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A STUDY TO DETERMINE WHICH MOTOR DEFICIT HAS THE STRONGEST ASSOCIATION WITH AN IMPROVEMENT IN FUNCTIONING IN ACTIVITIES OF DAILY LIVING IN STROKE PATIENTS

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304738

A RESEARCH REPORT SUBMITTED TO THE FACULTY OF HEALTH SCIENCES, SCHOOL OF THERAPEUTIC SCIENCES, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN OCCUPATIONAL THERAPY

JOHANNESBURG, APRIL 2015

DECLARATION

I, Caitlin Helen Muller, declare that this research report is my own work. It is being submitted for the degree of Master of Science in occupational therapy in the University of Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination at this or any other university.

_____

Caitlin H. Muller

_____ day of _____, 2015

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ABSTRACT

Keywords: Occupational Therapy, stroke rehabilitation, balance, upper limb movement, gait, functioning in activities of daily living.

Studies to determine which underlying motor deficits have the greatest impact on improvement in functioning within activities of daily living in stroke patients are non-existent with regard to the South African context. Effective stroke rehabilitation is essential due to rapid discharge rates and therefore it is important to focus on the motor deficit that will contribute most significantly to function. Patients from the ages of 35 to 85, who had suffered a stroke and were admitted to a private, neurological, rehabilitation facility in Johannesburg gave consent to participate in three outcome measures determining adequacy of balance (Berg Balance Scale), upper limb movement (Frenchay Arm Test) and gait (Timed Up-and-go Test) as well as one outcome measure determining level of functioning within activities of daily living (Functional Independence Measure). Results from the pre- and post-tests indicated that all participants improved during the time of rehabilitation. The findings of the outcome measures for each of the three different motor components were correlated with functioning in ADLs for each patient. The results showed that balance had the strongest correlation with functioning in ADLs, followed by upper limb movement, and then gait. The use of the FIM as a functional measure appeared to have some limitations and is not standardised to be used within the South African context.

LIST OF ABBREVIATIONS

ADL: Activity of daily living
BBS: Berg Balance Scale
FIM: Functional Independence Measure
INDS: Integrated National Disability Strategy
LB: Lower body
LL: Lower limb
NRP: National Rehabilitation Policy
OT: Occupational therapist, occupational therapy
PMB: Prescribed minimum benefit
RAF: Road Accident Fund
TUG: Timed up-and-go test
UB: Upper body
UL: Upper limb
WCA: Workers Compensation Assistance

DEFINITIONS

Motor deficits (for the purpose of this study): were explored under the components of balance, upper limb movement and gait.

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CHAPTER 1: INTRODUCTION

1.1 Introduction to the study

Hemiplegic patients, either as a result of traumatic or non-traumatic injury to the brain, form the largest part of the case-load of occupational therapists working in the field of adult neurological rehabilitation (1). This is because brain injury has the capacity to be disabling, often leaving survivors dependent in their daily activities, unable to integrate back into the community and unable to lead meaningful and independent lives (2). Additionally, the rate of stroke, which is a non-traumatic cause of hemiplegia in rural South Africa, has increased two-fold within the past forty years (3). More often than not, stroke survivors require intensive rehabilitation as soon as possible post-stroke in order to address the functional deficits they experience as well as to prevent learned non-use and dependence which arises when deficits are not dealt with immediately (4). The Bill of Rights in the Constitution of the Republic of South Africa states that "Everyone has the right to have access to health care services" (5), but South Africa has restricted effectiveness in the provision of health care and rehabilitation services. This is because patients are being discharged prior to achieving full functional independence in activities of daily living (ADLs) (5). This is contributing to the high rate of disability and morbidity in South Africa (3). Thus, it is essential to recognise that time is of the essence within rehabilitation facilities and it is of utmost importance for therapists to understand and treat the most important underlying deficits first in order to reduce the rate of disability country-wide. Basic survival and well-being are a result of being able to perform these activities independently (6), and this is the essence of the occupational therapy profession.

Early discharge occurs in both the public and private healthcare sectors. In the public sector, patients who are deemed less sick such as stroke patients are discharged from hospital to free up space for patients in greater need of acute hospital services, usually as a result of HIV-related infections (7). This is because patients who are considered medically stable are seen as safe for discharge, prior to receiving any rehabilitation post medical incident. Unfortunately, in the South African setting, the acute hospital is often the most accessible healthcare facility, upon which much of the population relies, to receive any rehabilitation at all. However, due to early discharge, this opportunity for rehabilitation is limited. Recent research has shown that without appropriate rehabilitation following stroke, deficits in the trunk and limbs can be further exacerbated through the development

of learned non-use (8). Learned non-use is a principle of neuroplasticity that occurs where particular brain functions are not stimulated, leading to decline in those functions (4). Thus, a delay in rehabilitation may contribute to disability that could potentially have been avoided through early and effective rehabilitation (3). Additionally, in the South African context, healthcare professionals are mandated to prioritise the management of patients with medical emergencies and this contributes to the shortage of healthcare professionals dedicated to working in rehabilitation settings (7). This further complicates the already resource strapped functioning of neurological rehabilitation (7). In the private sector, the lack of services to patients requiring longer-term non-emergency care is due to time-restrictions laid down by medical aid funds (9). Funds are often depleted before rehabilitation is complete due to the high cost of the initial acute medical care (9). Ultimately, this means that patients are being discharged before they are functional and able to perform ADLs independently (10). The early discharge of patients in neurological rehabilitation highlights the importance of occupational therapists understanding the underlying deficits that may arise from hemiplegia following stroke. This is because there is a limited time frame available to provide rehabilitation that ensures that patients improve in those components that contribute the most to successful completion of ADLs. Little is known as to which motor component has the greatest effect on improvement of functioning in ADLs, and therefore research into this topic is needed to aid in steering the profession into a more effective and efficient direction in neurological rehabilitation given the institutionally imposed time restrictions in patient care highlighted above.

Research has identified the link between motor, cognitive and perceptual disorders with improvement in functioning in ADLs after stroke (11). Motor, cognitive and perceptual deficits are all possible consequences of stroke however; motor components were shown to be the greatest contributor to participation in ADLs and the ability to complete tasks (11). This study will, thus, focus on the impact of particular motor deficits on functioning in ADLs, although it is necessary to note that stroke patients rarely present with only motor impairments. This emphasises the need for exclusion criteria that eliminates those participants whose cognitive or perceptual impairments affect their scores in outcome measures assessing motor components. In cases of physical dependence after stroke, the burden for caregivers is high (12). The period after stroke is stressful, emotional and tiring for both the patient and the family, additionally so if the patient requires increased physical assistance for ADL participation and mobility (12). Therefore, improvement in physical deficits following stroke will ensure an improvement in functioning in ADLs and a decreased burden of care.

Knowledge of the motor deficit that contributes most to improvement in functioning within ADLs would enable occupational therapists to focus their rehabilitation on the most important factor/s needed to restore that deficit. A focus on the most important aspect of rehabilitation, in conjunction with the principle that every patient requires tailor-made therapy, would enable occupational therapists to be more effective in therapy. This would contribute toward improving functioning in ADLs of stroke patients as well as their re-integration into the community and ultimately reducing the rate of disability and morbidity of stroke survivors in South Africa.

1.2 Problem statement

Previous studies are inconclusive regarding which underlying motor deficits have the greatest impact on improvement in functioning within ADLs. Without the knowledge of which deficits to treat first, and due to limited time as a result of inadequate funding in neurological rehabilitation units in South Africa, occupational therapists will be less effective in their rehabilitation of stroke patients.

1.3 Purpose

The information gained from this study regarding the effects of specific motor deficits on functioning in ADLs in stroke patients, can be used to contribute to effective implementation and prioritisation of intervention. When considering the particular challenges that patients and health professionals face in South Africa, such as early discharge rates as a result of lack of funding as well as a shortage of rehabilitation staff, more successful intervention will be ensured through better focused rehabilitation.

1.4 Research question

“Which underlying motor deficit has the strongest association with an improvement in functioning in ADLs in stroke patients?”

1.5 Aim

To establish which underlying motor deficit has the strongest association with an improvement in functioning in ADLs in stroke patients.

1.6 Objectives

1.6.1 To determine the strength of association between balance and functioning in ADLs.

1.6.2 To determine the strength of association between UL movement and functioning in ADLs.

1.6.3 To determine the strength of association between gait and functioning in ADLs.

1.6.4 To determine which motor deficit has the strongest association with functioning in ADLs.

1.6.5 To determine the level of improvement in ADL (pre- and post-test) scores.

1.7 Justification for Research

Neurological rehabilitation is an important area in the practice of occupational therapy as it constitutes a majority of an occupational therapist's case-load (1). Much research has been done regarding motor, cognitive and perceptual recovery in patients with hemiplegia following stroke, however there is little research on the effect of motor recovery in more detail. There is also little evidence that can be applied generally to the South African stroke population. Furthermore, lack of funding as well as a shortage of material and human resources that are geared towards rehabilitation leads to decreased time for patients in rehabilitation settings, placing pressure on occupational therapists to be effective in a short time-period. Currently, research shows that stroke patients are being discharged before they are functionally ready. The study is therefore important in order to identify the motor deficits that contribute most to improvement in functioning in ADLs. The information gained from this study can then contribute to the creation of treatment plans that are effective according to the challenges that patients and health professionals face in South Africa.

CHAPTER 2: REVIEW OF LITERATURE

2.1 Introduction to the Review of Literature

This review of literature will discuss the occurrence of stroke and the disabling consequences for those people who survive strokes. Interventions aimed at addressing the maximisation of independence in all people who have survived strokes will be addressed, as well as challenges that South African health professionals face in providing these interventions. It will further be seen that current South African policies are inconsistent with the practical reality of medical care. Additionally highlighted is the need to address the issue of patients being discharged from rehabilitation before they are successful in their ADLs. This, in turn, emphasises the need for effective and fast rehabilitation as well as the importance of the OT role within rehabilitation. Fast and effective rehabilitation is essential in preventing the development of adverse effects of neuroplasticity, such as learned non-use of particular functions that are affected following stroke. Literature reviewing particular motor deficits will be examined and how each contributes to functioning in ADLs will be explored. Also highlighted is the necessity of being able to treat the performance deficits that contribute most to improvement in functioning within ADLs first. It will be discussed how this will ultimately ensure the discharge of patients that are successful in their functioning within ADLs.

2.2 Background on Stroke in South Africa

2.2.1 Introduction to stroke

Not only is stroke the third leading cause of death (8), it is a severely disabling condition in survivors as it is the most common precursor of disability in the world (2). Due to medical advances, there is an increase in the number of people that survive post-stroke (11)(13). Among these survivors, neurological impairments such as hemiplegia, and deficits in cognition, visual perception and other sensory areas are seen (8). These deficits contribute to functional difficulty. This highlights the importance of being able to predict the specific performance components that will contribute to one's ability to perform ADLs successfully (14). These activities are described as a person's ability to care for themselves as well as their performance of certain roles and tasks within the home

environment (13). Stroke survivors often live with the burden of motor, sensory, perceptual and/or cognitive impairments that affect their ability to perform these functional tasks (11).

Typically, stroke occurs in people older than 70-years of age as a result of various stroke-related risk factors exacerbated by age (15)(16). The rate of male mortality following stroke is almost double that of female mortality following stroke (17). There is a 50% chance of suffering a stroke affecting either hemisphere of the brain (18).

2.2.2 Challenges in the South African Context

South Africa is a diverse mix of races and languages, and as a developing nation differs tremendously from more developed countries (17). South Africa is made up of four major racial groups – black people, white people, people of mixed colour and Asian/Indian people (19). The largest religious denomination in South Africa is Christianity (20). The average age of stroke sufferers in Southern Africa is far younger than in developed countries, which also means that their goals and values may differ from older stroke sufferers as they are in a different life stage (21). Important aspects of function for younger stroke patients may include returning to work and reintegrating into the community, things which may not feature for older people who have retired and lead a relatively sedentary lifestyle (21). The increase in stroke incidence in Southern Africa puts vast amounts of pressure on its developing healthcare system (17). Additionally, there are a great deal of informal settlements in the more rural areas of South Africa. This limits a large portion of the population with regard to health education as well as accessing available healthcare (17).

The Integrated National Disability Strategy (INDS) aims for “adequate resource allocations” with regard to both human and financial resources within the healthcare sector (22). It also states that in-depth and timely diagnoses along with specialised techniques that are relevant to the South African population are an important part of the rehabilitation process (22). This links with the importance of being able to diagnose the deficits that could lead to dysfunction in ADLs as quickly as possible in order to be able to provide appropriate intervention to address these deficits, ultimately reducing levels of disability in South Africa.

Additionally, the National Rehabilitation Policy (NRP) identifies that the few rehabilitation professionals that are working in South Africa are poorly distributed, leading to 65% of those professionals being based in Gauteng and the Western Cape, leaving the other

provinces severely under-resourced in terms of rehabilitation professionals (23). Furthermore, there is poor budget allocation to rehabilitation services as these were seen to be low priority and not necessary in comparison to medical treatment. The policy recognises that there has been little research done in the field of rehabilitation and such research that has been done “has not been harnessed to develop effective and efficient services that meet the needs of the population who require them” (23). Ultimately, the demand for rehabilitation can be seen to be larger than the availability of human and material resources as was found in the policy, once again leading to time-restrictions for patients needing rehabilitation (23)(24).

Another study looked at the average length of hospital stay in South Africa as well as the level of function on discharge from hospital after having suffered a stroke. The outcome was that patients from both the government and the private healthcare sector were being discharged between 12 and 34 days following stroke, which is relatively early. Thus, it seems that patients are potentially being discharged before they are functionally ready. In the same study, it was found that only after three months following a stroke, stroke survivors regain full functional mobility. This leaves a gap of time when patients who are unable to walk are already discharged home. This means that they may still require care, increasing the burden on their families. Also noted was that when patients are discharged from hospital before being fully functional, they have less opportunity for exploration and thus, less exposure to challenges that will create neuroplastic change. This means that these patients require continued rehabilitation in terms of physiotherapy and occupational therapy even after discharge. This has been found to be challenging in the rural areas of South Africa where these types of services are difficult to access (25). Even those patients that do have access to out-patient rehabilitation may only be able to attend once or twice a month due to the limited supply of health professionals and resources. Again, this emphasises the importance of fast and effective rehabilitation as a result of the limited resources for rehabilitation (in-patient and out-patient) that stroke survivors in South Africa are afforded. (26)

The private neurological rehabilitation sector has its own challenges. The majority of patients at private neurological facilities are funded by medical aid schemes, which almost certainly have limitations on benefits for members (9). Although the prescribed minimum benefit (PMB) for stroke patients states that a minimum of six weeks of rehabilitation is necessary (27), in instances where strokes are moderate to severe in nature, six weeks is not sufficient to assist patients in achieving functional independence. As mentioned

previously, limitations are often placed on the length of stay in rehabilitation facilities as a result of funds being depleted due to the high costs of initial acute medical care (9).

2.2.3 Types of Stroke

A stroke is the sudden onset of a focal neurological deficit, lasting more than 24 hours as a result of cerebrovascular disease. This is caused by either a blockage in the artery (ischaemic stroke) or by a burst artery (haemorrhagic stroke). Some areas of the brain receive blood flow via the anterior circulation, which arises from the internal carotid arteries while other areas of the brain receive blood flow via the posterior circulation which arises from the vertebral arteries. The anterior circulation supplies 80% of the brain's volume, which consists of most of the cerebral hemispheres and the caudate nucleus. Deficits to these areas manifest in dysphasia (if the stroke is in the dominant lobe), visual and spatial neglect and muscle weakness. The posterior circulation supplies 20% of the brain's volume, supplying the brainstem, cerebellum, diencephalon and posterior and inferior parts of the cerebral hemispheres. Deficits to these areas manifest in weakness, sensory loss, cortical blindness, diplopia, vertigo, ataxia, dysphagia, cranial nerve damage and contralateral hemiplegia. The anterior and posterior circulations are connected through the Circle of Willis which loops around the brainstem at the base of the brain. (28)(29) Blockage to the anterior circulation occurs more commonly. This is particularly detrimental to sufferers as the anterior circulation supplies 80% of the brain's volume, often leaving patients more dependent on caregivers due to severe physical and neurological deficits (25).

2.2.4 Pathophysiology of Stroke

A stroke affects both the anatomy and physiology of the brain. It damages nerve cell bodies, dendrites and axons as well as affecting the "programming" of nerve impulses throughout the intact brain tissue (30). The middle cerebral artery, on the lateral surface of the cerebral hemispheres is most commonly affected by stroke due to its tumultuous pathway around structures within the skull (31). This is also the artery primarily responsible for blood supply to areas of the primary motor cortex that control face, arm and trunk movement (31)(32). Rehabilitation aims to stimulate the recovery of lost movement in the areas affected following stroke such as in the arms, trunk and legs through the use of goal-orientated and purposeful tasks. This stimulates the formation of new neural pathways within unaffected brain tissue, based on the fact that the brain is able to re-organise itself post injury (30).

On a pathophysiological level, an ischaemic stroke causes a reduced cerebral perfusion. When the areas of the brain that control movement in the arms, trunk and legs receive oxygen-rich blood, they are able to function normally. When the cerebral perfusion decreases as a result of stroke so does the electrical functioning of the brain, leading ultimately to complete electrical failure and cell death within the affected areas. The body's defense is to activate thrombolytic factors to counteract the blockage. This fragments the embolus responsible for the blockage allowing oxygen-rich blood to continue travelling through the artery to the area of the brain that it supplies. In cases where the body's attempts to normalise the interrupted blood flow are unsuccessful, embolic stroke occurs and functional deficits are evident. Haemorrhage is a result of another form of stroke and occurs when a blood vessel ruptures or bleeds. This also compromises the various functions of affected areas such as balance, upper limb movement, and the ability to walk. (28)

2.2.5 Positive and Negative Symptoms of Stroke

A stroke is an upper motor lesion that can damage cortical and/or sub-cortical structures. This damage interferes with normal motor control. Negative symptoms of stroke involve the loss of normal behaviours and positive symptoms involve the release of abnormal behaviors. Both of these may be present post stroke. Negative symptoms present in the form of muscle weakness and fatigability of the muscle as a result of the body's inability to recruit motor neurons and modulate the firing rate of the motor neurons. Initiating and sustaining movement in the limbs and body becomes difficult as a result of slowness and impaired dexterity of the muscles. Affected areas of the body such as the trunk, arms and legs struggle to produce voluntary movement due to muscle weakness. (33)

Positive symptoms present in the form of spasticity and hyperreflexia; these symptoms provide added resistance to voluntary movement of the limbs and body also due to an inability to modulate the firing rate of motor neurons. Because these primary impairments interfere with normal movement, this can result in secondary impairment or adaptive features of stroke of a biomechanical nature; resulting in physiological, mechanical and functional changes in the muscle and other soft tissues that come about in response to immobility, disuse and failed attempts to move in the presence of weakness and spasticity. Ultimately, adaptive features are a result of muscles being immobilised in a shortened position. (33)

The inability to properly recruit and modulate motor neurons following stroke usually affects the production of movement on the contralateral side of the body. Primary and secondary features limit not only movement but also functional outcomes that are dependent on movement. As discussed previously, where there is inability to recruit motor units and properly modulate motor units, muscle weakness and/or spasticity is evident, and depending on the specific area of the brain affected this weakness and/or spasticity can be seen in the UL, trunk and lower limb (LL) of the affected side of the body(33)(30). This affects bilateral UL tasks, activities requiring the body to maintain an upright position or to move out of its base of support as well as affecting functional mobility (33).

