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TO ESTABLISH THE EFFECT OF TASK ORIENTED GROUP CIRCUIT TRAINING FOR PEOPLE AFFECTED BY STROKE IN THE PUBLIC HEALTHCARE SECTOR IN RSA

Megan Ballington

A thesis submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Doctor of Philosophy

Johannesburg, 2012

DECLARATION

I, Megan Ballington, declare that this research thesis is my own work. It is being submitted for the degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

_____ _____

Signed Date

DEDICATION

To Thomas for your endless patience and support and making the completions of this work a reality.

To Daniella and Jocelyn the most beautiful blessings I have.

ABSTRACT

Stroke remains a serious public health problem in low, middle and high income countries worldwide. In low and middle income countries there has been a greater than 100% increase in stroke incidence. The impact of HIV associated vasculopathy is recognized as contributing to the increased prevalence of stroke in younger patients (Tipping et al., 2007) and is an independent risk factor for stroke (Cole et al., 2004). The impact of this increased stroke incidence has not only resulted in an increase in death rates in the developing world, but has also resulted in increases noted in long term disability as a result of stroke.

The available resources for stroke care and rehabilitation are lacking in developing countries including Africa, particularly in rural areas. It has also been noted that 80% of the population live in areas where factors such as limited resources and cultural practices limit access to stroke services (Poungvarin 1998). Currently patients with stroke are discharged from hospitals in the public healthcare sector within six to 14 days of having a stroke, because of the pressure for beds (Mudzi, 2009; Reid et al., 2005; Hale, 2000). As a result patients are not benefitting from rehabilitation services and this leads to suboptimal recovery post stroke and to a large number of persons living with disabilities in under resourced communities. Because the patients with stroke are discharged so acutely after their stroke, carers become a necessity to cope with the burden of care. These conditions result in increased stroke survivor dependence in South Africa compared to the USA or New Zealand.

While 80% of stroke survivors who are initially unable to walk achieve independent walking (Jorgensen et al., 1995), at three months post stroke 25%-33% still require assistance or supervision when walking (Jorgenson et al., 1995; Duncan et al., 1994; Richards et al., 1993). Unfortunately these independent walkers seldom achieve walking speeds that are sufficient for community ambulation (Schmid et al., 2007; Lord and Rochester, 2005; Lord et al., 2004). Walking competency is a term used to describe a certain level of walking ability allowing an individual to participate in the community safely and efficiently (Salbach et al., 2004). It should also be noted that even those with mild and moderate strokes experience limitations with higher physical functioning which impacts on their quality of life and ability to return to work (Duncan and Lai, 1997).

The cerebral cortex has the ability to undergo functional and structural reorganization for several weeks and even months in more severe cases post stroke. Rehabilitation post stroke facilitates this process and can shape the reorganization of the adjacent intact cortex (Green, 2003). Further, it has

been concluded that to facilitate the best possible functional outcome for people post stroke, engagement in intensive task oriented therapy is necessary (Kwakkel et al., 2004; Van Peppen et al., 2004). Considering these findings it is extremely concerning that there is little or no rehabilitation provided to stroke survivors in the public healthcare sector in South Africa (Mudzi, 2009; Rhoda and Hendry 2003; Hale and Wallner, 1996; Stewart et al., 1994).

With this in mind, the aim of this study was to determine if an out -patient based task oriented group training programme would promote improved walking competency more than the current progressive resistance strength group training programmes that are common practice in persons who have had an acute stroke in the public healthcare system in South Africa. The specific objectives of this study were to establish the effect of a low intensity, namely once a week (for six weeks), out- patient based task programme on: walking competency, walking endurance, gait speed and health status in terms of physical functioning in persons with sub-acute stroke. Due to the high incidence of post stroke survivors with HIV it was important to establish if the training programme produced comparable effects in HIV positive and HIV negative subjects.

