):202-7.
150. Jones F, Riazi A. Self-efficacy and self-management after stroke: a systematic review. Disabil Rehabil. 2011;33(10):797-810.
151. Salbach NM, Mayo NE, Robichaud-Ekstrand S, Hanley JA, Richards CL, Wood-Dauphinee S. The effect of a task-oriented walking intervention on improving balance self-efficacy poststroke: a randomized, controlled trial. J Am Geriatr Soc. 2005;53(4):576-82.
152. Robinson-Smith G, Johnston MV, Allen J. Self-care self-efficacy, quality of life, and depression after stroke. Arch Phys Med Rehabil. 2000;81(4):460-4.
153. Kupfer DJ. Anxiety and DSM-5. Dialogues Clin Neurosci. 2015;17(3):245-6.
154. Lépine JP. The epidemiology of anxiety disorders: prevalence and societal costs. J Clin Psychiatry. 2002;63 Suppl 14:4-8.
155. Shorter E. A historical dictionary of psychiatry: Oxford University Press; 2005.
156. Edition F. Diagnostic and statistical manual of mental disorders. Am Psychiatric Assoc. 2013.
157. Bruce SE, Yonkers KA, Otto MW, Eisen JL, Weisberg RB, Pagano M, et al. Influence of psychiatric comorbidity on recovery and recurrence in generalized anxiety disorder, social phobia, and panic disorder: a 12-year prospective study. Am J Psychiatry. 2005;162(6):1179-87.
158. Hendriks SM, Spijker J, Licht CM, Beekman AT, Penninx BW. Two-year course of anxiety disorders: different across disorders or dimensions? Acta Psychiatr Scand. 2013;128(3):212-21.
159. Yonkers KA, Bruce SE, Dyck IR, Keller MB. Chronicity, relapse, and illness--course of panic disorder, social phobia, and generalized anxiety disorder: findings in

men and women from 8 years of follow-up. Depress Anxiety. 2003;17(3):173-9.
160. Campbell Burton CA, Murray J, Holmes J, Astin F, Greenwood D, Knapp P. Frequency of anxiety after stroke: A systematic review and meta-analysis of observational studies. Int J Stroke. 2013;8(7):545-59.
161. Chun HY, Whiteley WN, Dennis MS, Mead GE, Carson AJ. Anxiety After Stroke: The Importance of Subtyping. Stroke. 2018;49(3):556-64.
162. Ayerbe L, Ayis S, Wolfe CD, Rudd AG. Natural history, predictors and outcomes of depression after stroke: systematic review and meta-analysis. Br J Psychiatry. 2013;202(1):14-21.
163. Ferro JM, Caeiro L, Santos C. Poststroke emotional and behavior impairment: a narrative review. Cerebrovasc Dis. 2009;27(Suppl. 1):197-203.
164. Chemerinski E, Levine SR. Neuropsychiatric disorders following vascular brain injury. The Mount Sinai journal of medicine, New York. 2006;73(7):1006-14.
165. Aylett E, Small N, Bower P. Exercise in the treatment of clinical anxiety in general practice - a systematic review and meta-analysis. BMC Health Serv Res. 2018;18(1):559.
166. Aidar FJ, Jacó de Oliveira R, Gama de Matos D, Chilibeck PD, de Souza RF, Carneiro AL, et al. A randomized trial of the effects of an aquatic exercise program on depression, anxiety levels, and functional capacity of people who suffered an ischemic stroke. J Sports Med Phys Fitness. 2018;58(7-8):1171-7.
167. Guszkowska M. [Effects of exercise on anxiety, depression and mood]. Psychiatr Pol. 2004;38(4):611-20.
168. Swartzman LC GM, Armstrong TL. Psychosocial considerations in adjustment to stroke. Phys Med Rehabil. 2011:519-41.
169. Ayerbe L, Ayis SA, Crichton S, Wolfe CD, Rudd AG. Natural history, predictors and associated outcomes of anxiety