As a result of this central nervous system damage, there is a decrease in motor innervation to the muscles, often leaving only synergistic muscles with innervation (12). Brunnström proposes that synergistic muscles allow basic movements to be performed, linking to survival e.g. flexor synergy (bringing UL to mouth for feeding) (12). In the short-term, these synergies allow for survival, however as only large muscles are recruited for these synergies, movement is not energy efficient (12). Brunnström classifies the recovery of movement into six phases. The first three phases indicate recovery of movement in mass stereotyped flexor or extensor movement patterns. These initial phases limit selective control of movement, in turn limiting functioning in ADLs. The next three phases consist of the recovery of movements that require two patterns. These final phases indicate the recovery of discreet movement of each joint in a voluntary manner, which allows for full physical participation in ADLs (12).

2.2.6 Functional Localisation of Stroke Damage

A homunculus is a proportional, somatotopical representation of physical body functions such as limb, body and facial movement and sensation. Homunculi are found on the motor and sensory cortices. The premotor cortex and motor cortex are situated on the posterior-superio-lateral aspect of the frontal cortex. These areas are responsible for the planning and execution of movements of the ULs, the trunk and the LLs. There are larger areas of the homunculous dedicated to movements of muscles of the hand and face that are responsible for finely controlled movement. When parts of the homunculus are damaged due to lack of oxygenation to the area or compression of the area caused by haemorrhage, function of that particular area is affected. This damage contributes to the onset of positive, negative and secondary symptoms of stroke as discussed in the previous paragraph. (34)

2.2.7 Prognostic Factors of Stroke

Being able to predict medical and functional outcomes following stroke is essential in guiding the management of each patient. Even if a patient has a very positive medical prognosis, without appropriately intensive rehabilitation, the functional prognosis of the patient may be poor. This influences their ability to reintegrate into the community and continue contributing to the economy. In South Africa, there are a great deal of factors affecting medical prognosis with regard to co-morbidities and poverty. These factors will be discussed below. This means that stroke patients are already medically disadvantaged with regard to recovery. They are further disadvantaged if they do not have access to adequate rehabilitation as well as being at further risk of developing a second stroke. Thus, understanding the most important underlying impairments that contribute to good functional outcomes is essential. (8)

Research is currently inconclusive as to which indicator of "severity of stroke" would give the most accurate prediction of future recovery (14). Knowledge of the greatest motor deficit would help focus the rehabilitation teams' intervention within the limited time-frame available for rehabilitation (35). Functional outcome is limited by certain prognostic factors such as considering the patient's level of disability on admission, whether there is urinary and bowel incontinence, occurrence of a previous stroke, increased age and the extent of visual-perceptual deficits (8). Cognitive, affective and volitional impairments impact patients' ability to engage adequately in therapy, further inhibiting their progress. Flaccidity in the affected UL directly after stroke relates to a poor prognosis with regard to return of movement in that limb. If no movement is seen within the first month, it is less likely that any movement will return (36). More specifically, studies have been conducted that determine different motor components' contribution to function. These will be discussed in more detail within this review.

South Africa is still developing with regard to both acute healthcare and rehabilitation for stroke and other acquired brain injuries. Disability and mortality rates of stroke patients in South Africa and other developing countries are up to ten times that of more developed nations. South African stroke patients are already compromised with regard to prognosis; the population exhibits nearly all of the risk factors associated with stroke. Along with the lack of pre-stroke screening and post-stroke follow-up, there is a lack of access to rehabilitation post-stroke. This contributes to the decreasing chances that individuals suffering from stroke will survive and remain functional in South Africa in comparison to other countries that offer medical services of a higher standard (3).

2.2.8 Risk Factors for Stroke

One systematic review found that approximately 60 people die per day in developing countries as a result of stroke. This review projects that, by the year 2030, this figure will reach almost 120 deaths per day. Major risk factors for stroke include smoking, obesity, hypertension, diabetes and dyslipidemia. This is common in Africa and in the rest of the world. The study undertook to define the risk factors specific to the African population. The results showed that hypertension and diabetes were strong risk factors for stroke. This relates to lack of education regarding health management within the poorer communities of South Africa. There was also a higher association with stroke for participants younger than 45 years old in the African context. This age group forms much of the working class. When they become functionally disabled, requiring assistance with even basic ADLs such as dressing and going to the toilet, entire households who rely on their individual income may become destitute. This has a major impact on the economy as the working population is affected by this condition. Additionally, even in regions of Africa that are more developed, there is a poor prognosis for people who have had strokes, leaving many stroke survivors dependent on their families and society. Women were found to be at higher risk for all types of stroke in Africa, more so than in other countries. (37)

The conclusion was drawn that although the same risk factors are common in Africa and other countries, the strength of the associations of these risk factors with stroke were higher in developing countries such as South Africa. This difference in strength of association may be a result of different lifestyles, possible differences in genetics and the fact that infectious diseases, such as HIV, are rife in developing countries. This highlights the fact that South Africans are already compromised with regard to medical prognosis. Those patients that do survive stroke require even more intensive rehabilitation to maximise their functional prognosis.(37)This places a huge burden on the healthcare system of countries that are not yet developed, emphasising the importance of fast and effective rehabilitation. (17)

2.3 Effective and Fast Rehabilitation is Essential

2.3.1 Function as a Life-goal

One of the most important life goals of people with disabilities all over the world is to attain and maintain maximal independence, full physical, mental, social and vocational ability

and full inclusion and participation in all aspects of life (38). Additionally, international policy advocates for this to be attained (39). As this is a fundamental aspect of living, it needs to be addressed effectively and as quickly as possible in order to fulfill the needs of people who have survived strokes.

2.3.2 The Role of Neuroplasticity in Effective Rehabilitation

Recent research highlights the ability of the brain to re-organise and adapt to different experiences and stimuli. Neuroplasticity refers to this ability of the brain to encode different experiences and learn new behaviours. The fact that this process is context-specific emphasises the fact that the use of cortical territory differs from person to person, which depends on the daily activities performed by each person as well as *how* these activities are performed (30).

Natural neuroplasticity takes place in normal development when dendrites and axons are proliferated during periods of cytogenesis and histogenesis, during synapse formation and cell differentiation within periods of migration as well as during various apoptotic instances related to pruning (40). In adulthood, the central nervous system can re-organise following injury based on the same principles of neuroplasticity (40). This takes place according to different mechanisms of recovery that are categorised into two main stages (40). The first stage is spontaneous re-organisation and is accompanied by the second stage called training-induced recovery (40). Spontaneous recovery is said to slow down approximately three months following stroke and occurs due to resolution of reversible factors as well as the activation of learning networks (40).This form of recovery is dependent on individual context (40). Thus, the importance of effective use of this time is evident. The activation of the learning networks in the spontaneous recovery stage facilitates re-learning (40). Typically, plasticity takes place in areas surrounding the area that has been damaged, in re-organisation within the damaged area or in recruitment of new areas of the cortex for function (40). The ability of the cortex to re-organise appears to be dependent on intact subcortical connections (40). Where there is extensive damage to white matter, this severely restricts the ability of the brain to re-organise (40). If the brain is not stimulated to re-organise, the detrimental effects of learned non-use are likely to develop. This means that limbs not receiving sensory or motor input lose their correlating functional localisation in the brain (4).

Principles for neuroplasticity have long-since been proven to be of importance in rehabilitation and this is emphasised in recent research (8). Many of these principles

support the belief that rehabilitation needs to begin as soon as possible following stroke. Stroke rehabilitation taking place within five days of stroke was found to be more effective than the same rehabilitation that was only started after 30 days following the infarct (4). The first 90 days post-stroke have been identified as the most crucial for application of therapeutic techniques aimed at improving motor and sensory function (41). These findings highlight the importance of fast admission to rehabilitation facilities and early and focused intervention.

The intensity of rehabilitation is also of utmost importance (8). Therapy sessions forming part of the rehabilitation program need to create just the right challenge for patients. This ability is learned from multiple years of specialised studying at a tertiary level. One-on-one therapy is required for therapy sessions of high-intensity, which ultimately requires a low therapist to patient ratio. As previously discussed, there is a shortage of health care professionals with this knowledge in South Africa (7). Of these therapists, the majority live and work in Gauteng and the Western Cape. Therapists living and working in the rest of the country are few and far between, making it difficult for much of the population to access rehabilitation services and an adequate intensity of rehabilitation (23).

Increased repetition and duration of rehabilitation are highlighted as prerequisites for effective rehabilitation programs (8). This is further supported by theories of motor control that emphasise practice and repetition as essential in the development of specific skills into successful ADL performance (30). Repetition of therapeutic input can only truly be achieved when stroke survivors are in-patients in acute or rehabilitation settings or have close access to daily out-patient rehabilitation facilities. In the South African context daily therapy sessions are not always possible due to the inaccessibility of some regions of the country.

The neuroplasticity principle of “use it or lose it” implies that if certain areas of the brain are not used, their previous functions will be taken over by new functions that are deemed more important (8). Within hospitals, if rehabilitation is not as intensive as possible, the principle of “use it, or lose it” is highlighted. If those areas that have been affected by stroke are not challenged intensely enough to create new pathways to elicit function, those functions can be lost (4). In cases where there is no access to rehabilitation, there is a good chance that stroke survivors will rely on compensatory methods in order to participate in ADLs, resulting in learned non-use of previously normal functions. Compensatory methods are often energy-intensive as opposed to energy-efficient. This is detrimental in a population where one person often supports a household. Where that

person is permanently disabled following stroke, the entire household will suffer. On a greater level, the economy of the country will be negatively affected (37). Thus, early admission to rehabilitation facilities and correct targeting of the most important deficits is essential.

The neuroplasticity principle of “use it and improve it” relies on intensive training of specific functions that will improve that function (4). Stroke survivors need to be challenged in areas of deficit using goal-directed activity as a means and an end. Occupational therapy rehabilitation programs use meaningful tasks to encourage normal movement. This is particularly effective as patients understand the nature of therapy as well the reasoning behind the activities that are prescribed to them during therapy sessions, ultimately making the purpose of sessions as salient as possible (4). This emphasises the importance of using meaningful tasks as motivation to improve normal movement. ADLs provide a platform for this as patients who take part in these activities are able to find meaning in these activities in relation to their day-to-day functioning. This highlights the importance of linking motor deficits to functioning in ADLs in order to guide rehabilitation that is effective and time-efficient.

2.3.3 Premature Discharge in Public and Private Settings

Premature discharge from both acute hospitals and rehabilitation units is evident in all South African settings. This is due to lack of resources at a government level and limited funding from medical aids at a private rehabilitation level (7). Motor re-learning is used as one of the rehabilitation tools and is effectively the learning and acquisition of a skill (42). Skill acquisition in healthy participants can take many years of practice to master, yet post-stroke, patients are given limited time in rehabilitation units while still being expected to reach maximal levels of functioning. Normal movement is affected within stroke patients as well as other performance skills such as cognition and visual-perception; this means that their ability to learn skills of a physical nature may further be compromised by cognitive and visual-perceptual impairments. In these circumstances, the optimal environment for skill acquisition is inhibited. (42) Limited time for rehabilitation is detrimental to functional recovery. This is because in addition to deficits in performance skills and function, stroke patients in South Africa are usually ill, impacting the rate of their ability to learn.

Research to further health professionals’ effectiveness in rehabilitation would alleviate the pressure on the current limited resources. Research has also shown that stroke patients

benefit from rehabilitation from initial admission to the acute hospital right to their stay in rehabilitation units (8). This emphasises the importance of efficient treatment from the moment the patient is admitted. Stroke patients who receive focused intervention in the deficits contributing most to successful functioning in ADLs would be able to improve faster and function better as well as being more successful in their reintegration into the community. The consequence of not providing fast and effective rehabilitation is the establishment of a population of people who may return to their communities requiring assistance to complete their daily activities. Additionally, performance skills will be lost resulting in learned non-use and dependence (4).

2.3.4 Concluding the Need for Fast and Effective Rehabilitation

Stroke rehabilitation is therefore a great need in many countries, as well as South Africa. This also means that when patients do receive rehabilitation, it needs to be as fast and effective as possible, as once patients are discharged from therapy (in a state that is not always functional), they have less opportunity for continued intensity of therapy guided by a qualified therapist. This emphasises the necessity of being able to identify the most important contributors to functioning in ADLs so that these can be addressed as early as possible, at a time when patients are quick to respond to such treatments (41).

2.4 Occupational Therapy and Stroke Rehabilitation

The role of the OT is essential in stroke rehabilitation. In the South African setting, the OT forms part of a multidisciplinary team of professionals that give treatment to a person that has suffered a stroke. A multidisciplinary approach ensures the integration of medical, rehabilitative and social support and has been proven to reduce the rate of mortality following stroke, decrease the length of hospital stay and improve quality of life (43). Stroke management falls under the field of neurological rehabilitation and is an area specifically addressed during undergraduate training of OTs. One of the main goals of stroke rehabilitation is to improve health-related quality of life (44). Since the literature has suggested that ADLs are related to quality of life in stroke patients, OTs are able to play an important role in addressing independence in ADLs in order to improve quality of life (44). It can also be seen that physical independence and occupation are two of the most affected areas following stroke. These areas directly affect the ability to engage in ADLs, thus making it an important area of focus within OT intervention (43). Client factors such as selective control of movement of the limbs and performance skills such as balance and

postural alignment are addressed in therapy through the use of meaningful activities in areas of self-care, survival skills, leisure and work. Meaningful activities can be used as a "means" to treat physical performance components contributing to functional end goals. For example, a functional activity involving washing using a built-up sponge is meaningful to the patient as it is a function of which the patient understands the importance and participates in daily. This activity can be used as a means to improve the selective grasp and release of the patient's affected hand following stroke. Meaningful activities are also used as an "end" to allow for participation in and practice of functional goals that patients express the need to achieve. The practice of a functional activity involving washing using a built-up sponge can also be used as a means to practice an end goal that is meaningful to the patient such as being able to wash with less assistance. OT follows a client-centred approach in which the values and goals of the client are the focus of therapy. In most cases, the goals of the patient and the family extend further than merely being independent in ADLs, particularly as the working class is the predominant age group affected in developing countries. (30)

2.5 Rehabilitation goals after stroke

2.5.1 Importance of Understanding the Contribution of Underlying Deficits

Motor relearning theories have been found to be effective in the rehabilitation post-stroke (45). These theories can be seen to incorporate exercises specific to the improvement of particular motor components, the practice of components within functional tasks and the transference of learnt skills to successful performance in ADLs. The patient and the therapist acknowledge specific deficits in the performance of functional tasks and use treatment to address these specific deficits. This highlights the importance of understanding the underlying deficits in order to focus on these and consciously transfer skills to function (45).

Studies have shown that a better understanding of the underlying components of motor control and movement may lead to the development of more effective rehabilitation strategies as well as a greater knowledge of components impacting function (8). It has also been identified that there is poor carryover of improvements in isolated performance components to overall functional performance, therefore task-orientated therapy should

be used in conjunction with the knowledge of the underlying performance deficits in order to promote efficient rehabilitation (8). The importance of adequate activity analysis is highlighted in being able to understand how specific motor components influence functional performance within each step of the activity.

2.5.2 Motor Recovery and Function

Studies have been conducted assessing the impact of various factors on functioning in ADLs. Motor recovery, over and above cognitive and perceptual recovery was identified as being the greatest indicator of function (11)(35). The International classification of functioning, disability and health provides a way in which we can classify a person's ability to function. Within the classification, functioning and disability are broken down into body structures, body functions and activities and participation. This international classification helps to emphasise the importance of body structures and functions on participation (34). It also highlights the value of observing the deficits and then attempting to understand how these deficits affect performance in functional tasks (34). Ultimately, this is relevant because few studies have been done that investigate which component within motor recovery contributes most to functional recovery.

2.5.3 Balance and Function

2.5.3.1 Balance Dysfunction

Balance has been identified as a motor component that contributes to independence in functioning in ADLs. Being able to sit independently requires the development of adequate trunk control. This is only possible when the ability to maintain an upright position against gravity is achieved as well as the ability to react to factors that interfere with balance. Static sitting balance involves the ability to remain upright against gravity without any external interference. Dynamic sitting balance involves the ability to remain upright against gravity along with external interference. The development of standing balance involves learning to balance within a reduced base of support while gaining control over additional degrees of freedom as the lower limb (LL) requires control in standing. (33)

Following stroke, balance is affected due to positive and negative symptoms of stroke. The affected side of the trunk may exhibit paresis or spasticity, which in turn affects normal movement. Although deficit is usually seen on the contralateral side of the body, the trunk acts as one unit. The side unaffected by primary muscle weakness or spasticity will be affected secondarily due to poor instability of the affected side of the trunk (33).

Instability of the trunk affects the ability to control selective movements as well as to react reflexively to external influences in sitting and standing (33). Hemiparesis of the affected LL also impacts on balance in standing as well as any visual deficits resultant from the stroke.