This study used a stratified blocked randomised controlled trial design. Where group allocation was concealed. In addition assessor blinded evaluations were conducted at baseline, post intervention and at six months after the intervention had ceased. A total of 144 persons who had a stroke were stratified according to their walking speed – mild (able to walk at a gait speed > 0.8m/s), moderate (able to walk at a speed of 0.4-0.8 m/s) or severe (able to walk at a speed < 0.4m/s) – and randomly assiged to one of three training groups. One group received task oriented group circuit training (task group), the second group received progressive resistance strength training (strength group), and the third group participated in one multidisciplinary education group training session (control group). The task and strength interventions included 6 sessions, of 60 minutes each for six to 12 weeks. While the control intervention group participated in one three hour education session, which included advice on the importance of exercise and a 20-minute exercise session. All subjects had been discharged from the public healthcare sector and were less than six months post stroke at inclusion into the study. The primary objective was walking competency, which included the measurement of walking endurance, gait speed, functional balance and mobility (Salbach et al., 2004). The task group showed an improvement that was significantly greater than that achieved by the strength and control groups in walking endurance, gait speed, functional mobility and balance at the follow-up. These findings demonstrate that the provision of as little as six sessions of task training (in a developing country, where persons with sub-acute stroke have had no previous rehabilitation) improves walking competency to a significantly greater extent than either a strength intervention of equal intensity, or a

control intervention programme consisting of one three hour education visit in the sub -acute phase post stroke. While the strength group received a more frequent and intensive training compared with the control group, there were no significant differences in terms of walking competency between these two groups over the study period.

The task group showed significantly greater improvements in walking endurance, comfortable and maximum gait speed than the strength and control groups immediately post intervention. While post intervention, the task training led to superior gains in functional mobility and balance compared to the control group, it was not superior to the strength group.

For subjects, with a moderate gait disability at baseline, the improvements in walking endurance and in comfortable and maximum walking speed in the task group were significantly more than the strength and control groups. For subjects with a severe gait deficit at baseline, the task group improved significantly more than the control group on all measures of walking competency but not significantly more than the strength group. There were no significant differences among the groups for subjects with a mild gait deficit at baseline.

All three treatment intervention groups improved their score on the stroke impact scale 16 (SIS 16) over the course of the study period. The task group improved significantly more than the control group's health status in terms of physical functioning measured by the SIS16. There were no significant differences among the groups in the change scores for the measures of walking competency between the HIV positive and HIV negative subjects throughout the study period.

The results of this study demonstrate that an extremely limited number of task training sessions resulted in significantly greater improvements in walking competency than progressive strength training or a multidisciplinary education training approach. However, these results must be interpreted with caution, remembering the context of the sample population who had not received a period of in-patient rehabilitation prior to their inclusion into the study and were 10-15 years younger than subjects in numerous other studies. This appears to be the first study conducted with such a limited rehabilitative intervention post stroke. As a result, further research to evaluate the effectiveness of limited intensity task oriented training interventions for non -ambulant stroke survivors in the developing world where resources are limited, needs to be conducted. It is important to explore the benefits of different group based rehabilitative interventions for stroke survivors to alleviate the burden as a result of disability as much as possible.

Key words: Stroke, Task Oriented, Rehabilitation, Walking, Walking Competency

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LIST OF ABBREVIATIONS

-ve	- Negative
+ve	- Positive
10MWT	- Ten Metre Walk Test
2MWT	- Two Minute Walk Test
6MWT	- Six Minute Walk Test
ACSM	- America College of Sports Medicine
ADL	- Activities of Daily Living
AIDS	- Acquired Immunodeficiency Syndrome
BBS	- Berg Balance Scale
CHBH	- Chris Hani Baragwaneth Hospital
CMJAH	- Charlotte Maxeke Johannesburg Academic Hospital
DALY	- Disability Adjusted Life Years
ESD	- Early Supported Discharge
HIV	- Human Immunodeficiency Virus
HJH	- Helen Joseph Hopital
IADLs	- Instrumental Activities of Daily Living
ICC	- Intraclass Correlation Coefficient
m	- Metre
MCID	- Minimal Clinically Important Difference
MDC	- Minimal Detectable Change
m/s	- Metres per second
QOL	- Quality of Life
RCT	- Randomised Control Trial
RSA	- Republic of South Africa
SASPI	- South African Stroke Prevention Initiative
SES	- Socioeconomic Status
SIS16	- Stroke Impact Scale 16
TUG	- Timed-Up and Go
VO_2	- Peak Oxygen Consumption
WHO	- World Health Organization