up to 10 years after stroke: the South London Stroke Register. Age Ageing. 2014;43(4):542-7.
170. Chun HY, Whiteley WN, Carson A, Dennis M, Mead GE. Anxiety after stroke: time for an intervention. Int J Stroke. 2015;10(5):655-6.
171. Knapp P, Campbell Burton CA, Holmes J, Murray J, Gillespie D, Lightbody CE, et al. Interventions for treating anxiety after stroke. The Cochrane database of systematic reviews. 2017;5(5):Cd008860.
172. Coster WJ. Making the best match: selecting outcome measures for clinical trials and outcome studies. The American journal of occupational therapy : official publication of the American Occupational Therapy Association. 2013;67(2):162-70.
173. World Health O. Towards a Common Language for Functioning, Disability and Health (ICF). https://www.who.int/classifications/icf/icfbeginnersguide.pdf?ua=1: Geneva: World Health Organization:ICF; 2002.
174. Salter K, Jutai JW, Teasell R, Foley NC, Bitensky J. Issues for selection of outcome measures in stroke rehabilitation: ICF Body Functions. Disabil Rehabil. 2005;27(4):191-207.
175. Langhorne P, Holmqvist LW. Early supported discharge after stroke. J Rehabil Med. 2007;39(2):103-8.
176. Muehlbauer T, Gollhofer A, Granacher U. Associations Between Measures of Balance and Lower-Extremity Muscle Strength/Power in Healthy Individuals Across the Lifespan: A Systematic Review and Meta-Analysis. Sports Med. 2015;45(12):1671-92.
177. Kostka J, Niwald M, Guligowska A, Kostka T, Miller E. Muscle power, contraction velocity and functional performance after stroke. Brain and behavior. 2019;9(4):e01243.
178. Law M, Baptiste S, McColl M, Opzoomer A, Polatajko H, Pollock N. The Canadian occupational performance

measure: an outcome measure for occupational therapy. Can J Occup Ther. 1990;57(2):82-7.
179. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;6(7):e1000097.
180. (SBU) SBfMoSU. Checklist for assessment of study quality - observational studies https://www.sbu.se/sv/var-metod/: Statens Beredning för Medicinsk och Social Utvärdering (SBU); 2020 [
181. Sunnerhagen KS, Danielsson A, Rafsten L, Bjorkdahl A, Axelsson AB, Nordin A, et al. Gothenburg very early supported discharge study (GOTVED) NCT01622205: a block randomized trial with superiority design of very early supported discharge for patients with stroke. BMC Neurol. 2013;13:66.
182. Fure B, Wyller TB, Engedal K, Thommessen B. Emotional symptoms in acute ischemic stroke. Int J Geriatr Psychiatry. 2006;21(4):382-7.
183. Sagen U, Vik TG, Moum T, Morland T, Finset A, Dammen T. Screening for anxiety and depression after stroke: comparison of the hospital anxiety and depression scale and the Montgomery and Asberg depression rating scale. J Psychosom Res. 2009;67(4):325-32.
184. Trials CtRo. http://www.consort-statement.org/: CONSORT transparent Reporting of Trials 2010 [
185. Young FB, Weir CJ, Lees KR. Comparison of the National Institutes of Health Stroke Scale with disability outcome measures in acute stroke trials. Stroke. 2005;36(10):2187-92.
186. Rankin J. Cerebral vascular accidents in patients over the age of 60. II. Prognosis. Scott Med J. 1957;2(5):200-15.
187. Bonita R, Beaglehole R. Recovery of motor function after stroke. Stroke. 1988;19(12):1497-500.
188. Mahoney FI, Barthel DW. Functional evaluation: The Barthel Index: A simple index of independence useful in