The most relevant way of assessing balance is through the performance of functional tasks. Balance can be assessed during a sit-to-stand movement, by reaching for an object in sitting and standing, while looking around the room and by sitting down. The ability to do these things directly affects walking and stair-climbing ability as well as the ability to perform functional tasks such as dressing the lower body (LB). It is important to understand how deficits within this area affect performance in these functional activities. Without the correct activation of muscles in the trunk, the ability to dissociate and rotate the trunk as well as functional activity performance will be impacted. (30)

According to previous studies, the absence of balance directly after stroke was established as being a strong predictor of functional dependence (14). Because of this, treatment that focused on balance re-training was desirable within a stroke rehabilitation program. Balance was shown to relate particularly to the successful recovery of gait. Participants with initially poor balance post-stroke had a poor prognosis and often remained unable to walk or even transfer from one surface to another (14). Sitting balance is required for many tasks within personal management such as UB dressing and transferring from one surface to another. Additionally, standing balance is required for the completion of activities within the home as well as community integration. (45) As balance is a dynamic component and can change over time post-stroke, the Berg Balance Scale (BBS) is important in being able to quantify these changes, in order to allow for changes to be made to the treatment plan (46). One study explored the contribution of balance deficits to functional performance. It found that participants with poor balance after stroke showed slow improvement in functioning in ADLs (14). Although there is strong evidence supporting the correlation between balance and functional outcome internationally, this relationship has not been investigated in a South African context. Additionally, balance has not been compared to other motor components in terms of contribution to function.

2.5.3.2 Outcome Measure for Balance

Many scales exist that aim to assess balance. The BBS has been shown to be effective in assessing balance with good internal consistency, inter-rater reliability, intra-rater reliability, test-retest reliability, sensitivity and validity. However, this is qualified by finding

floor and ceiling effects (46). In physical therapists' management of stroke cases, it has also been shown that this scale is used most commonly (46). This is thought to be a result of ease in administration of the scale as well as minimal equipment being required. Sensitivity to change was emphasised in the calculation of $p<0.001$ in one study (46). The scale takes approximately 10-15 minutes to administer and assesses both static and dynamic aspects of balance (46). It consists of 20 sub-tests, involving the patient in sitting and standing positions. The participant is required to maintain particular stances as well as move between surfaces. Balance skills are assessed and each sub-test is scored out of four. There are different descriptions of scores for each sub-test and participants can score from zero to four for each sub-test. The entire assessment is out of 56 points. The BBS has been used successfully in studies of a similar nature to the current study (11).

2.5.4 Upper Limb Movement and Function

2.5.4.1 Upper Limb Dysfunction

Upper limb movement consists of the shoulder complex, the elbow and the forearm and the wrist and hand. Because patients may perform the same task with their UL in many different ways, it is important to observe the patient within these tasks and to establish which motor components are required in order to fulfill the task (34). It has been reported that up to 45% of stroke survivors have residual deficits in UL motor function that contribute to their disability (41).

As highlighted in the previous section on primary and secondary impairments, UL movement can be affected as a result of these impairments. Inability to recruit motor units results in muscle weakness of the affected limb, and an inability to initiate and sustain movement. Spasticity and hyperreflexia can provide additional resistance to the initiation of voluntary movement of the UL. These primary restrictions to movement result in immobility, which in turn result in the development of adaptive features of stroke such as muscle shortening. This may also lead to a lesser likelihood of the affected limb being used, as it requires so much effort, resulting in learned non-use. (33)

Research discussed opposing arguments regarding UL function following stroke and its correlation with functioning in ADLs (47). On the one hand, it was argued that as UL function improves, so should independence in functional tasks, particularly tasks requiring bilateral arm and hand function. On the other hand, it was stated that compensatory techniques might also be a contributing factor to independence in functional tasks and not

necessarily attributable entirely to improvement in UL movement (47). This means that someone with very poor UL movement may be completely independent in basic ADLs due to the learning of compensatory techniques and/or the use of assistive devices. Compensatory strategies are often not energy-efficient and require more effort than normal methods, limiting patients in completing more complex activities as well as causing them unnecessary fatigue. Rehabilitation techniques base treatment on the premise that improvement in UL movement will have a positive effect on completion of functional tasks (41). Actual findings in the study show that UL movement has a poor correlation with independence in functioning in ADLs. Additionally, improvement in speed of task completion and motor recovery did not mean that everyday functional use was restored (41). This can be attributed to the fact that the currently used standardised measures for UL function may not effectively predict UL use in ADLs. The relationship between UL movement and actual functional use of the UL has not been fully investigated and understood. This means that findings of standardised UL movement measures may not immediately be correlated with UL use functionally (41). Additionally, the spectrum of improvement in UL skill is vast and patients still report deficit in UL movement years after stroke. Alternatively, where the treatment of performance deficits is not addressed, learned non-use of that performance component develops (8). Movement deficit in the UL often correlates with non-use of the limb as it is quicker and easier to resort to use of the unaffected limb (41). Bilateral activities are often avoided for this reason, alluding to the fact that patients are not able to complete all activities, especially more complex ADLs and activities contributing to community integration. This is particularly detrimental to the younger, working population that is suffering strokes in South Africa. Thus, it can be seen that although many patients become functional using one-handed techniques, this is limiting, and is quite clearly, not an optimal solution for successful functioning following stroke.

2.5.4.2 Outcome Measure for Upper Limb Function

Several assessments are available to evaluate the severity of UL dysfunction after a stroke. The Frenchay Arm test has been used in several previous studies to evaluate arm and hand movement after hemiplegia. The assessment was used to measure improvement over the three-month period following stroke (36). Good inter-rater and test-retest reliability was found for the Frenchay Arm Test. It was also found to be valid and had no ceiling effect (36). The Frenchay Arm Test, along with other tests of UL function such as the Nine Hole Peg Test, the Ashworth Scale for muscle tone and the Motor Activity Log, have been used to evaluate the effectiveness of certain types of therapy and

their relationship to function and quality of life (48). The Frenchay Arm Test takes less than five minutes to administer and requires minimal equipment. (30) This makes it effective in the South African context, as it is concise and easy to understand, however its use with patients with cognitive impairment requires further research. Regrettably, outcome measures that look at arm and hand movement often give a poor idea of actual use within functional activities (41). It cannot be taken for granted that outcome measure findings can be adequately translated to ADL completion and overall participation (41).

The Frenchay Arm Test starts the measurement of UL function on a level at which the affected arm and hand already have varying degrees of voluntary movement. Tools required for this outcome measure include a glass half-filled with water, a cone, a hairbrush, a piece of paper, a pencil, a ruler, a clothes peg and a piece of dowel which is horizontally strung up. The participant is required to complete sub-tests such as drinking from the glass of water, lifting the cone, taking off/putting the clothes peg on the dowel, brushing their hair on all sides and drawing a line on the piece of paper. The test is completed in sitting with the participants' hands in their lap, with each task beginning from this position. There is no time limit for these activities and no half points. If the participant is able to complete the sub-test, they will score one point and if they are unable to perform the sub-test, they will score zero points. The entire assessment is scored out of five points. (30)

Because a certain level of selective control is required to successfully complete the Frenchay Arm Test, it is helpful to analyse UL function with regard to Brunnström's six stages of recovery of voluntary control, should the patient be unable to complete any of the five Frenchay subtests. The sequence of assessment with regard to Brunnström moves from stage one, which is flaccidity in the arm (no voluntary movement or stretch reflexes) to the sixth stage in which the patient is able to isolate movements in the arm and hand. This is the normal progression of recovery of movement however recovery does not necessarily pass through each stage. Stage two classification indicates that synergies can be elicited reflexively with flexion developing prior to extension as well as the development of spasticity in the affected arm. Stage three classification is evident of the initial stages of voluntary movement following particular flexion and/or extension synergies as well as increased spasticity. Classification in stage four indicates that voluntary movement that deviates from the synergies is developing. Here, specific movements such as being able to move the hand behind the back, into a forward horizontal movement of shoulder flexion and as well as being able to pronate and supinate the forearm can be performed. These movements require isolation of particular

muscles and allow for greater functional use of the UL. Decreased spasticity is evident as voluntary movement increases. Stage five classification is evidence of full independence from the synergies. This is indicated when the arm can be moved voluntarily to a side horizontal position, forward and above head height and supination and pronation is possible while the elbow is extended. Spasticity is almost non-existent in this stage. The sixth and final stage indicates normal, isolated movement in each joint and the ability to perform these movements with near normal coordination. (49)

Stage one in the affected hand is similar to the arm and is evident of complete flaccidity. Stage two indicates little or no active finger flexion. Recovery of a mass grasp or hook grasp is classified into Stage three. Here, there is no voluntary finger extension or release. Stage four indicates semi-voluntary finger extension within a small range of motion as well as lateral prehension with release by thumb movement. Stage five is evident of palmer prehension, specifically the development of a cylindrical and spherical grasp and voluntary mass finger extension. The sixth and final stage is indicated when all types of prehension have recovered. There is voluntary finger extension within a full range of motion and individual finger movements. (49)

Being able to classify the hemiplegic arm and hand into a specific stage allows for a more detailed description of the level of recovery and function of the arm. These stages can be used in conjunction with the Frenchay Arm Test in order to classify the function of the arm. Understanding that the arm is in the first stage of recovery and is still flaccid allows understanding as to why there has been failure in certain sub-tests of the Frenchay Arm Test (12). The focus of the use of Brunnström in this context is not treatment-based but rather concerned for its usefulness as a tool in assessment.

2.5.5 Gait and Function

2.5.5.1 Gait Dysfunction

Walking involves the hip complex, the knee and the ankle and the foot. Assessment of the basic components involved in gait does not allow the therapist to be able to predict how the patient will perform functionally. This can only be realised when the therapist observes the patient in the relevant functional task. However assessment cannot rely fully on observation, as the therapist is required to understand the underlying performance components contributing to gait (33).

Hemiparesis following stroke reduces the ability to control selective movements of the affected LL. This is a result of positive and negative symptoms of stroke and has an impact on balance in standing as well as gait. An inability to maintain the trunk in an upright position while stationary or while moving also affects the ability to walk (33).

Additional to balance, LL function was shown to be a strong predictor of the recovery of functioning in ADLs (50). It is also the factor that patients deem as the most important in order to be able to return to their previous lifestyle (51). As strength of the LL increases, so does function. Performance tests such as the Timed up-and-go Test (TUG) are used to assess LL function and are accurate in predicting functioning in ADLs (52). These studies pertain specifically to functional mobility and walking. LL movement has been found to improve at a rate faster than that of the UL (32). When compared to the UL that requires grasp, release, in-hand manipulation and dexterity in order to participate in functional, bilateral activities, the LL requires a lower level of recovery in order to contribute successfully to functional ambulation (32). The LL is also more likely to be stimulated during activities such as transfers and standing which occur daily (32). The ability to walk is also linked to more complex ADLs and community integration.

2.5.5.2 Outcome Measure for Gait

The TUG was useful in the evaluation of hemiplegic patients' movement. The findings showed that the activity phases in walking that were identified by the TUG were similar to those identified by therapists (53). The TUG was used to explore the relationship of trunk performance with balance, gait and functional ability in hemiplegic patients following stroke (54). The study showed that measures of trunk performance showed a significant correlation with scores of balance, gait and functional ability (54). Additionally, the TUG has been used to measure basic mobility competence as well as how this relates to functioning in ADLs (55). The study concludes that the TUG is recommended for use as a screening tool for mobility competence (55). The TUG has been shown to have excellent reliability and correlates with accurate prediction of those patients at risk of falling due to neurological deficits (56). No further research was found that showed evidence of gait's contribution to independence in functioning in ADLs, only to one's independence in mobility.

The test is fairly easy to administer. The tools required include a chair and a 3-metre walkway. The participant is required to stand up from the chair, walk the three metres, turn around and walk back to the chair. Timing begins from the moment the participant

stands up from the chair and is terminated once the participant sits down again. Participants are able to complete the assessment using a walking aid. The use of a walking aid must be recorded on the form. A score of above 13 seconds indicates that the participant is at a higher than average risk of falling.

2.5.6 Functional Independence Measure

2.5.6.1 Functional Dysfunction

As a result of a greater number of people surviving stroke, there are more people living with disabilities. This affects their mobility as well as their ability to perform ADLs (57). This has been shown to greatly impact their quality of life. Quality of life has been shown to correlate with daily participation in certain tasks such as leisure activity and ADLs. This is because of the physical requirements of these tasks linked with the fact that increased daily physical activity has been shown to correlate with increased quality of life. Lesions to descending motor tracts or areas of the cerebral cortex can result in impairments in client factors and performance skills such as balance, upper limb movement and gait. These components have been found to limit participation in ADLs, thus reducing daily physical activity (57).

For the purposes of this research, dysfunction will be monitored in terms of ADLs, specifically feeding, grooming, washing, upper body (UB) dressing, LB dressing, toileting, transferring to the toilet and transferring to the shower or bath. Where independence in these tasks is impacted, a greater amount of assistance is required, thus increasing the burden of care once discharged home. These tasks make up basic ADLs. Over and above this are instrumental ADLs that are more complex. These consist of survival skills and community integration. The ability to perform basic ADLs predicts ability to re-integrate into the community, thus if there is deficit in performance of basic ADLs, this will more than likely, impact on participation in instrumental ADLs.

Deficits in trunk control and balance have a severe impact on activities requiring a patient to move out of their base of support in sitting, such as dressing their UB or reaching for objects. Balance deficits contribute greatly to activities requiring standing such as transferring from one surface to another or dressing their LB in a standing position. Deficits in the affected UL affect the ability to perform ADLs using normal movements. Having the use of only the unaffected UL promotes the use of compensatory, one-handed strategies. An activity such as brushing teeth requires that the opening and closing of

toothpaste, application of toothpaste and actual brushing of the teeth be done using only one hand. Activities such as UB dressing require that the unaffected UL dress the affected UL and trunk, promoting the development of learned non-use within the affected UL. Gait deficits impact on patients' ability to move from one surface to another and set-up their own tasks in preparation for task completion.

Ultimately, when there is reduced control of engagement in daily activities, there is reduced satisfaction within life roles. This contributes to the fact that depression is a common occurrence after stroke, relating to changing levels of self-efficacy and self-esteem. (12)

2.5.6.2 Outcome Measure for Function

Although the reliability and validity of the FIM has been questioned in many research studies, it is a well-known tool used in private health care settings in South Africa. There are studies indicating the FIM's reliability and sensitivity, and it was shown to be an effective tool in assessing physical function of people with traumatic brain injury (58). The FIM was compared to other functional measures and was reported to be one of the most reliable and sensitive measures for patients with brain injuries. The tool's reliability and validity have been established and inter rater reliability was shown to be 0.95 (41). Studies conclude that that the ability to predict walking competence of patients after stroke is important for effective discharge planning (59). Furthermore, the seven-point subscale of the FIM was used to measure the predicted outcome compared to the achieved outcome in this study. The overall results showed a moderate correlation between predicted outcome and achieved outcome (59). Inaccurate predications were associated with lower FIM level admission scores ($p=0.002$) and a longer length of stay ($p<0.005$), however accuracy was not affected by changes in age, gender or side of stroke (59). Quadriplegia was shown to be more likely to predict inaccurate outcomes than hemiplegia ($p=0.025$) (59). Construct validity was assessed for individuals post-stroke, with an outcome of $r = 0.65$ (r= Pearson's product moment correlation coefficient) (41). Therapists using the measure are required to take a test every two years to ensure they are using it correctly. This contributes to the reliability of the outcome measure in assessing functional performance in different areas. The FIM is endorsed by the Agency for Healthcare (41).

The FIM consists of 18 items that are scored according to a seven-point rating scale of independence. The FIM scores that will be used for the purposes of this research are those that are applicable to OT and functional performance, particularly self-care and

transfers. The areas of self-care that will be scored are feeding, grooming, washing, UB dressing, LB dressing and toileting. The specific transfers that will be scored are those to the toilet and the shower. Each area is scored on a scale of one to seven. A score of one equates to the patient requiring the assistance of two people to complete the task (complete dependence). A score of two equates to the patient being able to perform 25-49% of the task. A score of three equates to the patient being able to perform 50-74% of the task. A score of four equates to the patient being able to perform 75-99% of the task. A score of five equates to the patient being able to perform the task with either set-up of the task or supervision while doing the task. A score of six indicates that the patient is able to set-up and complete the task independently, but requires assistive devices or additional time. A score of seven indicates that the patient is able to perform the task independently.

2.6 Conclusion to the Review of Literature

In conclusion, it can be seen that there is limited time in both private and public rehabilitation facilities in South Africa, often resulting in the discharge of patients before they are functional in ADLs and able to live as independently as possible. This impacts patients' access to the necessary rehabilitation required following stroke. Studies have been done on underlying deficits and their effect on function in isolation but there is a lack of research identifying which motor deficit has the greatest impact on improvement in functioning in ADLs. This highlights the importance of identifying the components that contribute most to improvement in functioning in ADLs so that these can be the initial focus of an effective treatment plan. Additionally, there is little research related to the relationship of specific motor components with functional performance in the South African context. It has been established that the South African population bares many differences to those populations in developed countries. In being able to identify the motor deficits that contribute most to functional performance in a South African population, occupational therapists will be more effective within the contextual limitations in a private rehabilitation center in South Africa.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Study Design

A longitudinal correlational design was used. Each participant was assessed in the three chosen components of motor recovery as well as with regard to their functioning in ADLs. This was done at two (pre-test) and four-weeks (post-test) post admission to a private, neurological rehabilitation facility.

3.2 Population Studied

Patients who had suffered a stroke and subsequent hemiplegia from the age of 35 to 85, situated in private neurological, rehabilitation facilities in Johannesburg.

3.3 Sample Studied

Any male or female patient from the age of 35 to 85 admitted to the 40-bed, private, neurological, rehabilitation facility in Johannesburg who fulfilled the inclusion criteria was invited to participate in the study.

3.3.1 Inclusion Criteria

- The participants presented with stroke and subsequent hemiplegia as diagnosed by a medical practitioner.
- The participants were from the age of 35 to 75 (this is justified by the increase of incidence of stroke with age).
- Two weeks post-admission to the rehabilitation facility where the research took place.
- Ability to provide informed consent (verbal or written), implying ability to cognitively understand the information letter and give verbal consent in the presence of a witness. In the case of expressive aphasia, the patient was able to give written consent through providing a signature or thumbprint.

3.3.2 Exclusion Criteria

- Presence of co-morbidities, such as severe cognitive and perceptual deficits, visual disturbances as assessed by the occupational therapist or any other member of the multidisciplinary team, and fainting or dizziness identified by the medical team.
- Major comprehension impairment severe enough to have effected the completion of study assessments, as evaluated by the multidisciplinary team.