CHAPTER 1

1. INTRODUCTION

1.1 BACKGROUND

According to World Health Organization (WHO) statistics 2002, there are 20.5 million stroke survivors worldwide. In the USA stroke is a leading cause of long term disability (Heart Disease and Stroke statistics, 2007) and in Canada there are approximately 300 000 people living with the effects of stroke (Heart and Stroke Foundation of Canada, 2007). A study conducted in North East Melbourne Australia reported increased stroke incidence with increased socioeconomic disadvantage. A great contributor to this incidence pattern was non - fatal stroke incidence, which may have implications for service delivery to those who can least afford it (Thrift et al., 2006). Thus the burden of stroke lies not only in the high mortality, but in the high morbidity that leaves up to 50% of stroke survivors chronically disabled (Wilkinson et al., 1997). In 1999, more than 1 100 000 American adults reported difficulty with functional limitations in activities of daily living, as a result of stroke (Survey of Income and Program Participation [SIPP]; a survey of the US Bureau of the Census).

Unfortunately these statistics are not confined to developed countries. Stroke is the fourth most frequent cause of death in the Republic of South Africa (RSA), causing 5% of all reported deaths. However, it is the second highest cause of death in the age group 50-64 years and is the highest cause of death in the age group above 65 years of age (Statistics South Africa Release P0309.3/2003). The SASPI (South African Stroke Prevention Initiative) Project Team in Limpopo Province found the stroke prevalence in the province to be 300/100 000. Unfortunately there is increasing evidence to show that the incidence of stroke may be increasing (Fritz, 1997; Hoffman, 1998), particularly in light of the increasing stroke incidence in people with HIV seropositivity (Mochan et al., 2003).

In sub-Saharan Africa it is well established that there is a huge burden due to HIV/Aids, and in 1999 thirty percent of the adult admissions at Chris Hani Baragwaneth Hospital (CHBH) were HIV positive, of which 60% of the female population were seropositive in the group aged 25-34 years while in the male patients there was 37% seropositivity in this age group. An interesting finding in a study conducted by Mochan et al., (2003) was that 57% of the patients presented with stroke as the first manifestation of their HIV infection. These data identify the high prevalence of young patients with stroke at CHBH who require rehabilitation.

The CHBH is a 3300 bed hospital that serves the city of Soweto and the surrounding area. The 1998/1999 yearbook reported that the hospital served a population of about three million people, and the hospital's rehabilitation team treated between 90-100 new stroke cases per month. The hospital at that time employed 21 physiotherapists and eight physiotherapy assistants, to service the hospital (Hale, 2002). Currently, patient with strokes are discharged from CHBH within 6 days of having a stroke because of the pressure for beds (Mudzi, 2009). As a result patients are not being rehabilitated thus resulting in a large number of persons with disabilities in under resourced communities. Because the patients with stroke are discharged so soon after their stroke, carers become a necessity to cope with the burden of care. Following their early discharge, the only rehabilitation patient with strokes receive from most public healthcare hospitals, is in the form of group classes (regardless of patient presentation) provided in clinics. These classes consist of mobility and strengthening exercises carried out in sitting and lying. Analysis of physiotherapy attendance at these clinics indicated that the most common condition treated was hemiplegia due to stroke (Stewart et al., 1994). Subsequent evaluation of these services indicates that both the physiotherapists and undergraduate physiotherapy students felt ill equipped to deal with the extremely large number of patients with stroke who attend so infrequently (Hale and Wallner, 1996; Stewart et al., 1994). The lack of rehabilitation services for acute and sub-acute patient with strokes, and the increased burden of care as a result of their early discharge from hospital, contribute to long term disability (Wasserman et al., 2009; Green et al., 2005).