scoring improvement in the rehabilitation of the chronically ill. Md State Med J. 1965;14:61-5.
189. Gosman-Hedström G, Svensson E. Parallel reliability of the Functional Independence Measure and the Barthel ADL index. Disabil Rehabil. 2000;22(16):702-15.
190. Richards SH, Peters TJ, Coast J, Gunnell DJ, Darlow M-A, Pounsford J. Inter-rater reliability of the Barthel ADL Index: how does a researcher compare to a nurse? Clin Rehabil. 2000;14(1):72-8.
191. Prasad K, Kumar A, Misra S, Yadav AK, Johri S, Sarkar RS, et al. Reliability and validity of telephonic Barthel Index: an experience from multi-centric randomized control study. Acta Neurol Belg. 2018;118(1):53-9.
192. Berg K, Wood-Dauphine S, Williams J, Gayton D. Measuring balance in the elderly: preliminary development of an instrument. Physiother Can. 1989;41(6):304-11.
193. Wood-Dauphinee S, Berg K, Bravo G, Williams J. The Balance Scale: responsiveness to clinically meaningful changes. Canadian journal of rehabilitation. 1996;10:35-50.
194. Mathias S, Nayak US, Isaacs B. Balance in elderly patients: the "get-up and go" test. Arch Phys Med Rehabil. 1986;67(6):387-9.
195. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142-8.
196. Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. J Gerontol. 1990;45(6):P239-43.
197. Lenhard WL. Hypothesis Tests for Comparing Correlations www.psychometrica.de/correlation.html: Psychometrica. ; 2014 [
198. Domholdt E. Physical therapy research : principles and applications. 2. ed. ed. Philadelphia: Philadelphia : Saunders; 2000.

199. Cohen J. Statistical power analysis for the behavioral sciences. Hillsdale: L. Erlbaum Associates; 1988.
200. Pallant J. SPSS survival manual : a step by step guide to data analysis using IBM SPSS. 5. ed. ed. Maidenhead: Maidenhead : McGraw-Hill; 2013.
201. Kim JT, Park MS, Yoon GJ, Jung HJ, Choi KH, Nam TS, et al. White matter hyperintensity as a factor associated with delayed mood disorders in patients with acute ischemic stroke. Eur Neurol. 2011;66(6):343-9.
202. Lees R, Stott DJ, Quinn TJ, Broomfield NM. Feasibility and diagnostic accuracy of early mood screening to diagnose persisting clinical depression/anxiety disorder after stroke. Cerebrovasc Dis. 2014;37(5):323-9.
203. Vuletic V, Lezaic Z, Morovic S. Post-stroke fatigue. Acta Clin Croat. 2011;50(3):344-.
204. Kim WH, Jung HY, Choi HY, Park CH, Kim ES, Lee SJ, et al. The associations between insomnia and health-related quality of life in rehabilitation units at 1 month after stroke. J Psychosom Res. 2017;96:10-4.
205. Kootker JA, van Mierlo ML, Hendriks JC, Sparidans J, Rasquin SM, de Kort PL, et al. Risk Factors for Symptoms of Depression and Anxiety One Year Poststroke: A Longitudinal Study. Arch Phys Med Rehabil. 2016;97(6).
206. Mihalov J, Mikula P, Budis J, Valkovic P. Frontal Cortical Atrophy as a Predictor of Poststroke Apathy. J Geriatr Psychiatry Neurol. 2016;29(4):171-6.
207. Mutai H, Furukawa T, Houri A, Suzuki A, Hanihara T. Factors associated with multidimensional aspect of post-stroke fatigue in acute stroke period. Asian J Psychiatr. 2017;26:1-5.
208. Nijsse B, van Heugten CM, van Mierlo ML, Post MW, de Kort PL, Visser-Meily JM. Psychological factors are associated with subjective cognitive complaints 2 months post-stroke. Neuropsychol Rehabil. 2017;27(1):99-115.
209. Ojagbemi A, Owolabi M, Akinyemi R, Arulogun O, Akinyemi J, Akpa O, et al. Prevalence and predictors of