3.4 Selection of Participants

Convenience sampling was used to accrue participants. Any stroke patient, male or female, presenting with hemiplegia from the age of 35 and 85, who was admitted to the rehabilitation facility was invited to participate in the study. All patients allocated to the OTs employed at the facility, presenting with the inclusion criteria, were used for the study.

3.5 Sample Size

A sample of 42 participants was included. Sample size calculation was done using the Cochrane formulation for non-intervention sample size calculation. Based on a population of 60 patients over a six-month period, a minimum of 40 patients were determined as representative of the population based on a 0.05 margin of error (60).

3.6 Venue of Data Collection

The study was conducted at a private rehabilitation facility in Johannesburg.

3.7 Ethics Approval (Appendix A)

Ethics approval for this study was granted by the University of the Witwatersrand Human Ethics Research Committee (M130809) on 11/10/2013 (Appendix A).

3.8 Measuring instruments

3.8.1 Berg Balance Scale (Appendix B)

The outcome measure used to assess functional balance was the BBS. The requirements of the BBS are an even surface, a step, a ruler and a chair without armrests. This test measures balance using 14 tasks (including sitting and standing unsupported, sitting to standing, retrieving an object from the floor in standing, turning 360 degrees and various transfers. The patient is given a score of between zero and four, ranging from requiring moderate to maximal assistance to being independent in the task (30). A total score is calculated out of a possible 56. Scores of less than 20 are evidence of impairment in balance. Scores of between 21 and 40 are indicative of acceptable balance and scores of between 41 and 56 indicate good balance (46). The scale looks at both static and dynamic balance (46). The scale is effective in assessing balance, showing good internal consistency, inter-rater reliability, intra-rater reliability, test-retest reliability, sensitivity and validity; however, this is qualified by finding floor and ceiling effects (46).

3.8.2 Frenchay Arm Test (Appendix C)

The outcome measure used to assess UL movement was the Frenchay Arm Test. It is simple and easy to carry out. The tools required for completion of the Frenchay Arm Test are a ruler, a cylinder (12mm diameter, 5cm long), a glass filled with water, a clothes peg, a dowel (10mm diameter), a 10cm square base, a table and a chair. The test consists of five sub-tests that are to be performed with the patient's affected hand. The patient receives a score of one if they successfully complete the task and a score of zero if they are unable to complete the task successfully. No partial scores may be given. (30) Good inter-rater and test-retest reliability was found for this outcome measure. It was also found to be valid and had no ceiling effect (36).

3.8.3 Modified Timed up-and-go Test (Appendix D)

The outcome measure used to assess balance during gait as well as quality of gait was the TUG. The test has good inter-rater reliability and high validity in testing gait parameters. The requirements of the TUG are a measured 3m walkway and a chair. The patient is required to stand up from a chair, walk 3m, turn around, and return to sit down on the chair. Performance is scored as:

1 Normal

2 Very slightly abnormal
3 Mildly abnormal
4 Moderately abnormal
5 Severely abnormal

Able-bodied adults should be able to complete the course in a time of less than 13 seconds. A score of more than 13 seconds indicates that the participant is at high-risk for falling. (30) The TUG was found to be reliable and correlates with accurate prediction of those patients at risk of falling due to neurological deficits (56).

3.8.4 Functional Independence Measure (Appendix E)

The outcome measure used to measure the functional performance in specific areas was the FIM. The FIM assesses function in different areas such as eating, grooming, dressing of the UL and LL, washing of the UL and LL, toileting, and transfers. The functional assessment is a routine assessment completed weekly on every patient at the facility. These scores are sent to funders and it is essential that they are an accurate reflection of a patient's progress. The FIM assesses the patient on a seven-point scale within each area, where a score of one represents complete dependence and a score of seven represents complete independence (41). The areas mentioned above are the areas of the assessment that were used in this study to represent functioning in ADLs. There are studies indicating the FIM's reliability and sensitivity, and it was shown to be an effective tool in assessing physical function of people with traumatic brain injury (58).

3.9 Demographic Information Sheet (Appendix F)

Medical and personal history was recorded on the demographic information sheet. This sheet was purposefully designed for this study.

3.10 Procedure

3.10.1 The researcher contacted the manager of the private rehabilitation facility in order to gain consent. An information letter (Appendix G) was sent to the manager explaining the purpose of the study and what it entailed. A copy of this research proposal was attached to the letter in order to inform the manager of the researcher's plan of action.

3.10.2 The manager was required to complete an informed consent form and fax or email the completed form back to the researcher. The manager of the hospital gave permission via a written letter (Appendix H). This gave the researcher permission to approach patients within the facility and gain informed consent from them personally in order to continue with the study.

3.10.3 The patients who complied with the inclusion criteria were invited to participate in the study. Each patient was given an information letter (Appendix I). This explained the research procedure and what was expected of each participant. If they were willing to participate in the study, the patient provided informed consent (Appendix J).

3.10.4 A demographic information sheet (Appendix F) was completed for each participant, accessing the medical records as well as interviewing the participant.

3.10.5 The assessments (BBS, Frenchay Arm Test and TUG) were performed with the patients who gave informed consent. This was done two weeks and four weeks post admission to the facility. The assessments were conducted in the neurological rehabilitation gymnasium at the facility.

3.10.6 The researcher compiled the information from the FIM assessments, which are routinely completed by the rehabilitation team. The researcher performed the BBS (Appendix B), Frenchay Arm Test (Appendix C), and the TUG (Appendix D) on all participants. The two other occupational therapists working at the unit completed the FIM (Appendix E) of the patients. This was done to reduce researcher bias. Inter-rater reliability was ensured as therapists using the FIM as a tool are required to undergo testing in competence of use two-yearly.

3.10.7 The assessments were performed two and four weeks post admission and the resultant scores were recorded on the assessment scoring sheets. Similarly, scores from the FIM were obtained two and four weeks post admission and were recorded on a Microsoft Excel spread sheet.

3.10.8 Data from both the two and four week tests was analysed for all assessments.

3.11 Ethical Considerations

- Ethical approval was gained from the Human Research Ethics Committee (M130809) on 11/10/2013 (Appendix A).
- An information letter (Appendix G) was given to the manager of the rehabilitation facility, and informed consent (Appendix H) was given.
- An information letter (Appendix I) was given to each participant and each participant gave informed consent (Appendix J) to participate in the study. Patients

unable to write made use of the verbal patient informed consent form (Appendix K) which allowed them to consent using their thumb-print or by giving verbal permission for next-of-kin to sign consent.

- A number was assigned to participants on assessment. This was used to organise and store their individual information in order to ensure anonymity and confidentiality.
- Participants were allowed to stop participation in this study and withdraw at any time and were not required to state their reason for doing so.
- Participants continued with their usual rehabilitation. Their participation in the study did not affect their rehabilitation in any way.

3.12 Data Analysis

The data was stored in a file, inside a locked cabinet, in the researcher's home. This data was entered into excel spreadsheets from where the analysis was done by a statistician. Descriptive statistics from the demographic information of the sample in the form of frequencies were displayed in tables and graphs.

The data from the study was analysed using a non-parametric Rank Sign Test, as the data were not normally distributed. The data collected from the pre- and post-tests was analysed. The data collected fell into the different motor categories as well as a functional category. The test was used to establish the relationship between findings that fell into different categories. Positive or negative relationships between the variables were found.

The correlations that were explored are as follows:

Table 3.1: Correlations explored

Variable A in correlation coefficient	Variable B in correlation coefficient
Functioning in ADLs	Balance
Functioning in ADLs	Upper limb movement
Functioning in ADLs	Gait

Descriptive statistics were used to portray means and standard deviations between pre- and post-tests.

CHAPTER 4: RESULTS

4.1 Introduction to the results

The results of the study will now be presented. Firstly, the demographic data of the sample will be shown, followed by various tables and graphs highlighting the correlations between balance, UL movement and gait with functioning in ADLs. Lastly, p-values, means and standard deviations will be presented and scatterplots will be included in order to visually represent some of the strong correlations. The sample consisted of 42 participants. No data was analysed where patients had been discharged from the rehabilitation facility prior to participation in both the two- and four-week tests.

4.2 Demographics

4.2.1 Gender of participants

In this study, 45.23% of the participants were male and 54.76% of the participants were female.

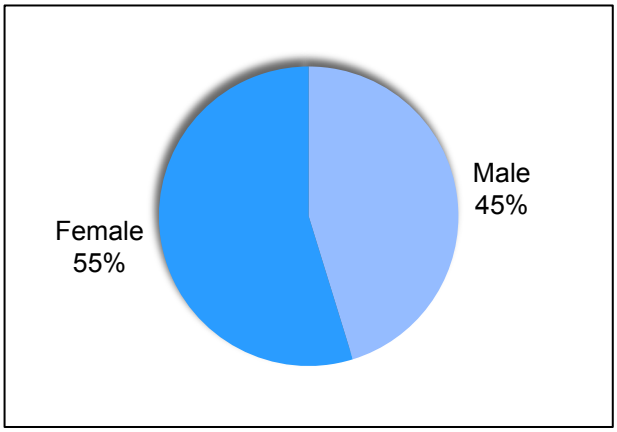


Figure 4.1: Gender of participants (n = 42)

4.2.2 Age distribution of participants

In this study, 9.5% of the participants were younger than 40 years old, with the majority of participants falling into the 40-70 year age group (61.9%). There is an increasing

frequency of people having suffered a stroke in the 51-60 year category. In this study, 28.57% of participants were older than 70.

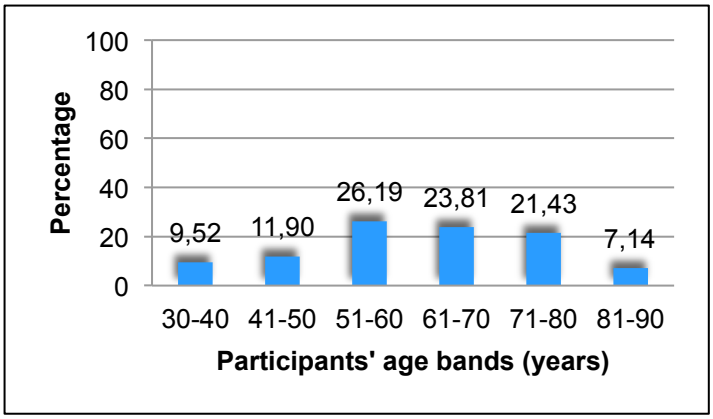


Figure 4.2: Age distribution of participants (n = 42)

4.2.3 Ethnicity of participants

More than half of the participants were white (59.52%), 30.95% of participants were black and only 9.5% of participants were coloured. There were no Indian participants in this study.

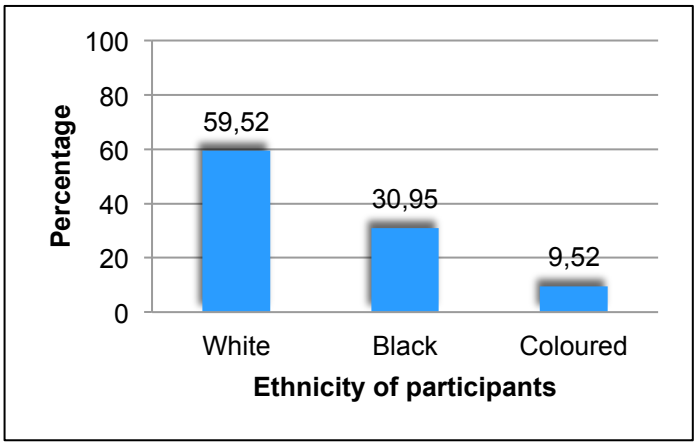


Figure 4.3: Ethnicity of participants (n = 42)

4.2.4 Primary language of participants

With regard to the home language of each participant, Afrikaans-speakers were the largest group (42.86%), the second two largest groups being English-speaking (23.81%)

and African language variations (23.8%) and the smallest group being made up of one Polish-speaking participant (2.38%) and one German-speaking participant (2.38%).

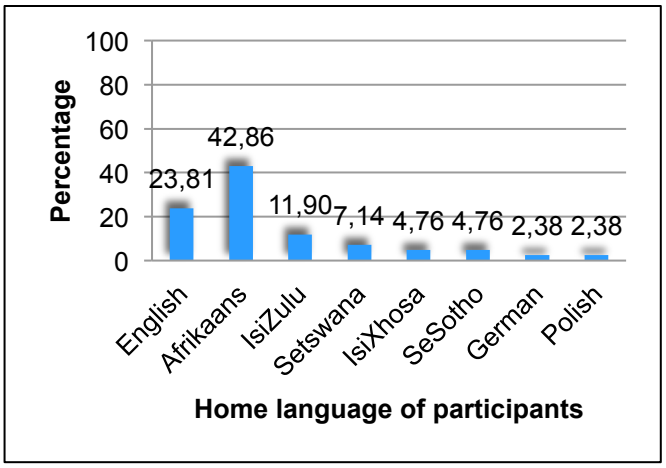


Figure 4.4: Home language of participants (n = 42)

4.2.5 Marital status of participants

In this study, 69.05% of participants were married, 19.05% widowed and 4.76% divorced. Only 7.14% of participants were single.

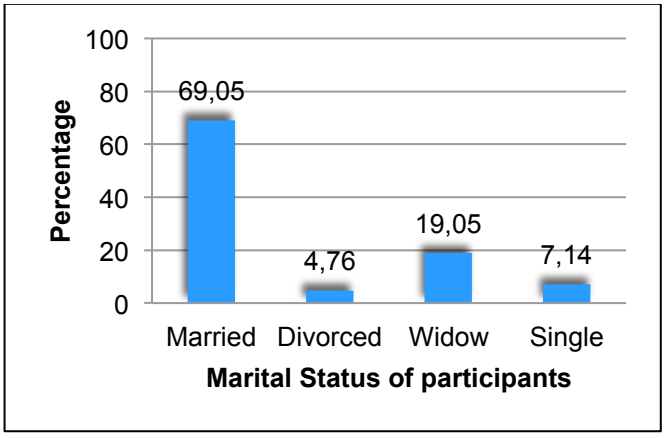


Figure 4.5: Marital status of participants (n = 42)

4.2.6 Religion of participants

Christianity was the dominant religion group (86.71%), with small percentages of Islamic (2.38%) and Catholic (4.76%) participants. In this study, 7.14% of participants reported that they followed no religion.

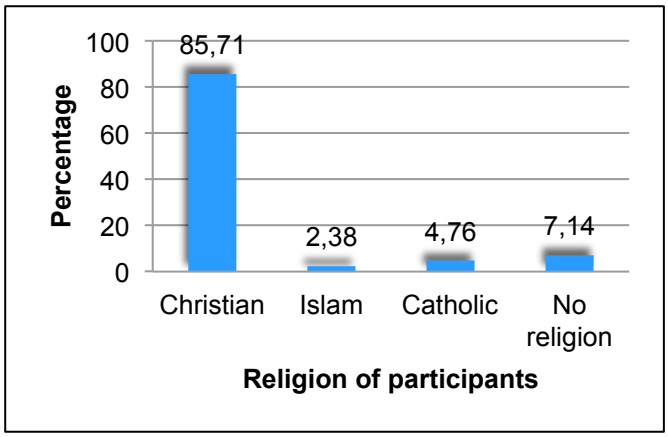


Figure 4.6: Religion of participants (n = 42)

4.2.7 Living situation of participants

The majority of participants lived in formal establishments (92.86%) with only 7.14% of participants living in informal dwellings.

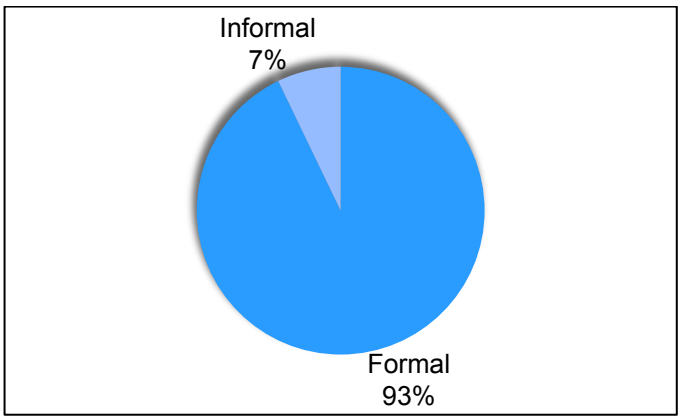


Figure 4.7: Living situation of participants (n = 42)

4.2.8 Employment status of participants

More than half of the participants were employed at the time of assessment (52.38%), with 40.48% being pensioners and 7.14% being unemployed.

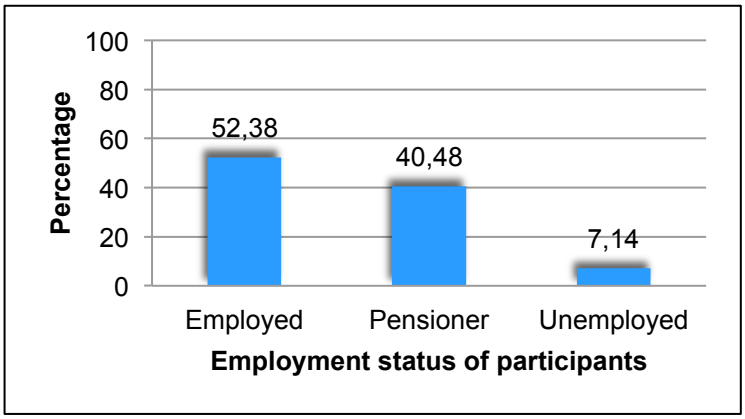


Figure 4.8: Employment status of participants (n = 42)

4.2.9 Highest level of education of participants

In this study, 35.71% of participants had achieved a matric level of education while 28.57 reported not having achieved a matric level of education. Over 30% of participants had achieved higher levels of education (tertiary).