The evidence indicates that at least 50 -55% of stroke survivors will be left with some form of residual disability that will subsequently impact on their quality of life (Warlow, 1998; Ashburn, 1997). This residual disability includes both an inability to walk safely (Perry et al., 1995) and dependence on carers for certain activities of daily living (ADL). Walking is the activity most affected by stroke with as many as 80% of people in the acute phase post stroke losing this ability (Jorgensen et al., 1995; Friedman, 1990; Wade et al., 1987). The inability to walk is a devastating loss to survivors of stroke. In addition the ability to walk competently is a prerequisite for most daily living activities (Carr and Shepherd, 2003). Walking competency is a term used to describe a certain level of walking ability allowing an individual to participate in the community safely and efficiently. This level of walking requires adequate speed to cross a street safely, an ability to cover sufficient distances to perform ADL's, a level of balance that allows one to turn and look in different directions while walking and cope with perturbations. It also demonstrates an ability to anticipate and avoid obstacles or accommodate to environmental changes/obstacles (Shumway-Cooke A and Woollacott M, 2001; Patla, 1997). Thus survivors of stroke, who show improvements in walking, are not necessarily competent

walkers as they may still present with limitations in activities of daily living which ultimately affect their quality of life (QOL).

In a sub district of the Limpopo Province, 66% of stroke survivors required assistance with at least one ADL (Connor et al., 2004). This prevalence of stroke survivors who require assistance is much higher than in New Zealand (22%) and the USA where 26% of stroke survivors require assistance with ADL's (Heart Disease and Stroke statistics 2007). This increased dependence in South Africa compared to the USA or New Zealand may be due to the difficulties encountered in rehabilitation service delivery to stroke survivors in South Africa. In Soweto only 55% of patients with stroke, between the ages of 50-75 were able to walk independently (Hale et al., 1998) compared with 78-85% in the USA (Segal and Whyte, 1997; Gresham et al., 1995).

This may be the result of inadequate care after stroke which leaves more survivors disabled (Connor et al., 2004). In light of the fact that there is significant evidence that increased rehabilitation intensity improves ADL functioning and impairments (Kwakkel et al., 1997; Langhorne et al.,1996), it is essential we explore and find systematic and cost effective ways in which to utilize rehabilitation services in South Africa. Rehabilitation offers the opportunity to reduce this burden of care (Green, 2003). Given the resource intensive nature of many rehabilitation programmes, however, group based therapy may be a means of providing rehabilitation to a greater number of patients at one time.

A task oriented training approach to therapy is defined as a therapeutic approach to retraining the patient with movement disorders based on the systems theory of motor control. In the systems theory, successful motor behaviour is the product of an interaction between the individual and the desired task (Shumway-Cooke A and Woollacott M, 2001). Task oriented training is advocated in stroke rehabilitation to improve performance in ADLs such as walking and upper limb reaching to grasp objects (Blennerhassett and Dite, 2004; Salbach et al., 2004).

Walking task oriented therapy focuses on gait oriented activities to promote recovery of locomotion or walking after stroke. Extensive repetition of challenging activities specific to walking are performed in standing and walking positions, instead of conventional therapy that frequently involves isolated movements performed in sitting, lying and standing that do not focus on functional activites (Hesse et al., 2003). Task oriented therapy, which is designed to strengthen the affected lower extremity, enhance gait balance, speed and endurance by

practicing activities related to walking has been shown to result in significant improvements in walking competency (Salbach et al., 2004; Dean et al., 2000). Due to the nature of task oriented therapy, circuit training based groups can be run where two or more patients can be treated simultaneously (Carr and Shepherd, 2003). Such an approach, however, requires sufficient personnel to ensure that patients practice correctly and safely. However, effectively implementing a gait oriented task training circuit class in under resourced out patient clinics is a challenge, not only to ensure the specificity of training but also to ensure safety.