anxiety in an African sample of recent stroke survivors. Acta Neurol Scand. 2017;17:17.
210. Paker N, Bugdayci D, Celik B, Sabirli F, Bardak AN. Functional recovery in stroke patients with and without diabetes mellitus. Turkiye Fiziksel Tip ve Rehabilitasyon Dernegi. 2016;62(3):201-5.
211. Pedroso VSP, Vieira ELM, Brunoni AR, Lauterbach EC, Teixeira AL. Psychopathological evaluation and use of the hospital anxiety and depression scale in a sample of Brazilian patients with post-stroke depression. Rev Psiquiatr Clín. 2016;43(6):147-50.
212. Vuletic V, sapina L, Lozert M, Lezaic Z, Morovic S. Anxiety and depressive symptoms in acute ischemic stroke. Acta Clin Croat. 2012;51(2):243-6.
213. Donnellan C, Al Banna M, Redha N, Al Sharoqi I, Al-Jishi A, Bakhiet M, et al. Association between Metacognition and Mood Symptoms Poststroke. J Geriatr Psychiatry Neurol. 2016;29(4):212-20.
214. Oosterveer DM, Mishre RR, van Oort A, Bodde K, Aerden LA. Depression is an independent determinant of life satisfaction early after stroke. J Rehabil Med. 2017;49(3):223-7.
215. Ponchel A, Labreuche J, Bombois S, Delmaire C, Bordet R, Henon H. Influence of medication on fatigue six months after stroke. Stroke Res Treat. 2016;2016 (no pagination)(2410921).
216. van der Kemp J, Kruithof WJ, Nijboer TCW, van Bennekom CAM, van Heugten C, Visser-Meily JMA. Return to work after mild-to-moderate stroke: work satisfaction and predictive factors. Neuropsychol Rehabil. 2017:1-16.
217. Wu C, Ren W, Cheng J, Zhu B, Jin Q, Wang L, et al. Association between serum levels of Vitamin D and the risk of post-stroke anxiety. Medicine. 2016;95(18):e3566.
218. Yu S, Arima H, Bertmar C, Hirakawa Y, Priglinger M, Evans K, et al. Depression but not anxiety predicts

recurrent cerebrovascular events. Acta Neurol Scand. 2016;134(1):29-34.
219. Yuan H, Zhang N, Wang C, Luo BY, Shi Y, Li J, et al. Factors of Hamilton Depression Rating Scale (17 items) at 2 weeks correlated with poor outcome at 1 year in patients with ischemic stroke. Neurol Sci. 2014;35(2):171-7.
220. de Weerd L, Rutgers WA, Groenier KH, van der Meer K. Perceived wellbeing of patients one year post stroke in general practice--recommendations for quality aftercare. BMC Neurol. 2011;11:42.
221. Tang WK, Chen Y, Lu J, Liang H, Chu WC, Tong Mok VC, et al. Frontal infarcts and anxiety in stroke. Stroke. 2012;43(5):(3p).
222. Verbraak ME, Hoeksma AF, Lindeboom R, Kwa VI, Verbraak ME, Hoeksma AF, et al. Subtle problems in activities of daily living after a transient ischemic attack or an apparently fully recovered non-disabling stroke. J Stroke Cerebrovasc Dis. 2012;21(2).
223. White JH, Attia J, Sturm J, Carter G, Magin P. Predictors of depression and anxiety in community dwelling stroke survivors: A cohort study. Disabil Rehabil. 2014;36(23):1975-82.
224. Tang WK, Lau CG, Mok V, Ungvari GS, Wong K-S. Impact of Anxiety on Health-Related Quality of Life After Stroke: A Cross-Sectional Study. Arch Phys Med Rehabil. 2013;94(12).
225. Castellanos-Pinedo F, Hernandez-Perez JM, Zurdo M, Rodriguez-Funez B, Hernandez-Bayo JM, Garcia-Fernandez C, et al. Influence of Premorbid psychopathology and lesion location on affective and behavioral disorders after ischemic stroke. J Neuropsychiatry Clin Neurosci. 2011;23(3):340-7.
226. Ku HL, Chen CH, Yang YT, Hu CJ, Wu D, Chen CC, et al. Association between cerebral lesions and emotional changes in acute ischemic stroke patients. J Nerv Ment Dis. 2013;201(5):400-6.