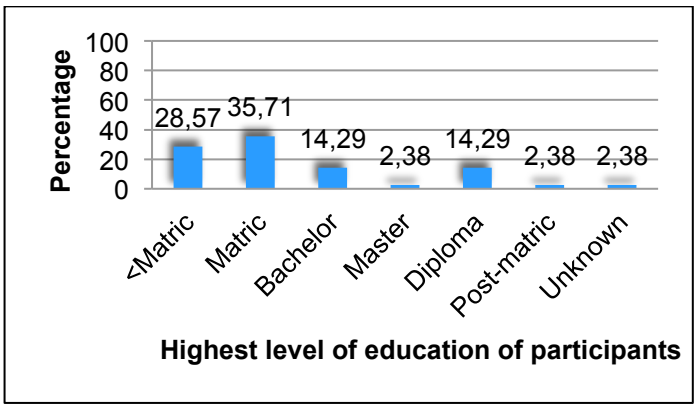


Figure 4.9: Level of education of participants (n = 42)

4.2.10 Laterality of stroke of participants

59.52% of participants had suffered a right hemisphere stroke, 38.09% of participants had suffered a left hemisphere stroke and 2.38% (one participant) had suffered a bilateral stroke.

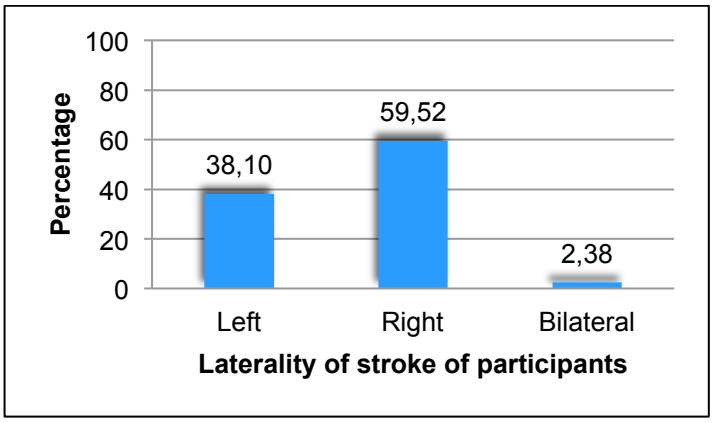


Figure 4.10: Laterality of stroke of participants (n = 42)

4.2.11 Days since stroke

The majority of participants were assessed 21-40 days after being diagnosed with a stroke 61.90%). Other findings show that participants were assessed in the rehabilitation centre as follows: 1-20 days after stroke (11.90%), 41-60 days after stroke (9.52%), 61-80 days after stroke (9.52%) and more than 100 days after stroke (7.14%). None of the participants fell into the 81-100 days category after stroke diagnosis.

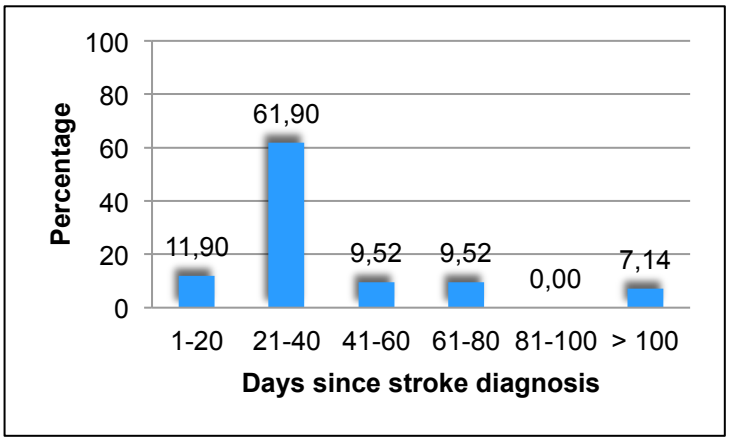


Figure 4.11: Days since stroke diagnosis (n = 42)

4.3 Change in activity of daily living scores

In the following table, the tasks from the FIM were compared pre- and post-test to determine if there was a statistically significant difference after intervention.

Table 4.2: Significant differences means and standard deviations of pre- and post-tests (n = 42)

	Pre-test		Post-test		P-value
	Mean	Standard deviation	Mean	Standard deviation	
Eating	4.78	1.25	5.08	1.29	0.01
Grooming	4.13	1.22	4.75	1.10	0.00
Washing	2.93	1.33	3.53	1.38	0.00
UB dressing	3.38	1.43	4.10	1.34	0.00
LB dressing	2.70	1.42	3.38	1.48	0.00
Toileting	2.98	1.64	3.43	1.69	0.00
Toilet transfer	3.23	1.75	3.83	1.60	0.00
Tub/shower transfer	3.2	1.6	3.65	1.63	0.00

To calculate the change in score difference between pre- and post-test for each test, the non-parametric sign ranked test was used. Descriptive statistics were used to show means and standard deviations between pre- and post-tests. All values seen in the table are statistically significant.

4.4 Study results on the correlation between motor deficits and improvement in activities of daily living

Spearman's rank correlation coefficient was used for analysis, as the data were not normally distributed. The following results contribute to the aim of establishing which underlying motor deficit has the greatest correlation with an increase in functioning in ADLs. The two tables that follow provide a key for strength and significance of correlations.

Table 4.3: Indication of strength of correlation

Indication of strength of correlation	
Poorly correlated (0.00 – 0.30)	
Moderately correlated (0.31 – 0.50)	*
Strongly correlated (0.51 – 0,80)	**
Very strongly correlated (0.81 – 1)	***

Table 4.4: Indication of significance of correlation (p ≤ 0.05)

Indication of significance of correlation	
Not statistically significant correlation	
Statistically significant correlation	*

4.4.1 Correlation of balance with functioning in activities of daily living

The following tables show the correlation of balance, UL movement and gait with functioning in each task from the FIM.

4.4.1.1 Correlation of balance with functioning in activities of daily living (pre-test)

Table 4.5: Correlation of balance with functioning in activities of daily living pre-test (n=42)

Balance	Eating	Groom	Washing	UB Dressing	LB Dressing	Toileting	Toilet Transfer	Tub/Shower Transfer	Overall function
Strength (r-value)	0.59**	0.56**	0.78**	0.80**	0.82***	0.82***	0.84***	0.84***	0.88***
Significance (p-value)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	

Balance had a very strong correlation with overall functioning in ADLs (r = 0.88), UB dressing (r = 0.80), LB dressing (r = 0.82), toileting (r = 0.82), transferring to the toilet (r = 0.84) and transferring to the tub/shower (r = 0.84). As can be seen in the table above, all correlations were statistically significant. A scatterplot (Figure 4.12) was done to visually represent the information in the table above (Table 4.5).

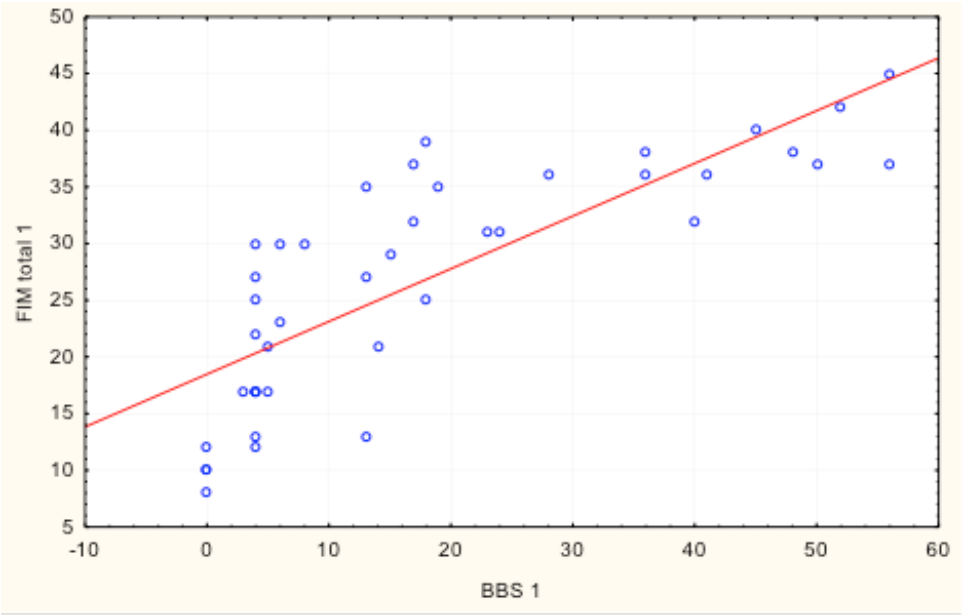


Figure 4.12: Correlation of balance with overall functioning in activities of daily living (pre-test) (n = 42)

4.4.1.2 Correlation of balance with functioning in activities of daily living (post-test)

Table 4.6: Correlation of balance with functioning in ADLs post-test (n = 42)

Balance	Eating	Groom	Washing	UB Dressing	LB Dressing	Toileting	Toilet Transfer	Tub/Shower Transfer	Overall function
Strength (r-value)	0.56**	0.61**	0.76**	0.88***	0.85***	0.81***	0.90***	0.85***	0.86***
Significance (p-value)	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	

Balance had a very strong correlation with overall functioning in ADLs (r = 0.86), UB dressing (r = 0.88), LB dressing (r = 0.85), toileting (r = 0.81), transferring to the toilet (r = 0.90) and transferring to the tub/shower (r = 0.85). As shown in the table above, all correlations were statistically significant. A scatterplot (Figure 4.13) was done to visually represent the information in the table above (Table 4.6).

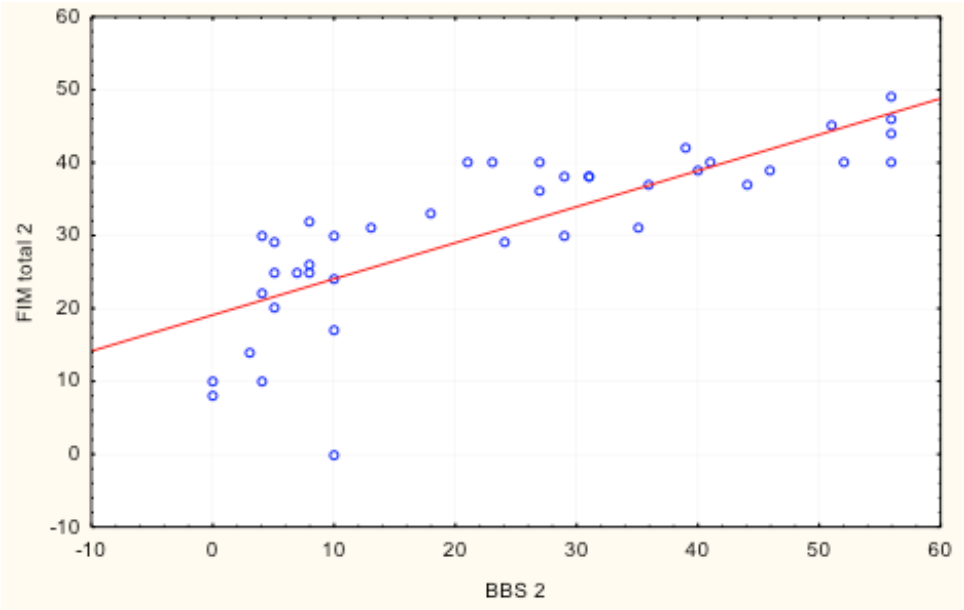


Figure 4.13: Correlation of balance with overall functioning in activities of daily living (post-test) (n = 42)

4.4.2 Correlation of upper limb movement with functioning in activities of daily living

4.4.2.1 Brunnström stage of participants' arms

It is helpful to look at the Brunnström stage of participants (Figure 4.14) as a background for the correlations seen below. 45.23% of participants had no active movement in their affected limb and were scored as being in stage 1 of Brunnström. 11.9% of participants were scored as being stage 2 of Brunnström. 19.05% of participants exhibited flexor and/or extensor synergies in their affected limb and were scored as being in stage 3 of Brunnström. 4.76% of participants were scored as being in stage 4 of Brunnström. 19.05% of participants were scored as being in stage 5 of Brunnström. No participants were scored as stage 6 or 7.

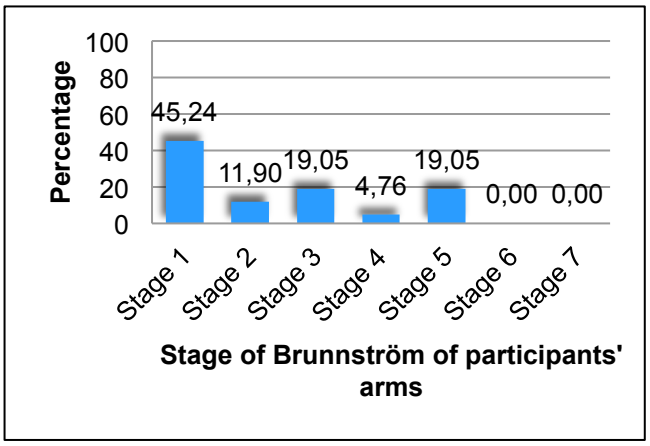


Figure 4.14: Brunnström stage of participants' arms (n = 42)

4.4.2.2 Correlation of upper limb movement with functioning in activities of daily living (pre-test)

Table 4.7: Correlation of upper limb movement with functioning in ADLs pre-test (n = 42)

UL Movement	Eating	Groom	Washing	UB Dressing	LB Dressing	Toileting	Toilet Transfer	Tub/Shower Transfer	Overall function
Strength (r-value)	0.41*	0.49*	0.62**	0.76**	0.64**	0.57**	0.70**	0.66**	0.71**
Significance (p-value)	0.03*	0.01*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	

Upper limb movement had a strong correlation with overall functioning in ADLs (r = 0.71), washing (r = 0.62), UB dressing (r = 0.76), LB dressing (r = 0.64), toileting (r = 0.57), transferring to the toilet (r = 0.70) and transferring to the tub/shower (r = 0.66). As shown in the table above, all correlations were statistically significant. A scatterplot (Figure 4.15) was done to visually represent the information in the table above (Table 4.7).

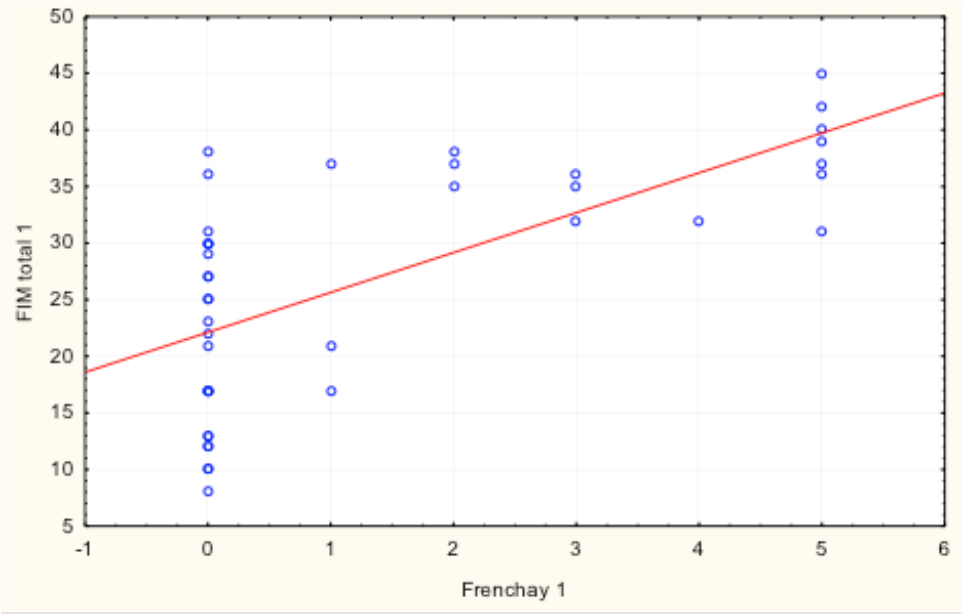


Figure 4.15: Correlation of upper limb movement with overall functioning in activities of daily living (pre-test) (n = 42)

4.4.2.3 Correlation of upper limb movement with functioning in activities of daily living (post-test)

Table 4.8: Correlation (r-values) of upper limb movement with functioning in activities of daily living (post-test) (n = 42)

UL Movement	Eating	Groom	Washing	UB Dressing	LB Dressing	Toileting	Toilet Transfer	Tub/Shower Transfer	Overall function
Strength (r-values)	0.51**	0.52**	0.64**	0.76**	0.76**	0.64**	0.68**	0.59**	0.67**
Significance (p-values)	0.01*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	

Upper limb movement had a strong correlation with overall functioning in ADLS (r = 0.67), eating (r = 0.51), grooming (r = 0.52), washing (r = 0.64), UB dressing (r = 0.76), LB dressing (r = 0.76), toileting (r = 0.64), transferring to the toilet (r = 0.68) and transferring to the tub/shower (r = 0.59). As shown in the table above, all correlations were statistically

significant. A scatterplot (Figure 4.16) was done to visually represent the information in the table above (Table 4.8).

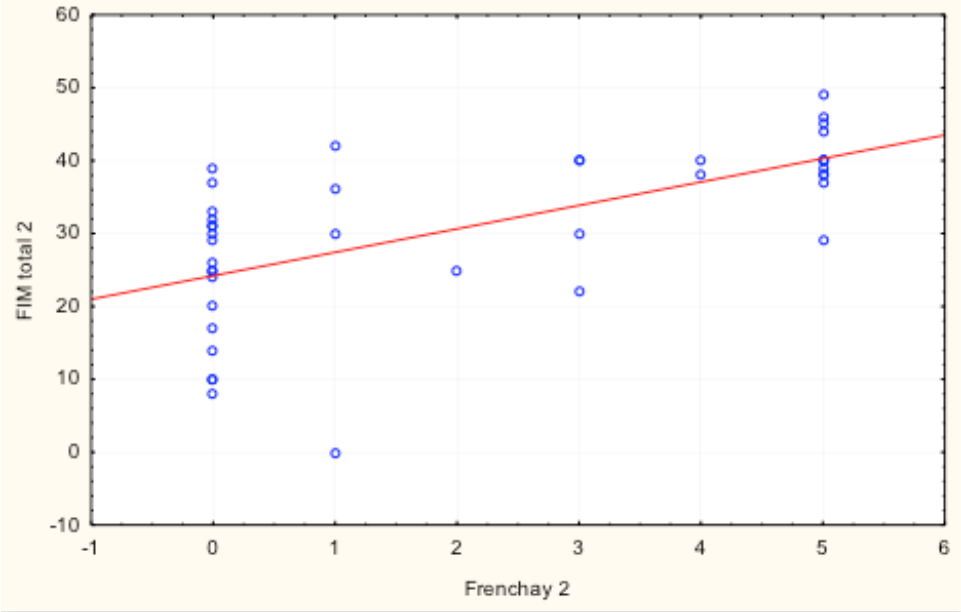


Figure 4.16: Correlation of upper limb movement with overall functioning in activities of daily living (post-test) (n = 42)

4.4.3 Correlation of gait with functioning in activities of daily living

4.4.3.1 Correlation of gait with functioning in activities of daily living (pre-test)

Table 4.9: Correlation of gait with functioning in activities of daily living (pre-test) (n = 42)

Gait	Eating	Groom	Washing	UB Dressing	LB Dressing	Toileting	Toilet Transfer	Tub/Shower Transfer	Overall function
Strength (r-value)	-0.07	-0.17	-0.07	-0.01	-0.01	-0.19	-0.14	-0.29	-0.07
Significance (p-value)	0.41	0.41	0.33	0.42	0.50	0.18	0.47	0.04*	

Gait had a weak, negative correlation with overall functioning in ADLs (r = -0.07), eating (r = -0.07), grooming (r = -0.17), washing (r = -0.07), UB dressing (r = -0.01), LB dressing (r

= -0.01), toileting (r = -0.19), transferring to the toilet (r = -0.14) and transferring to the tub/shower (r = -0.29). As shown in the table above, only the correlation of tub/shower transfers with functioning in ADLs was statistically significant. A scatterplot (Figure 4.17) was done to visually represent the information in the table above (Table 4.9).