Group training, (if used correctly) can ensure greater use of the short time allowed for intensive rehabilitation (Carr and Shepherd, 2003) especially where there are high patient to staff ratios. Practicing as a group in an interactive way may increase motivation, by adding a competitive and cooperative component to the practice situation (Mc Nevin et al., 2000). Patients also benefit from the experience of peers and helping each other (De Weerdt et al., 2001). It has been found that exercise classes can be efficacious and feasible, and improve locomotor function in chronic stroke (Teixeira-Salmela et al., 2001; Dean et al., 2000). Thus implementing group classes in the acute phase post stroke may facilitate better service delivery to the large number of stroke survivors in South Africa. In addition, these classes being task oriented in nature may lead to significantly greater improvements in walking competency in this stroke population. Improved walking competency would enable greater physical functional ability to perform ADLs in the home and ultimately in the community thus leading to improved QOL since limited physical functioning and disability is associated with a decrease in QOL (Mayo et al., 2002; Hartmen-Maeir et al., 2007).

1.2 PROBLEM STATEMENT

South Africa that already faces a huge burden as a result of HIV/Aids and diseases of poverty, now faces the challenges of adapting its healthcare system to cope with the coming epidemic of vascular disease (Connor et al., 2004). As stated, there is an increase in the percentage of HIV related persons with stroke who require rehabilitation. Rehabilitation service delivery in the public healthcare sector is extremely limited. We need to determine if a walking task oriented programme, which has good evidence of being effective in the developed world, can be appropriately and effectively adapted in South Africa, a developing country where rehabilitation services are limited.

1.3 AIM OF THE STUDY

To determine if an out patient based task oriented group circuit training programme promotes better walking competency than the current practice (a strength training programme) in persons who have had an acute stroke in the public healthcare system in South Africa.

1.4 OBJECTIVES OF THE STUDY

The objectives of the study are devided into three sections presented below in temporal order .

For the purposes of objective 5 of the objectives of study 3 that is: “to establish the effect of the programme on self-reported physical functioning”, the Stroke Impact Scale 16 (SIS16) was used. A large number of persons who attend the CHBH, Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) and Helen Joseph Hopitals (HJH) in Johannesburg South Africa do not speak English. The two most common languages spoken in this area are Sotho and Zulu. Thus the SIS16 was translated into Sotho and Zulu as described in study 1. The findings of which are presented in Chapter 4.

1.4.1 Objective of Study 1

1. To develop a linguistically valid Zulu and Sotho Version of the Stroke Impact Scale 16 (SIS 16).

To establish the effect of the task training programme as outlined in the objectives of study 3 below, it was necessary to conduct a pilot study (study 2) with the following objectives outlined below. The findings of study 2 are presented in Chapter 5.

1.4.2 Objectives of Study 2

The objectives of study 2 are to:

1. select and train the research assistants
2. to develop and evaluate the strength and task intervention programmes
3. to determine the feasibility of using the proposed project site
4. to evaluate proposed outcome measures and become familiar with their use
5. to determine factors that influence subjects’ adherence to an out patient programme

To establish and fulfill the aim of the study the objectives for study 3 are outlined below. The findings of study 3 are presented in Chapter 7.

1.4.3 Objectives of Study 3

To establish the effect of:

1. a once a week (for six weeks) out patient based task oriented group circuit training programme on functional walking (walking competency) in persons with sub-acute stroke.
2. the programme on walking endurance
3. the programme on gait speed
4. the programme at six months post intervention
5. the programme on health status in terms of physical functioning
6. the programme in HIV positive and HIV negative persons with sub-acute stroke

1.5 SIGNIFICANCE OF THE STUDY

To cope with the increasing numbers of stroke survivors in South Africa living with disabilities, an appropriate rehabilitation service for stroke survivors who are discharged from hospital without any rehabilitation needs to be established. Should this out patient based rehabilitation service lead to improved walking competency, it could provide a model for the development of similar programmes for the rehabilitation of persons with stroke in other parts of the country.

The study will provide objective information regarding the effectiveness of task training performed at a much lower intensity than has been previously evaluated. Furthermore, in light of the white paper (1994) that emphasized that all citizens with disability should receive the necessary rehabilitation they require, a study of this nature may be a resource efficient solution to a problem that has not been addressed to date. There have been no previous studies of this nature in South Africa, thus this research is relevant to the improvement of rehabilitaion services post stroke in this country.