227. Kuptniratsaikul V, Kovindha A, Suethanapornkul S, Manimmanakorn N, Archongka Y. Long-term morbidities in stroke survivors: a prospective multicenter study of Thai stroke rehabilitation registry. BMC Geriatr. 2013;13:33.
228. Kutlubaev MA, Shenkin SD, Farrall AJ, Duncan FH, Lewis SJ, Greig CA, et al. CT and Clinical Predictors of Fatigue at One Month after Stroke. Cerebrovascular Diseases Extra. 2013;3(1):26-34.
229. Morris JH, van Wijck F, Joice S, Donaghy M. Predicting health related quality of life 6 months after stroke: the role of anxiety and upper limb dysfunction. Disabil Rehabil. 2013;35(4):291-9.
230. Arba F, Ali M, Quinn TJ, Hankey GJ, Lees KR, Inzitari D, et al. Lacunar Infarcts, Depression, and Anxiety Symptoms One Year after Stroke. J Stroke Cerebrovasc Dis. 2016;25(4):831-4.
231. Kellett N, Drummond A, Palmer T, Munshi S, Lincoln N. Impact of transient ischaemic attack and minor stroke on daily life. Int J Ther Rehabil. 2014;21(7):318-23.
232. de Weerd L, Luijckx GJ, Groenier KH, van der Meer K. Quality of life of elderly ischaemic stroke patients one year after thrombolytic therapy. A comparison between patients with and without thrombolytic therapy. BMC Neurol. 2012;12:61.
233. Lincoln NB, Brinkmann N, Cunningham S, Dejaeger E, De Weerdt W, Jenni W, et al. Anxiety and depression after stroke: a 5 year follow-up. Disabil Rehabil. 2013;35(2):140-5.
234. Babulal GM, Huskey TN, Roe CM, Goette SA, Connor LT. Cognitive impairments and mood disruptions negatively impact instrumental activities of daily living performance in the first three months after a first stroke. Top Stroke Rehabil. 2015;22(2):144-51.
235. Kneebone, II, Fife-Schaw C, Lincoln NB, Harder H. A study of the validity and the reliability of the Geriatric Anxiety

Inventory in screening for anxiety after stroke in older inpatients. Clin Rehabil. 2016;30(12):1220-8.
236. Wolfe CD, Crichton SL, Heuschmann PU, McKevitt CJ, Toschke AM, Grieve AP, et al. Estimates of outcomes up to ten years after stroke: analysis from the prospective South London Stroke Register. PLoS Med. 2011;8(5):e1001033.
237. Forster A, Young J. Incidence and consequences of falls due to stroke: a systematic inquiry. BMJ. 1995;311(6997):83-6.
238. Berg KO, Maki BE, Williams JI, Holliday PJ, Wood-Dauphinee SL. Clinical and laboratory measures of postural balance in an elderly population. Arch Phys Med Rehabil. 1992;73(11):1073-80.
239. Hof AL. The equations of motion for a standing human reveal three mechanisms for balance. J Biomech. 2007;40(2):451-7.
240. Tang PF, Woollacott MH. Inefficient postural responses to unexpected slips during walking in older adults. J Gerontol A Biol Sci Med Sci. 1998;53(6):M471-80.
241. Pijnappels M, Kingma I, Wezenberg D, Reurink G, van Dieën JH. Armed against falls: the contribution of arm movements to balance recovery after tripping. Exp Brain Res. 2010;201(4):689-99.
242. Oguz S, Demirbuken I, Kavlak B, Acar G, Yurdalan SU, Polat MG. The relationship between objective balance, perceived sense of balance, and fear of falling in stroke patients. Top Stroke Rehabil. 2017;24(7):527-32.
243. Raju RS, Kaur P, Pandian JD. Psychosocial problems, quality of life, and caregiver burden among stroke caregivers in India. Int J Stroke. 2012;7(1):100-1.
244. Shimoda K, Robinson RG. Effects of anxiety disorder on impairment and recovery from stroke. J Neuropsychiatry Clin Neurosci. 1998;10(1):34-40.
245. Balaban CD. Neural substrates linking balance control and anxiety. Physiol Behav. 2002;77(4):469-75.