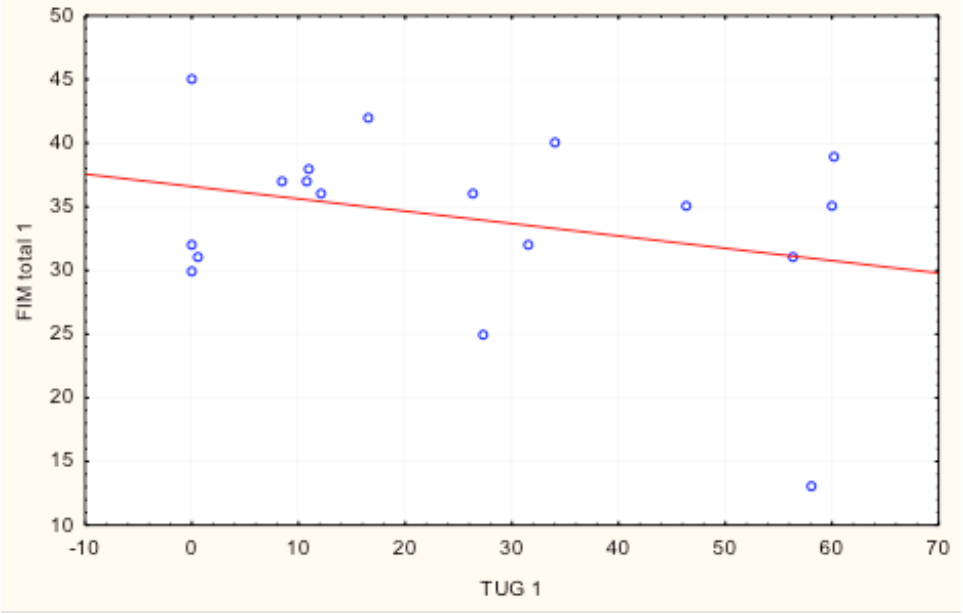


Figure 4.17: Correlation of gait with overall functioning in activities of daily living (pre-test) (n = 42)

4.4.3.2 Correlation of gait with functioning in activities of daily living (post-test)

Table 4.10: Correlation of gait with functioning in activities of daily living post-test (n = 42)

Gait	Eating	Groom	Washing	UB Dressing	LB Dressing	Toileting	Toilet Transfer	Tub/Shower Transfer	Overall function
Strength (r-value)	-0.41*	-0.30	-0.31*	-0.62**	-0.47*	-0.43*	-0.57**	-0.45*	-0.55**
Significance (p-value)	0.02*	0.18	0.15	0.00*	0.00*	0.12	0.01*	0.20	

Gait had a strong, negative correlation with overall functioning in ADLs (r = -0.55), UB dressing (r = -0.62) and transferring to the toilet (r = -0.57). Gait had a moderate, negative correlation with eating (r = -0.41), washing (-0.31), LB dressing (r = -0.47), toileting (r = -0.43) and transferring to the tub/shower (r = -0.45). As shown in the table above, correlations of eating, UB dressing, LB dressing and toilet transfers with functioning in ADLs are all statistically significant. A scatterplot (Figure 4.18) was done to visually represent the information in the table above (Table 4.10).

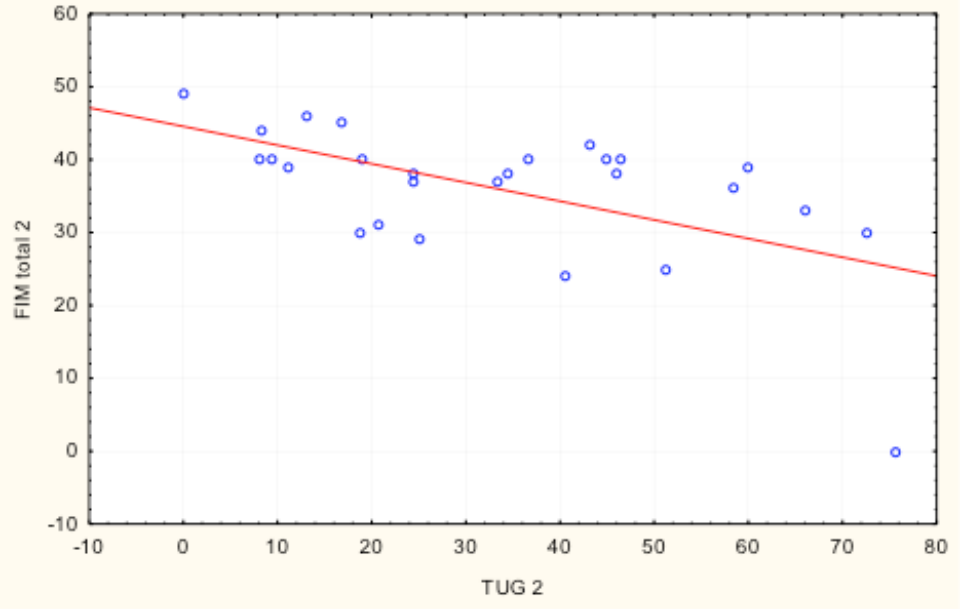


Figure 4.18: Correlation of gait with overall functioning in activities of daily living (post-test)

4.5 Conclusion to the results

The results from this study were presented in this chapter. A large number of strong correlations were produced after analysis of the data, and therefore only significant results were presented. Balance was found to have the strongest correlation with improvement in functioning of ADLs, followed by UL movement and then gait. A discussion of these results will be presented in the next chapter.

CHAPTER 5: DISCUSSION

5.1 Introduction to discussion

The next chapter will discuss the demographics of the sample and the background of the clinical setting used for data collection. It will also include a discussion of the correlations of balance, UL movement and gait with improvement in functioning in ADLs that were presented in the results. The effectiveness of each outcome measure will also be discussed. This information will be integrated with contextually relevant literature to create a platform for the recommendations of how to address the management of stroke patients in South Africa.

5.2 Background of clinical setting

The data was collected at a 40-bed, private, neurological rehabilitation hospital in Johannesburg. Patients seen at the facility include in-patients that are admitted for the first time or for re-admission. The hospital does not provide services for the management of out-patients. Patients receive intervention from various members of the multi-disciplinary team; and disciplines include physiotherapy, occupational therapy, speech therapy, psychology, social work and dietetics. The rehabilitation doctor oversees medical management of each patient. The majority of patients' rehabilitation stay is paid for by their medical aid fund. Some patients may be dependents on a family member's medical aid plan. Private-paying patients are rare however they do make up a small portion of patients. Another small portion of patients is made up of those being paid for by the Workers Compensation Assistance (WCA) and the Road Accident Fund (RAF). This group of patients consists of people that have been injured on duty or while using the South African roads. It is evident that the majority of patients at this hospital boast a high socio-economic status as they are able to subscribe to medical aids or pay privately. A small minority of patients comes from a low socio-economic background and often the reason for their admission is due to being injured on duty, and are thus funded by WCA. The sample from this clinical setting can be seen to incorporate patients from varying socio-economic levels.

According to government policy for stroke patients, PMB consists of six weeks of rehabilitation (27). This means that medical aid funds are obliged to pay for this minimum benefit for members unless the applicable medical aid plan states the exclusion of PMB.

Medical aids may continue to cover rehabilitation costs over and above PMB based on weekly motivations sent by the rehabilitation facility. This is dependent on the weekly progress and expected progress of the patient as well as the type of medical aid plan of the patient. Some medical aids employ case managers that are directly involved in the management of patients from a funding perspective. This leaves the patient's length of stay directly in the hands of the funders which may cause hospital stay to be cut short in some instances. Although six weeks is prescribed as the minimum benefit for stroke patients, this is quite often not enough time to properly rehabilitate patients so that they are able to integrate back into the community, especially if the stroke suffered is moderate to severe.

5.3 Sample demographics

Although the literature shows that strokes are more common in males than in females, the sample of this study was made up of a greater number of females than males (Figure 4.1). The fact that more females make up the sample may be based on the fact that a slightly larger group of females survive strokes than males in Southern Africa (61). Women were also found to be at a higher risk for stroke in African nations (37). A great deal of the participants fell into the '51-60' and '61-70' age groups, which is evident of a typical picture of stroke (Figure 4.2) (16). Another large group of participants fell into the '31-50' age group, which is indicative of the South African population where strokes are being suffered by younger people who are taking anti-retroviral medication due to HIV (37)(62).

The majority of the participants were white with the second largest group being black (Figure 4.3). There were no Indian participants in the study. This sample was therefore not representative of the South African population with regard to race. (19)

Participants were asked what language they spoke at home and not the language that they spoke at the rehabilitation hospital. In this study, the most commonly spoken language at home was Afrikaans, followed by English (Figure 4.4). A smaller group of participants was made of people speaking African languages at home. There were two participants who spoke European languages and living in South Africa although not originally from South Africa.

The majority of participants were married which suggests that they may have assistance at home, post-discharge (Figure 4.5). Marriage is common within the '51-60' age group

and this was also the age group that showed the highest number of strokes. The rest of the participants were divorced, widowed or never married. The vast majority of participants were Christian (Figure 4.6). The largest portion of this group consisted of protestant participants while the minority consisted of catholic participants. Christianity is the most common religious denomination in South Africa (20).

Most participants lived in formal establishments (Figure 4.7). This was congruent with them being admitted to a private rehabilitation hospital due to their high socioeconomic backgrounds. Those people that lived in informal dwellings may have been on medical aids provided by their employment, provided by another family member who was the main bread winner or due to funding received from the WCA pursuant to having a stroke while on duty at the place of their employment. Alternatively, this group of people may have paid cash. Approximately half of the participants were employed, with the next largest group being pensioners (Figure 4.8). This is congruent with the age groups that show the highest incidence of stroke within this study (16). Three people were unemployed.

Most participants had a basic education, with approximately a third of participants not having achieved matric (Figure 4.9). Having a matric or tertiary education is common for a group of people that have a high socioeconomic status. Tertiary education attended by participants included post-matric, college and university.

Twenty percent more participants suffered a right hemisphere stroke than a left hemisphere stroke (Figure 4.10). One person suffered a severe, bilateral stroke. Literature indicates that there is a 50% chance of suffering a stroke on either side (18). Due to the nature of this report, data collection was limited to a period of less than a year which may have contributed to seeing less left hemisphere strokes at that particular time of year. Based on the large number of participants portraying no active movement in their affected ULs, it seems that many participants suffered middle cerebral artery strokes (32). The majority of participants suffered strokes 21 to 40 days prior to assessment for this study (Figure 4.11). On average, medical stabilisation and acute hospital stay takes five to ten days where after patients are transferred straight to a rehabilitation facility. In cases of severe stroke, this process may take longer due to admission to the intensive care unit for medical stabilisation (25). In some cases, previous patients are re-admitted to rehabilitation after being discharged for days, months or even years before. This accounts for the participant who was assessed for this study 2302 days after being diagnosed with a stroke.

5.4 Improvement in overall Functional Independence Measure scores

Results indicate a statistically significant improvement in the overall FIM scores ($p \leq 0.05$) for all participants from the two-week pre-test assessment to the four-week post-test assessment (Table 4.2). This was true for the functional assessment as well as for the three motor assessments of balance, UL movement and gait. This indicates a fair to good prognosis for participants in this study. In considering the mean pre-test scores for the participants within each task as presented by the FIM, the average for each task showed that participants required minimal to moderate assistance (Table 4.2). This means that very few patients required the assistance of more than one caregiver for ADL completion. Participants with a more severe prognosis may have required up to two caregivers for completion of each task within the FIM. Most participants can be classified in the stage of spontaneous recovery where learning networks are activated (40). This allowed for enhancement of training-induced recovery and motor re-learning. These findings also suggest that conditions in the rehabilitation facility were beneficial for effective rehabilitation (4). The majority of participants had been stabilised medically in the acute hospital before being transferred to the private rehabilitation facility where they participated in daily rehabilitation intervention with multiple members of the multidisciplinary team. This improvement in functioning in ADLs indicates that one of the main goals of stroke rehabilitation, to improve health-related quality of life, is being reached (44).

5.5 Correlation of balance with improvement in functioning in activities of daily living

Balance is affected following stroke due to the nature of the lesion which may directly impact reflexive movement of the trunk. Hemiplegia of the ULs and LLs also has an effect on balance as one half of the body is not contributing to equilibrium and righting reactions as opposed to prior to the stroke. There is also decreased ability to perform protective reactions. Because balance is a reflexive skill, primary damage alludes to the fact that the type of stroke suffered is severe in nature, affecting not only cortical structures but also sub-cortical structures. (33) This severity impacts ability to participate in ADLs.

Balance showed a strong correlation with improvement in functioning in ADLs, specifically those ADLs requiring change in position and movement out of their base of support, for example transferring to the toilet or the bath/shower and LB dressing (Table 4.5 and Table 4.6). Correlations were of a 'strong' or 'very strong' nature. This may exclude activities such as eating and grooming as within these activities balance can be compensated for. Unfortunately, there is no compensatory method for balance that avoids restricting the patient's movement. Activities such as eating, grooming, washing and UB dressing had strong correlations with balance. Eating and grooming can potentially be compensated for as the trunk can be supported. Washing involves movement outside of the patient's base of support which is evidence of the strong correlation with balance. Activities such as LB dressing, toileting and transfers were evident of very strong correlations with balance. These activities all require movement outside of the patient's base of support. It is also known that proximal stability is necessary for distal mobility and control, which alludes to the fact that if the trunk is supported, this makes it easier to move distal body parts (33). Alternatively, if the trunk is not controlled, the base of support is poorly stabilised and dynamic movement is made more challenging. This finding is congruent with international findings in the literature where balance was shown to contribute greatly to overall functional performance (33). Overall function showed a strong correlation to improvement in balance (Table 4.5 and Table 4.6).

The BBS evaluates balance skills in a seated and standing position. Areas of self-care as grouped in the FIM do not require a person to be standing in order to complete these activities. They can all be completed in a seated position. This means that only static and dynamic sitting balance are skills needed for these tasks. Static and dynamic standing balance may contribute to tasks such as LB dressing however standing up to dress the LB is not the only method that can be used. Over and above areas of self-care, being able to integrate into the community requires a great deal more skill (63). This is not something that is always addressed in rehabilitation facilities due to limited time with patients. Because medical aids focus on gains in self-care, these are the areas that are focused on in therapy. Often, as soon as patients are functional within their personal management skills, the medical aids deem them safe to be discharged. This means that where patients are not afforded adequate rehabilitation, they are equipped only to function within their home environment, or in a seated position. Over and above this, they struggle to integrate back into the community (63).

Ultimately, ADL completion is unsafe in participants with poor balance, which makes it less desirable for them to engage in ADLs. Additionally, the majority of ADLs are

completed in the bathroom. This is a small space in which slippery, wet surfaces are common, creating a more dangerous environment. When participants feel unsafe, there is less chance that they will engage in certain activities without assistance or supervision. This will limit their problem-solving and learning. When participants have good sitting balance, they are able to participate in tasks and gain confidence in their abilities. This means that by targeting balance in sitting and standing as main rehabilitation goals, participants will be able to contribute on a greater level to their own function. This is particularly important for reducing the burden of care post-discharge as well as reducing disability within the community. Thus, identifying balance as one of the most important deficits is essential in the creation of appropriate treatment programs that aim to improve functioning in ADLs.

If patients are enabled to continue engaging in ADLs using compensatory strategies (which may very well occur if patients are discharged before being functionally ready), they may develop learned non-use. This relates to the neuroplasticity principle of “use it or lose it” where non-use of a function or ability results in loss of that functions’ localisation in the brain (4). This communicates with the neuroplasticity principle of “use it and improve it” which encourages active, repetitive use of the performance skill being addressed in order to counteract learned non-use (4). Rehabilitation programs need to incorporate use of active engagement within various different activities and environments in order to promote transference of the skill being learnt (4). This diversity will also ensure adequate intensity of therapy if done using repetition throughout daily sessions (4).

The BBS was effective in showing changes in balance within each task as presented by the FIM. Results from this outcome measure also correlated strongly with functioning in ADLs. This is congruent with findings from other studies using the BBS as an outcome measure (11).

5.6 Correlation of upper limb movement with improvement in functioning in activities of daily living

Improvement in UL movement was shown to correlate to improvement in functioning in ADLs, however not as strongly as balance (Table 4.7 and Table 4.8). Again UL showed weaker correlations with activities such as eating and grooming which may be attributed to the fact that these activities can be done with the unaffected arm and hand, using a one-handed technique. Some instances in eating (cutting a piece of meat) and grooming (tying hair into a pony-tail) do require both hands however the activities can be done using

a modified method. Activities such as washing, dressing the UB and toileting do correlate strongly with an improved ability to move the affected UL, while activities such as eating and grooming only correlate moderately due to the abundance of compensatory options for completion of those tasks. Overall function correlated strongly with improved UL movement.