1.6 THESIS OUTLINE

The thesis will be presented in the following chapters as outlined below:

Chapter 2: Literature Review

Chapter 3: Instrumentation and Outcome Measures: This chapter presents the outcome measures used in the thesis with a brief review of their psychometric properties

Chapter 4: Study 1 (Linguistic Validation): Presents the details of the linguistic validation of the SIS16 into Sotho and Zulu

Chapter 5: Study 2 (Pilot Study): Presents the details of the findings for the objectives of study 2 as outlined above

Chapter 6: Methodology: Presents the methodology that was used for study 3

Chapter 7: Results: Gives the detailed findings of study 3

Chapter 8: Discussion

Chapter 9: Conclusion

CHAPTER 2

2. LITERATURE REVIEW

2.1 INTRODUCTION

The following chapter will review the background literature that supports the need to implement an out-patient based rehabilitation programme in the public healthcare sector in South Africa. The available statistics and the associated impact of stroke worldwide and in South Africa will be presented with particular reference to the impact of the Human Immunodeficiency Virus (HIV) on stroke. The burden of stroke in South Africa cannot be fully reviewed without reference to HIV, as it is an independent risk factor for stroke. The impact of disability following stroke, in terms of independent gait and community ambulation will be discussed. This includes an in depth review of the available literature on the relevant therapeutic interventions used to design this study. These treatment approaches include: progressive strength training, task oriented gait training and cardiovascular endurance training post stroke. However due to the extensive amount of literature available on post stroke gait rehabilitation, less pertinent techniques that are not applicable to the objectives of this study will not be covered. The concept of group based therapy and circuit training will also be presented.

Literature for this review was sourced using Pubmed, CINAHL, Pedro and the Cochrane collaboration data bases. Key words used in these searches included: stroke, hemiplegia, exercise, walking, rehabilitation, task specific training, physical therapy. In addition relevant references from all articles were sourced, if not already reviewed.

For the purposes of this study stroke has been defined according to the widely recognized WHO definition “rapidly developing clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin” (WHO MONICA Project, 1988). Stroke is a non-communicable disease that is caused by an interruption of blood flow to the brain (ischaemic stroke) or when a blood vessel ruptures (haemorrhagic stroke). While stroke frequently results in death, if the patient survives, they present with numerous impairments which present in a wide diversity of clinical signs and symptoms. The degree of disability post stroke varies according to the extent of neurological recovery, the site of the lesion, the patient’s premorbid status and the environmental support systems.

2.2 EPIDEMIOLOGY

The WHO statistics on age standardized death rates and Disability Adjusted Life Years (DALY) reported in 2009, showed that cerebrovascular disease is still the third leading cause of death worldwide (WHO, 2009). These statistics from the WHO additionally highlight the findings of Feigin et al's., (2009) comprehensive systematic review of stroke incidence, morbidity and case fatality. They identified a greater than 100% increase in stroke incidence in low to middle income countries (Feigin et al., 2009). Furthermore, they found between 2000 and 2008, the overall stroke incidence in low- to middle income countries was 20% greater than in high income countries. The impact of this increase in stroke is not only an increase in death rates in the developing world, but the increase in long term disability as a result of stroke. Murray and Lopez, (1997) noted that stroke is the second highest cause of long term disability. The WHO global burden of disease report for 2009 clearly shows the notably higher statistics of the lower income developing countries compared with high income developed countries. The age standardised DALY rate (combines years of life lost from premature death and years of life lived with disabilities) for cerebrovascular disease of a few countries is presented below.

Table 1.1: DALY Rate for a Few Countries in 2009

Country	**No / 100 000 persons**
USA	327
UK	348
Canada	211
New Zealand	305
Singapore	283
South Africa	1284
India	837
China	1072
Brazil	836

As a result, stroke is emerging as the leading cause of preventable death and disability in adults in numerous developing countries (Lemoghoum et al., 2005). The burden of stroke and its consequences will continue to increase unless measures to control cardiovascular risk factors are urgently implemented (Feigin et al., 2009). These rising consequences and the associated burden are particularly severe in low and middle income countries, who can least afford the associated costs of care and rehabilitation (Abergunde et al., 2007).