246. Balaban CD, Thayer JF. Neurological bases for balance-anxiety links. J Anxiety Disord. 2001;15(1-2):53-79.
247. Feldman R, Schreiber S, Pick CG, Been E. Gait, balance, mobility and muscle strength in people with anxiety compared to healthy individuals. Human movement science. 2019;67:102513.
248. Fearon P, Langhorne P. Services for reducing duration of hospital care for acute stroke patients. The Cochrane database of systematic reviews. 2012(9):Cd000443.
249. The Swedish Stroke Register. The Swedish strokeregister anuual report 2019 2019 [Available from: http://www.riksstroke.org/wp-content/uploads/2019/09/Riksstroke_A%CC%8Arsrapport-2018_slutversion.pdf.
250. Santana S, Rente J, Neves C, Redondo P, Szczygiel N, Larsen T, et al. Early home-supported discharge for patients with stroke in Portugal: a randomised controlled trial. Clin Rehabil. 2017;31(2):197-206.
251. Kegelmeyer DA, Kloos AD, Siles AB. Selecting measures for balance and mobility to improve assessment and treatment of individuals after stroke. Top Stroke Rehabil. 2014;21(4):303-15.
252. Therapy AoNP. StrokEDGE II Documents https://www.neuropt.org/practice-resources/neurology-section-outcome-measures-recommendations/stroke: The American Physical Therapy Association (APTA) Neurology Section; 2018 [Available from: https://www.neuropt.org/practice-resources/neurology-section-outcome-measures-recommendations/stroke.
253. Bernhardt J, Hayward KS, Kwakkel G, Ward NS, Wolf SL, Borschmann K, et al. Agreed Definitions and a Shared Vision for New Standards in Stroke Recovery Research: The Stroke Recovery and Rehabilitation Roundtable Taskforce. Neurorehabil Neural Repair. 2017;31(9):793-9.

254. Goh HT, Nadarajah M, Hamzah NB, Varadan P, Tan MP. Falls and Fear of Falling After Stroke: A Case-Control Study. PM & R : the journal of injury, function, and rehabilitation. 2016;8(12):1173-80.
255. Denissen S, Staring W, Kunkel D, Pickering RM, Lennon S, Geurts AC, et al. Interventions for preventing falls in people after stroke. The Cochrane database of systematic reviews. 2019;10(10):Cd008728.
256. Boutron I, Moher D, Altman DG, Schulz KF, Ravaud P. Extending the CONSORT statement to randomized trials of nonpharmacologic treatment: explanation and elaboration. Ann Intern Med. 2008;148(4):295-309.
257. Vandenbroucke JP, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. Ann Intern Med. 2007;147(8):W163-94.
258. Herrmann C. International experiences with the Hospital Anxiety and Depression Scale--a review of validation data and clinical results. J Psychosom Res. 1997;42(1):17-41.
259. Chan DY, Chan CC, Au DK. Motor relearning programme for stroke patients: a randomized controlled trial. Clin Rehabil. 2006;20(3):191-200.
260. Saso A, Moe-Nilssen R, Gunnes M, Askim T. Responsiveness of the Berg Balance Scale in patients early after stroke. Physiother Theory Pract. 2016;32(4):251-61.
261. Blum L, Korner-Bitensky N. Usefulness of the Berg Balance Scale in stroke rehabilitation: a systematic review. Phys Ther. 2008;88(5):559-66.
262. Mansfield A, Inness EL, Wong JS, Fraser JE, McIlroy WE. Is Impaired Control of Reactive Stepping Related to Falls During Inpatient Stroke Rehabilitation? Neurorehabil Neural Repair. 2013;27(6):526-33.
263. Gupta SK. Intention-to-treat concept: A review. Perspect Clin Res. 2011;2(3):109-12.

264. Streiner D, Geddes J. Intention to treat analysis in clinical trials when there are missing data. Evidence-based mental health. 2001;4(3):70-1.
265. Moher D, Schulz KF, Altman D. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomized trials. JAMA. 2001;285(15):1987-91.
266. Ruiz-Canela M, Martínez-González MA, de Irala-Estévez J. Intention to treat analysis is related to methodological quality. BMJ. 2000;320(7240):1007-8.