When linked to the classification of Brunnström stage of the participants, it can be seen that the majority of participants had no active movement in their affected limbs. This lack of movement is a poor prognostic indicator of movement in the UL (36). This inability to move at all may result in early use of compensatory techniques as well as the early stages of learned non-use (47). When patients have limited time in rehabilitation facilities, learned non-use is detrimental to recovery of client factors and performance skills. Initial flaccidity in the affected limb also alludes to a poor prognosis with regard to return of movement and function (36).

Participants, who were classified, according to Brunnström, in stage three, four or five, had active movement in varying stages. These are the groups of participants that are able to attempt functional use of their limbs. This is also when active engagement is optimal as these patients have residual movement that can be improved. It is also a motivating factor for patients to see their affected limbs contributing to a functional task. In contrast to the LLs and to the trunk, the affected UL is often completely ignored by the patient (especially if there is decreased active movement and sensation in the limb) unless a therapist provides appropriate facilitation and motivation for the limb to be moved in an active-assisted or passive manner during therapy sessions. Unlike the LL and the trunk which are used in a non-compensatory manner during daily activities such as transfers, the UL is not forced to participate in any ADLs as many of these can be compensated for using a one-handed technique (4). The UL, therefore, requires vast external input from the OT. This will predominantly occur within therapy sessions, therefore making it difficult for patients to continue with UL rehabilitation if discharged prematurely. This highlights the need for therapists to be addressing the most important deficits effectively due to the time-pressures being placed on length of stay in rehabilitation units (9). OT treatment needs to incorporate a high intensity focus of daily rehabilitation as well as independent tasks that the patient can complete even while not in therapy; which will also ensure adequate repetition and transference of skills learnt in therapy as is recommended for optimal neuroplasticity to occur (4).

The FIM looks at function as a whole and not necessarily at how the task is completed. There is little emphasis on quality of movement but rather on the ability to complete the task. This is also the focus of medical aid funds. This further contributes to learned non-use of the affected limb by the patient and facilitated by therapists who are working towards functional goals. With regard to basic functional tasks such as dressing and washing, compensatory techniques can be incorporated fairly easily and do not often require additional cost, however, when it comes to higher level skills such as driving, more expensive and time-consuming compensations need to be made such as adaptations to the vehicle. The ability to compensate for these higher-level skills is rarely taken into account by medical aid funds, leaving patients to address these issues out of their own pocket, if at all.

Ultimately, UL movement had a strong correlation with recovery in function and it is necessary to include the treatment of UL movement in an appropriate treatment program. On a basic level of ADLs, an UL deficit can be compensated for; however for many young, stroke patients in South Africa, integration into the community is the ultimate goal in terms of which two-handed techniques are of utmost importance (63).

The Frenchay Arm Test was fairly effective in evaluating changes in UL movement from pre-test to post-test. This is congruent with findings from other studies evaluating arm and hand movement (36). However, this outcome measure does require a substantial level of recovery of movement in order to complete sub-tests, and it is likely that if a participant is unable to complete one of the sub-tests, they will be unable to complete further sub-tests. This means that the outcome measure does not detect smaller changes in UL movement. This has clinical implications due to the fact that there appears to be a lack of UL movement outcome measures that are sensitive. It is essential that future research addresses this gap in UL rehabilitation in order to properly evaluate the hemiplegic UL. For current OT practice, it is recommended that the Frenchay Arm test be used in conjunction with Brunnström's stages of recovery of movement of the hand and arm in order to represent movement in the UL more comprehensively.

5.7 Correlation of gait with improvement in functioning in activities of daily living

The correlation between gait and improvement in functioning in ADLs was poor to moderate (Table 4.9 and Table 4.10). This appears appropriate as walking is rarely required for completing personal management tasks. In cases where mobility is required, for example fetching clothing from the wardrobe, modes of mobility other than gait are acceptable which eliminates gait as a requirement for completion. Tasks such as eating and grooming do not require the participant to set anything up and therefore requires no mobility at all. The self-care tasks represented in the FIM form part of a personal management routine that can all be done in one room of the home and does not take into account a higher level of ADLs that contribute toward integration into the community. Furthermore, higher level ADLs are not the focus of the medical aid funds when considering how long patients still need for rehabilitation. Balance has been shown to correlate with gait which is relevant based on the premise that proximal stability is required for distal mobility, however this does not mean that gait is correlated with functioning in ADLs especially on the basic level scored by the FIM.

In comparison to UL movement, gait does not need to be as dexterous to be functional. Additionally, compensation and use of aids with regard to walking does not promote learned non-use in the affected LL as it does in the UL where compensation involves one-handed techniques thus contributing to learned non-use of the affected UL(32). Gait and stepping (and use of the affected LL) is necessary in daily activities such as transferring. This increases the intensity of practice, repetition and transference of these skills even outside of therapy as well as allowing the affected LL to contribute to functional tasks (4). There is less chance of compensation of the LL in functional activities than in tasks requiring UL movement.

While improvement in gait has not been shown to correlate with completion of self-care tasks, it has been shown to correlate with functional mobility and improved ability to integrate into the community in previous pieces of literature (50). It is also one of the most important expectations/goals for rehabilitation as reported by patients (51). This contradicts the expectations of the medical aid funds, as their focus does not extend to higher-level skills that may contribute to community re-integration.

Furthermore, increased daily physical activity has been shown to correlate with increased quality of life (44). This means that where gait can be incorporated into daily life, it will also contribute to quality of life. Dependent on the individual goals of each patient, gait may not be the most important deficit to treat in achieving function in ADLs within the home however it is highly beneficial when community reintegration is desired.

The TUG was effective as an outcome measure in determining changes in gait from pre-test to post-test. This was congruent with other studies considering gait within samples of participants presenting with neurological deficits (56). This outcome measure does require that the participant is able to walk either independently, or with the use of an assistive device. This excludes participants who are mobile using a wheelchair, from being assessed using this outcome measure. Ultimately, it can be seen that it is more applicable to higher functioning participants.

5.8 Limitations of Functional Independence Measure as a Tool for Function

As has been discussed in the previous sections of this chapter, the use of the FIM as a tool by which medical aid funds can monitor patient progress is not as sensitive and reliable as may be necessary within the South African context. Medical aid funds place huge emphasis on patients' abilities to perform self-care activities and use these scores as cues for patients being ready for discharge. In reality, people who have suffered strokes have greater expectations than merely being able to participate in self-care and personal management once discharged. This is true for the majority of stroke patients but especially true for the younger population who are suffering strokes (37). People who suffer strokes when they are younger than 60 years old are usually employed. Post-discharge they aim to return to work and reintegrate back into their communities (63). These goals are limited when patients are not allowed adequate time in rehabilitation facilities to progress to the desired level. This highlights the importance of being able to identify those deficits that contribute most to functional performance so that when time constraints are imposed by medical aid funds, patients are as functional as possible in as short a time as possible.

5.9 Summary of Discussion

This discussion has presented a brief description of the clinical setting where data was collected as well as the demographics of the sample used. Insight was given with regard to correlations found between balance, UL movement and gait with functioning in ADLs. Balance was found to have the strongest correlation with improvement in functioning

within ADLs, followed by improvement in UL movement. Improvement of gait was found to have a very poor correlation with an improvement in functioning within ADLs. Where there was no active UL movement on admission, prognosis was poor and compensatory strategies were more likely to be used. Although UL movement did not correlate as strongly with functioning in ADLs as balance, it was seen that use of both ULs is essential for more complex tasks, often required for work and community integration. Additionally, gait contributes to a more successful community integration. Finally, limitations of the outcome measures used in South Africa were highlighted. The FIM is used in many private rehabilitation facilities in South Africa however it is not standardised for use within the South African context. It was not deemed sensitive enough in considering functioning levels for younger stroke patients who often have higher expectations of integrating back into the community and returning to work. It is essential for a tool to be developed that takes the individuality of the South African context into account when assessing and providing intervention for stroke patients.

5.10 Evaluation of the Study

5.10.1 Limitations of the Study

The exact site of infarct was not included in the demographical information. This would have been useful information as much of the functional deficit that was seen can be attributed to a particular site of injury. Where improvement was not seen in certain participants, derivations could have been drawn from the site of injury.

Only the Brunnström stage for the arm was classified; however the Frenchay Arm Test assesses both the arm and the hand. Having a brief classification of hand function would have been useful in further explaining the results of the Frenchay Arm Test.

Three different researchers collected data with regard to the functioning in ADLs of each participant. Although the FIM has inter-rater reliability and therapists are tested two-yearly for competence in the use of the outcome measure, there may have been discrepancy between how the participants were scored due to human error.

The FIM does not give a description of *how* the participant is completing each task. This would be helpful in identifying whether participants are using compensatory methods or

methods using normal movement. More clarity could have been given to the discussion regarding this topic.

The data collection period was limited due to the nature of this project being a research report.

Although a power calculation was done, the sample size for this study was small.

This sample is not representative of the majority of the South African population as only a small portion of the population has access to private health care. These patients received rehabilitative intervention for longer than much of the population.

CHAPTER 6: CONCLUSION

6.1 Summary of Findings

This study reinforced the concern that stroke patients within private healthcare are discharged before they are functionally ready to integrate back into the community.

The participants in this study showed improvement in functioning within ADLs from the pre-test to the post-test scores. This reinforces the idea that principles of neuroplasticity were utilised in the clinical setting, allowing for neuroplastic change.

Balance was shown to have a very strong correlation with an improvement in functioning of ADLs and it was also shown to be a prognostic factor in terms of general functional recovery. When patients have poor balance, they are not safe to participate in ADLs without supervision/assistance. This limits their own problem solving, learning and ultimate recovery in functioning of ADLs as they may struggle to interact with their environment.

Upper limb movement was shown to have a strong correlation with an improvement in functioning of ADLs. Evidence showed that where participants had no active movement in their affected limb on admission, they were likely to compensate during functional activity completion, finding alternative methods of completing tasks. Literature supports that although one-handed techniques can be used in basic ADLs, bilateral UL movements are essential for more complex ADLs such as those required for returning to work and community integration.

Gait was shown to have a poor to moderate correlation with recovery in functioning of ADLs. Gait was not seen as a pre-requisite for participation in basic ADLs although it is identified by stroke patients as one of their most important goals for rehabilitation. Although gait does not necessarily contribute to functioning in ADLs, it does contribute to functional mobility and assists with more complex ADLs and community re-integration.

It was identified that balance appears to be the most important underlying deficit and needs to be addressed as a main goal of rehabilitation. UL movement and gait were

identified as being important for more complex ADLs where bilateral UL movement and functional mobility are required.

While this study addressed particular motor deficits resulting from stroke and their impact on functioning in ADLs, other aspects of impairment such as cognitive and visual perceptual deficits should not be deemed less important. Additionally, it should be highlighted that very rarely do patients suffer purely motor impairments, with stroke presentation often being a combination of motor, cognitive and visual perceptual deficits.

The use of the FIM as a functional measure appeared to have some limitations. It is not standardised to be used within the unique South African context. In this way, reliability of the functional scoring of each participant was compromised.

6.2 Recommendations for Future Studies

Since the results of this study are only applicable to the private sector, it is recommended that this study be replicated within public rehabilitation.

Since the sample used in this study was only made up of 42 participants, it is recommended that a future study include a larger sample.

6.3 Recommendations for Clinical Practice

This study found that balance may have the greatest impact on functioning in ADLs and therefore should be considered as one of the most important underlying deficits by therapists working in adult neurological rehabilitation. It is important for OTs working in the field of adult neurological rehabilitation to consider the findings of this research while simultaneously acknowledging the client-centred ethos of occupational therapy.

The Fenchay Arm Test should be used in conjunction with other UL outcome measures in order to ensure accurate evaluation of UL function.

The FIM should be used solely for evaluation of functioning within the home environment as it is not sensitive enough, nor entirely relevant, for adequate evaluation of more complex ADLs related to community integration.

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Appendix A

R14/49 Ms Caitlin Muller

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130809

NAME: (Principal Investigator)	Ms Caitlin Muller
DEPARTMENT:	Occupational Therapy Life Healthcare Centre Riverfield Lodge
PROJECT TITLE:	The Association between Change in Functioning in Activities of Daily Living and Components of Motor Recovery After Stroke
DATE CONSIDERED:	30/08/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Juliana Freeme
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	11/10/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and ONE COPY returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. I agree to submit a yearly progress report.

Principal Investigator Signature

Date 15/10/2013

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Berg Balance Scale

Appendix B

Participant code: _____
Date: _____
Location: _____
Rater: _____
Ax number (circle): 1 2

ITEM DESCRIPTION	SCORE (0-4)
Sitting to standing	_____
Standing unsupported	_____
Sitting unsupported	_____
Standing to sitting	_____
Transfers	_____
Standing with eyes closed	_____
Standing with feet together	_____
Reaching forward with outstretched arm	_____
Retrieving object from floor	_____
Turning to look behind	_____
Turning 360 degrees	_____
Placing alternate foot on stool	_____
Standing with one foot in front	_____
Standing on one foot	_____
Total	_____

GENERAL INSTRUCTIONS
Please document each task and/or give instructions as written. When scoring, please record the lowest response category that applies for each item.

In most items, the subject is asked to maintain a given position for a specific time. Progressively more points are deducted if:

- the time or distance requirements are not met
- the subject's performance warrants supervision
- the subject touches an external support or receives assistance from the examiner

Subject should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will adversely influence the performance and the scoring.

Equipment required for testing is a stopwatch or watch with a second hand, and a ruler or other indicator of 2, 5, and 10 inches. Chairs used during testing should be a reasonable height. Either a step or a stool of average step height may be used for item # 12.

Berg Balance Scale

SITTING TO STANDING
INSTRUCTIONS: Please stand up. Try not to use your hand for support.
( ) 4 able to stand without using hands and stabilize independently
( ) 3 able to stand independently using hands
( ) 2 able to stand using hands after several tries
( ) 1 needs minimal aid to stand or stabilize
( ) 0 needs moderate or maximal assist to stand

STANDING UNSUPPORTED
INSTRUCTIONS: Please stand for two minutes without holding on.
( ) 4 able to stand safely for 2 minutes
( ) 3 able to stand 2 minutes with supervision
( ) 2 able to stand 30 seconds unsupported
( ) 1 needs several tries to stand 30 seconds unsupported
( ) 0 unable to stand 30 seconds unsupported

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL
INSTRUCTIONS: Please sit with arms folded for 2 minutes.
( ) 4 able to sit safely and securely for 2 minutes
( ) 3 able to sit 2 minutes under supervision
( ) 2 able to able to sit 30 seconds
( ) 1 able to sit 10 seconds
( ) 0 unable to sit without support 10 seconds

STANDING TO SITTING
INSTRUCTIONS: Please sit down.
( ) 4 sits safely with minimal use of hands
( ) 3 controls descent by using hands
( ) 2 uses back of legs against chair to control descent
( ) 1 sits independently but has uncontrolled descent
( ) 0 needs assist to sit

TRANSFERS
INSTRUCTIONS: Arrange chair(s) for pivot transfer. Ask subject to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use two chairs (one with and one without armrests) or a bed and a chair.
( ) 4 able to transfer safely with minor use of hands
( ) 3 able to transfer safely definite need of hands
( ) 2 able to transfer with verbal cuing and/or supervision
( ) 1 needs one person to assist
( ) 0 needs two people to assist or supervise to be safe

STANDING UNSUPPORTED WITH EYES CLOSED
INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.
( ) 4 able to stand 10 seconds safely
( ) 3 able to stand 10 seconds with supervision
( ) 2 able to stand 3 seconds
( ) 1 unable to keep eyes closed 3 seconds but stays safely
( ) 0 needs help to keep from falling

STANDING UNSUPPORTED WITH FEET TOGETHER
INSTRUCTIONS: Place your feet together and stand without holding on.
( ) 4 able to place feet together independently and stand 1 minute safely
( ) 3 able to place feet together independently and stand 1 minute with supervision
( ) 2 able to place feet together independently but unable to hold for 30 seconds
( ) 1 needs help to attain position but able to stand 15 seconds feet together
( ) 0 needs help to attain position and unable to hold for 15 seconds

Berg Balance Scalecontinued…..

REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING
INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Examiner places a ruler at the end of fingertips when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The recorded measure is the distance forward that the fingers reach while the subject is in the most forward lean position. When possible, ask subject to use both arms when reaching to avoid rotation of the trunk.)
( ) 4 can reach forward confidently 25 cm (10 inches)
( ) 3 can reach forward 12 cm (5 inches)
( ) 2 can reach forward 5 cm (2 inches)
( ) 1 reaches forward but needs supervision
( ) 0 loses balance while trying/requires external support

PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION
INSTRUCTIONS: Pick up the shoe/slipper, which is place in front of your feet.
( ) 4 able to pick up slipper safely and easily
( ) 3 able to pick up slipper but needs supervision
( ) 2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance independently
( ) 1 unable to pick up and needs supervision while trying
( ) 0 unable to try/needs assist to keep from losing balance or falling
TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING
INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.
( ) 4 looks behind from both sides and weight shifts well
( ) 3 looks behind one side only other side shows less weight shift
( ) 2 turns sideways only but maintains balance
( ) 1 needs supervision when turning
( ) 0 needs assist to keep from losing balance or falling

TURN 360 DEGREES
INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.
( ) 4 able to turn 360 degrees safely in 4 seconds or less
( ) 3 able to turn 360 degrees safely one side only 4 seconds or less
( ) 2 able to turn 360 degrees safely but slowly
( ) 1 needs close supervision or verbal cuing
( ) 0 needs assistance while turning

PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED
INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touch the step/stool four times.