Stroke statistics in Sub-Saharan Africa are scarce and unreliable. Births and death registration data in Sub-Saharan Africa is limited and tends to be unreliable, largely due to under-registration and misclassification (Kengne and Anderson, 2006; Bah, 2003; Murray and Lopez, 1996; Bradshaw et al., 1992). In developing countries only a small proportion of persons with stroke present to a health facility, as a result many strokes go undiagnosed (Walker et al., 2000; Sudlow and Warlow, 1997). Thus, it is thought that stroke incidence, prevalence and case fatality may be considerably greater than the data that are available. Currently there have not been any community- based stroke prevalence studies of first ever stroke with long-term follow done in the Republic of South Africa (RSA) (Connor and Warlow, 2000; Warlow, 1998). Prevalence studies provide information regarding the burden of stroke in terms of post stroke disability and the need for health services. However, the South African Stroke Prevention Initiative (SASPI) project team conducted the first population based prevalence study in 2004, and found stroke prevalence in Limpopo province at 300/100 000 (Connor et al., 2004). Of particular interest in this study was the finding that despite there being fewer strokes than a similar study in New Zealand (Bonita et al., 1997), a far greater proportion of the sample required assistance with at least one activity of daily living. A total of 66% of the stroke survivors needed assistance with at least one activity of daily living, which is greater than in developed countries. This finding gives some insight into the number of dependent stroke survivors in South Africa, who should be receiving rehabilitation.

Stroke is the most common cause of death among people over 50 years of age in South Africa. (Statistics South Africa Release P0309.3/2007).However, contrary to major misconceptions, 40% of stroke victims in Sub-Saharan Africa are under 70 years of age (Strong et al., 2007; Treulsen et al., 2007; Walker et al., 2003). Lemogoum et al., (2005) found that stroke occurs at much younger ages in Sub-Saharan Africa compared to high income countries. Similar findings have been noted in three other studies, where persons with stroke were 10-15 years younger than in developed countries (Connor et al., 2004; Walker et al., 2003; Hoffman, 1998). This confirms the literature that states South Africa is in a health transition (Connor et al., 2007). The increasing economic development in developing countries is resulting in a shift from diseases of poverty and communicable diseases, towards more chronic non-communicable diseases associated with lifestyle (Reid et al.,, 2005). The impact of HIV associated vasculopathy must be emphasized, as it is contributing to the increased prevalence of stroke in younger patients in sub-Saharan Africa (Tipping et al., 2007), because it is an independent risk factor for stroke (Cole et al., 2004).

2.3 STROKE AND HIV

South Africa like other countries in Africa has been severely affected by the global HIV/AIDS pandemic (Lewis et al., 2003; Arthur et al., 2000). The South African national burden of disease study found HIV/AIDS to be the leading cause of disease burden in 2000, and these findings have not changed since (Lopez et al., 2006). While only ten percent of the world's population live in sub-Saharan Africa, two thirds of the world's population of people living with HIV/AIDS are living in sub-Saharan Africa (UNAIDS, 2008). This explains the findings over the past decade from studies in both rural and urban tertiary hospitals in Africa, that have noted a sharp increase in prevalence of HIV related medical ward admissions from 4% - 35% (Reid et al., 2005). This increase in hospital adult medical ward admissions, with no increase in hospital capacity in terms of bed numbers or staffing levels, has impacted significantly on patient hospital length of stay. As a result of the HIV/AIDS pandemic, there has been an increased pressure for beds in hospitals due to the increased patient loads (Veenstra and Oyier, 2006; Reid et al., 2005; Colvin et al., 2001; Gilks et al., 1998;). Reid et al.'s, (2005) study found the average length of stay to be 7.7 days, and further stated their concern that the increased HIV related admissions may result in patients with other conditions receiving inadequate care and being discharged prematurely. Similarly in Nairobi, Kenya the increased HIV-related admissions were at the expense of uninfected patients who were in effect crowded out of the hospitals (Gilks et al., 1998). At CHB Hospital the average length of stay for patients with stroke has decreased from an average of 14 days in 1999 (Fearnhead, 2006; Hale, 2002) to 6 days in 2009 (Mudzi, 2009). Consequently, patients with stroke are discharged home with extremely limited rehabilitation (including physiotherapy). These patients with stroke are discharged into the care of their family, while still functionally dependent (Fearnhead, 2006; Mudzi, 2009).