( ) 4 able to stand independently and safely and complete 8 steps in 20 seconds
( ) 3 able to stand independently and complete 8 steps in > 20 seconds
( ) 2 able to complete 4 steps without aid with supervision
( ) 1 able to complete > 2 steps needs minimal assist
( ) 0 needs assistance to keep from falling/unable to try

STANDING UNSUPPORTED ONE FOOT IN FRONT
INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width.)
( ) 4 able to place foot tandem independently and hold 30 seconds
( ) 3 able to place foot ahead independently and hold 30 seconds
( ) 2 able to take small step independently and hold 30 seconds
( ) 1 needs help to step but can hold 15 seconds
( ) 0 loses balance while stepping or standing

STANDING ON ONE LEG
INSTRUCTIONS: Stand on one leg as long as you can without holding on.
( ) 4 able to lift leg independently and hold > 10 seconds
( ) 3 able to lift leg independently and hold 5-10 seconds
( ) 2 able to lift leg independently and hold ≥ 3 seconds
( ) 1 tries to lift leg unable to hold 3 seconds but remains standing independently.
( ) 0 unable to try of needs assist to prevent fall

( ) TOTAL SCORE (Maximum = 56)

Appendix C

Frenchay Arm Test

Participant code: _____
Date: _____
Location: _____
Rater: _____
Ax number (circle): 1 2

This short test consists of five tasks to be performed with the affected hand:

1. Stabilize a ruler while drawing a line with a pencil held in the other hand. To pass, the ruler must be held firmly.
2. Grasp a cylinder (12mm diam., 5 cm long) set on its end approximately 15 cm from the table edge, lift it about 30 cm and replace it without dropping.
3. Pick up a glass half-full of water positioned 15-30 cm from the table edge, drink some water and replace the glass without spilling any water.
4. Remove and replace a spring clothes peg from a 10 mm diameter dowel, 15 cm long, set in a 10 cm square base, placed 15-30 cm from the table e3dge. The peg must not be dropped or the dowel knocked over.
5. Comb the hair (or imitate); the hair must be combed across the top, down the back, down each side of the head.

The test is performed in sitting with the hands in the lap, with each task starting from this position. A score of 1 is given for the successful performance, zero for failure.

Assessment form

Item	Pass (one point)	Fail (zero points)
1		
2		
3		
4		
5		

Appendix D

Timed Up and Go Test

Participant code: _____
Date: _____
Location: _____
Rater: _____

TUG time: _____

General information

- The patient should sit on a standard armchair, placing his/her back against the chair and resting his/her arms on the chair's arms. Any assistive devices used for walking should be nearby.
- Regular footwear and customary walking aids should be used.
- The patient should walk to a line that is 3m (9.8 feet) away, turn around at the line, walk back to the chair, and sit down.
- The test ends when the patient's buttocks touch the seat.
- Patients should be instructed to use a comfortable and safe walking speed.
- A stopwatch should be used to time the test (in seconds)

Set-up

- Measure and mark a 3 meter (9.8 feet) walkway
- Place a standard height chair (seat height 46 cm, arm height 67 cm) at the beginning of the walkway

Patient Instructions

- Instruct the patient to sit on the chair and place his/her back against the chair and rest his/her arms on the chair's arms.
- The upper extremities should not be on the assistive device (if used for walking), but should be nearby.
- Demonstrate the test to the patient.
- When the patient is ready, say "Go".
- The stopwatch should start when you say "Go", and should be stopped when the patient's buttocks touch the seat.

The Functional Independence Measure (FIM)

Appendix E

Life *Rehabilitation*

Patient:

Date of review:

		Admission	1st Review	2nd Review	3rd Review	4th Review	5th Review	6th Review	7th Review
SELF-CARE	Eating								
	Grooming								
	Bathing								
	Dressing Upper								
	Dressing Lower								
	Toileting								
	Swallowing *								
SPHINCTER	Bladder I: Assistance								
	Bladder II								
	Bowel I: Assistance								
	Bowel II: Frequency								
TRANSFER	Bed, Chair, Wheelchair								
	Toilet								
	Tub, Shower								
	Car transfer*								
LOCOMOTION	Walk/Wheelchair								
	Stairs								
	Community Access*								
	MOTOR FIM+FAM SUBSCORE								
COMMUNICATION	Comprehension audio/visual								
	Expression verbal/non-verbal								
	Reading*								
	Writing*								
	Speech Intelligibility*								
PSYCH/SOC ADJUST	Social Interaction								
	Emotional status*								
	Adjustment to limitations*								
	Employability*								
COGNITIVE FUNCTION	Problem Solving								
	Memory								
	Orientation*								
	Attention*								
	Safety Judgement*								
	COGNITIVE FIM+FAM SUBSCORE								
	TOTAL FIM+FAM SCORE								

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Appendix F

Participant code: _____

Demographical Questionnaire

Diagnosis (left/right): _____
Date of diagnosis: _____
Medical history: _____
_____
Date of admission: _____
Date of birth: _____
Gender: _____
Ethnicity: _____
Home language: _____
Employment status: _____
Marital status: _____
HLE completed: _____
Religion: _____
Other therapy received: _____
Brunnstrom level: _____

Social Circumstances:
Type of dwelling (e.g. informal or formal, number of bedrooms):
_____
Total amount of income in household:
_____
Number of dependents in household:
_____
Care situation of patient at home:
_____

Permission letter

Appendix G

To: Unit Manager of the Therapy Department
Life Healthcare

Dear Sir,

My name is Caitlin Muller. I am an M.Sc Occupational Therapy student from the University of Witwatersrand. I am doing this study as a part of my Masters degree. The title of my research is "**A study to determine which motor deficit has the strongest correlation with an improvement in functioning in activities of daily living".**

In-patients fulfilling the inclusion criteria at your facility are invited to participate in a research study. This letter of information is to help you decide if you would agree for in-patients at your facility to take part in this research study. Before you agree, it is important that you understand what it involves. If you have any questions regarding areas that are not fully explained in this letter, please do not hesitate to contact the researcher.

WHAT IS THE PURPOSE OF THIS STUDY?

Patients that have been diagnosed with hemiplegia, will be the focus of the study that investigates the correlation between the motor components of balance, upper limb (UL) movement, and gait with functioning in activities of daily living (ADLs). Balance will be assessed as the participants' ability to hold themselves in their chosen position, against gravity. UL movement considers the participants' range of motion, muscle strength, control of movement and coordination within certain planes. Gait will be considered in terms of the participants' ability to carry their bodies whilst walking. Assessments will be done in these three different motor areas; balance, UL movement, and gait. These will be additional assessments over and above those done at this facility ordinarily. The UL outcome measure will require participants to perform various grasps as well reach their arms forward and backward in a number of functional tasks. It will look at the participants' ability to perform the movement as well as the quality of the movement. The balance outcome measure will look at the participants' ability to maintain certain positions (sitting, standing) and their ability to transition between these positions. The gait outcome measure will require the participant to stand up from sitting, walk three metres, turn around, walk back to the chair and sit down. It will look at the participants' ability to perform the outcome measure as well as the quality of the movement.

Patients at this facility are assessed functionally on a weekly basis. These results are used to track progress as well as the effectiveness of treatment. With your permission, I will also use the results of this functional assessment (FIM) for my study. The results will be used to investigate relationships between functioning in ADLs, balance, UL movement, and gait in order to establish which of the motor components contributes most to function. During the study, the patients will receive normal, intensive rehabilitation as a part of the Life Healthcare package. Additionally, the researcher will assess the patients in the above-mentioned motor and functional areas.

WHAT IS THE DURATION OF THIS STUDY?

Forty patients will be assessed. The study will last for four weeks per patient. After the patient is discharged from the facility, their involvement in this study will terminate. The four assessments will take approximately 45 minutes and will be performed twice during the patients' stay at the facility - once after two weeks, and a second time after four weeks.

EXPLANATION OF PROCEDURES TO BE FOLLOWED

This study involves the assessment of balance using a 20-point scale, the assessment of UL movement using a five-task assessment, the assessment of gait using a 3-metre walking test. The functioning in ADLs will be observed during the normal day of the patient, as per usual procedure. The assessments will be performed by two other occupational therapists working at the facility and I.

ARE THERE ANY RISKS INVOLVED IN YOUR PARTICIPATION IN THE STUDY?

Due to the nature of the balance test, the researcher will take utmost care to ensure the participants' safety. The researcher will ensure participants are not injured by standing closely to them during the assessments. Safety will also be ensured by making sure the participant knows exactly what the assessment entails before the assessment commences. The researcher will also give reminders throughout the assessments regarding the safest method to complete the assessment. The researcher will follow principles of safe transfers as practiced in the field of physical rehabilitation.

HAS THIS STUDY RECEIVED ETHICAL APPROVAL?

This study protocol has been submitted to the Faculty of Health Sciences Research Ethics Committee of the University of Witwatersrand and the ethical clearance has been obtained.

WHAT ARE YOUR RIGHTS OF YOUR PATIENTS IN THIS STUDY?

The results of these assessments will only be used for investigation in this study and participants will remain anonymous. Participation is totally voluntary and participants have the right to withdraw from the study at any time, without stating any reason for doing so, and without any penalty. Withdrawal from this study will not affect patients' access to therapy in any way. The researcher may withdraw participants from the study if it is considered to be in their best interest.

SOURCE OF ADDITIONAL INFORMATION

For the duration of this study, participants will be under the care me, Ms. Caitlin Muller. If at any time you have any questions, please do not hesitate to contact her. The telephone number is 072 274 5446, through which you can reach me.

CONFIDENTIALITY

All information obtained during the course of this study is strictly confidential. Data that may be reported in scientific journals will not include any information which identifies your patients in this study. Any information uncovered regarding test results or state of health as a result of participation in this study will be held in strict confidence. Patients will be informed of any finding of importance to their health or continued participation in this study but this information will not be disclosed to any third party in addition to those listed above without their permission.

CONTACT DETAILS

For further information/reporting of study related events please contact the Wits Occupational Therapy Department on 011 717 3701. Please contact the Chairman of the ethics committee, Prof P Cleaton-Jones at anisa.keshav@wits.ac.za or at 011 717 1234 if you have any complaints or problems.

Yours sincerely

Caitlin Helen Muller
Occupational Therapist
Tel: 072 274 5446

Appendix H

Life Rehabilitation

National Rehabilitation office
Oxford Manor, 21 Chaplin Road, Illovo, 2196
Private Bag X13, Northlands, 2116, South Africa
Telephone +27 11 219 9620
Facsimile +27 86 686 0441
www.rehab.co.za

2 October 2013

Caitlin Muller
Department of Occupational Therapy
Faculty of Humanities
University of Witwatersrand

Request for permission to conduct research

Dear Caitlin

Many thanks for the request for permission to conduct research at our Life Rehabilitation Units at Life Riverfield Lodge, Fourways on the topic: *The association between different components of motor recovery with functional performance in patients with hemiplegia.*

Life Rehabilitation supports the development of the field of rehabilitation through evidence-based research and we have a number of ongoing research projects in our units.

I hereby grant permission to you to access our Life Riverfield Lodge in order to conduct your research under the following conditions:

- Obtaining permission from the University ethics department to conduct the research
- As we value patient confidentiality and patients' right to choose, no patient may be identified, either by name or by the unit where the patient received his/her rehabilitation;
- No comparison is to be made between patients receiving rehabilitation at various rehabilitation units;
- No specific mention is to be made of the amount or type of intervention provided for a specific patient;
- No disclosure of specific norms and standards used in Life Rehabilitation units, unless specific permission is granted by myself to do so;
- Access to patient documentation must be controlled and supervised;
- Patient participation in the study is voluntary, and they may choose not to participate;
- The data gathered may only be used for the purpose of the research no information obtained in our units may be used by third parties

Access to the unit is dependent upon permission by the relevant managers to limit disruption to the unit routine and patients' rehabilitation programmes. Please liaise with Ms Kerusha Govender, Rehabilitation Clinical Specialist, or Ms Ida Geldenhuys, Therapy Manager at Life Riverfield Lodge.

I wish you success with your research, and look forward to the results. We would appreciate a copy of your research upon completion.

Sincerely,

Nina Strydom
Support Specialist
Clinical Products
Life Healthcare
Tel: + 27 31 313 7912
Fax: + 27 866781450
Mobile: + 27 84 566 1281
Email: nina.strydom@lifehealthcare.co.za

Information letter - Participant

Occupational Therapy Department, University of Witwatersrand

Hello,

Appendix I

My name is Caitlin Muller. I am an M.Sc Occupational Therapy student from the University of Witwatersrand. I am doing this study as a part of my Masters degree. The title of my research is "**A study to determine which motor deficit has the strongest correlation with an improvement in functioning in activities of daily living**".

INTRODUCTION

You are invited to participate in a research study. This letter of information is to help you decide if you would like to take part in this research study. Before you agree to take part in this study, it is important that you understand what it involves. If you have any questions regarding areas that are not fully explained in this letter, please do not hesitate to contact the researcher. Your doctor at the rehabilitation facility will be notified of your participation in this study should you choose to take part.

WHAT IS THE PURPOSE OF THIS STUDY?

You have been diagnosed with hemiplegia, either as a result of traumatic or non-traumatic injury to the brain. The researcher would like you to consider taking part in a research study that investigates the correlation between the motor components of upper limb (UL) movement, balance and gait with functioning in activities of daily living. UL movement considers the participants' range of motion, muscle strength, control of movement and coordination within certain planes. Balance will be assessed as the participants' ability to hold themselves in their chosen position, against gravity. Gait will be considered in terms of the participants' ability to carry their body whilst walking. As a participant in this study, you will be assessed in these three different motor areas. These will be additional assessments over and above those done at this facility ordinarily. The UL outcome measure will require the participant to perform various grasps as well as reach their arms forward and backward in a number of functional tasks. It will look at the participants' ability to perform the movement as well as the quality of the movement. The balance outcome measure will look at the participants' ability to maintain certain positions (sitting, standing) and their ability to transition between these positions. The gait outcome measure will require the participant to stand up from sitting, walk three metres, turn around, walk back to the chair and sit down. It will look at the participants' ability to perform the test as well as the quality of the movement.

As a patient at this facility, you are assessed functionally on a weekly basis. These results are used to track your progress and the effectiveness of your treatment. With your permission, I will also use the results of this assessment (Functional Independence Measure) for my study. They will be used to investigate relationships between functioning in activities of daily living, UL movement, balance and gait in order to establish which of the motor components contributes most to function.

During the study, you will receive normal, intensive rehabilitation as a part of the Life Healthcare package. Additionally, the researcher will assess you in the above-mentioned motor and functional areas.

WHAT IS THE DURATION OF THIS STUDY?

If you decide to take part in this study, you will be one of approximately 40 patients. The study will last for four weeks. After you are discharged from the facility, your involvement in this study will terminate. The four assessments will take approximately 45 minutes and will be performed twice during your stay at the facility, once after two weeks, and a second time after four weeks.

EXPLANATION OF PROCEDURES TO BE FOLLOWED

This study involves the assessment of balance using a 20-point balance scale, the assessment of UL movement using a five-task assessment, and the assessment of gait using a 3-metre walking test. Your functioning in activities of daily living will be observed during a normal day at the rehab centre. The outcome measures will be done by two occupational therapists and I working at the facility.

ARE THERE ANY RISKS INVOLVED IN YOUR PARTICIPATION IN THE STUDY?

Due to the nature of the balance test, the researcher will take utmost care to ensure the participants' safety. The researcher will ensure participants are not injured by standing closely to them during the assessments. Safety will also be ensured by making sure the participant knows exactly what the assessment entails before the assessment commences. The researcher will also if necessary, give reminders throughout the assessments regarding the safest method to complete the assessment. The researcher will follow principles of safe transfers as practiced in the field of physical rehabilitation.

HAS THIS STUDY RECEIVED ETHICAL APPROVAL?

This study protocol was submitted to the Faculty of Health Sciences Research Ethics Committee of the University of Witwatersrand and ethical clearance has been obtained.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS STUDY?

The results of these assessments will only be used for investigation in this study and you will remain anonymous. Your participation is totally voluntary and you have the right to withdraw from the study at any time, without stating any reason for doing so, and without any penalty. Withdrawal from this study will not affect your access to therapy in any way. The researcher may withdraw you from the study if it is considered to be in your best interest.

SOURCE OF ADDITIONAL INFORMATION

For the duration of this study, you will be under the care of Ms. Caitlin Muller. If at any time during your stay at this facility, you have any questions, please do not hesitate to contact her. The telephone number is 072 274 5446, through which you can reach her.

CONFIDENTIALITY

All information obtained during the course of this study is strictly confidential. Data that may be reported in scientific journals will not include any information which identifies you as a patient in this study. Any information uncovered regarding your test results or state of health as a result of your participation in this study will be held in strict confidence. You will be informed of any finding of importance to your health or continued participation in this study but this information will not be disclosed to any third party in addition to those listed above without your permission.

CONTACT DETAILS

For further information/reporting of study related events please contact the Wits Occupational Therapy Department on 011 717 3701. Please contact the Chairman of the ethics committee, Prof P Cleaton-Jones at anisa.keshav @wits.ac.za or at 011 717 1234 if you have any complaints or problems.

Yours sincerely
Caitlin Helen Muller
Occupational Therapist
Tel: 072 274 5446

Appendix J

INFORMED CONSENT FORM - PARTICIPANT

I hereby confirm that I have been informed by the researcher, Ms. Caitlin Muller, about the nature, conduct, benefits and risks of the study, "**A study to determine which motor deficit has the strongest correlation with an improvement in functioning in activities of daily living**".

I have also received, read and understood the above written information (patient information letter) regarding the study.

I am aware that the results of the study, including personal details regarding my sex, age, gender, date of birth, initials and diagnosis will be anonymously processed into a study report.

I understand that my participation is voluntary and, may at any stage, without prejudice, withdraw my consent and participation in the study. I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in this study.

Participant's name: _____ (please print)

Participant's signature: _____

Date: _____

I, Caitlin Muller, herewith confirm that the abovementioned patient has been informed fully about the nature, conduct and risks of the above study.

Researcher's name: _____ (please print)

Researcher's signature: _____

Date: _____

Witness's name: _____ (please print)

Witness's signature: _____

Date: _____

Appendix K

VERBAL PATIENT INFORMED CONSENT

*Consent procedure should be witnessed whenever possible

(Applicable for patients who cannot write due to their dominant hand being affected due to hemiplegia or cannot read due to language barriers or illiteracy.)

I, the undersigned, Caitlin Muller, have read and explained fully to the patient and/or his/her relative, the patient information leaflet which has indicated the nature and purpose of the study in which I have invited the patient to participate. The explanation I have given has mentioned both the possible risks and benefits of the study. The patient has indicated that he/she understands that he/she will be free to withdraw from the study at any time for any reason without having to disclose this reason. The patient has also indicated that he/she understands that withdrawal will not jeopardize his/her treatment.

I hereby certify that the patient has agreed to participate in this study.

Participant's name: _____ (please print)

Participant's signature: _____

Date: _____

Participant's thumbprint:

Left thumb

Right thumb

Researcher's name: _____ (please print)

Researcher's signature: _____

Date: _____

Witness's name: _____ (please print)

Witness's signature: _____

Date: _____

(Witness to sign that he/she has witnessed the process of informed consent)