HIV has been recognized as an independent risk factor for stroke (Reid et al., 2005; Cole et al., 2004). Thus HIV associated vasculopathy is strongly contributing to the increased stroke prevalence in sub-Saharan Africa (Hoffman, 1998; Fritz, 1997) and specifically, the increase in younger persons with stroke (Tipping et al., 2007; Mochan et al., 2003). Of interest following these findings, is the fact that 57% of the HIV admissions at CHB Hospital in 1999, presented with stroke, as the first manifestation of their HIV infection (Mochan et al., 2003). This data identifies the potentially high prevalence of younger patients with stroke who may require rehabilitation. Moreover, the impact of patients with stroke who are discharged as soon as they are medically stable, indicates that the provision of these rehabilitation services needs to be on an out -patient basis.

2.4 STROKE AND HYPERTENSION

Not only is hypertension the most consistent and powerful predictor of stroke, it is the cause of up to 70% of all stroke cases (Lavados et al., 2005), and it is the most common risk factor causing death worldwide (WHO global health risks report 2004). Bearing in mind the greater than 100% increase in stroke incidence in low- and middle income countries (Feigen et al., 2009), hypertension awareness and compliance remains a challenge (Wasserman et al., 2009; Thorogood et al., 2007). As noted worldwide, hypertension in South Africa has also been confirmed to be the most common risk factor for stroke. In the SASPI project team 71% of the stroke survivors were hypertensive (Connor et al., 2005).

While there is extensive evidence that hypertension is the most common modifiable risk factor for stroke, the prevalence of uncontrolled hypertension in patients who are taking antihypertensive medications remains extremely high (Li et al., 2005). In the SASPI project team in RSA a total of 45% - 52% of the strokes were attributed to uncontrolled blood pressure (Connor et al., 2004). These observations are consistent with other studies (Wolf- Maier et al., 2004; Klungel et al., 2000). The greater incidence of stroke in RSA has been related to limited healthcare facilities and uncontrolled hypertension (Wasserman et al., 2009; Lemogoum et al., 2005). In a follow up survey of the SASPI project, 75.8% of the persons with stroke were still hypertensive. Contributing to this high percentage of uncontrolled hypertension, thirty seven percent were not taking antihypertensive medication (Thorogood et al., 2007). The low prevalence of awareness, treatment and control of hypertension exposes an extremely serious challenge for stroke prevention in RSA. Some of the reasons why such a large percentage of the persons with hypertension are not taking medication from clinics include transport difficulties in getting to clinics, difficulty with drug supplies and equipment problems (Connor et al., 2004). In conclusion the study from the SASPI project team found a high prevalence of hypertension and highlighted the challenge that South Africa may be facing an emerging epidemic due to vascular disease (Thorogood et al., 2007; Yusuf et al., 2001).

In light of the fact that treatment of hypertension reduces the risk of stroke by 35%-40% (Aronow et al., 2004; Collins et al., 1990), and it is a modifiable risk factor, it stands to reason that prevention of hypertension is of paramount importance and one of the essential roles of primary health care in the prevention of stroke (Hale et al., 1998).

2.5 STROKE AND POVERTY

Stroke is both a cause of poverty and is caused by poverty. In most countries, the poorest people have the highest risk of developing chronic disease, and ironically they are the ones least able to afford the financial resources needed to cope with the disease (Suhrcke et al., 2006). Numerous studies have shown that socioeconomic status (SES) is an important risk factor for stroke (Zhou et al., 2006; Arrich et al., 2005; Avendano et al., 2005; Kapral et al., 2002). With the result, that as SES declines so the incidence of stroke and stroke mortality increases (Zhou et al., 2006; Arrich et al., 2005; Avendano et al., 2005; Kapral et al., 2002). Bell et al., (2004) noted that although SES does not directly affect hypertension (the most common risk factor for stroke), SES does influence 'health behaviours' such as diet, alcohol consumption, smoking, physical activity and other risk factors that in turn affect hypertension.

While poverty increases the risk factors for stroke (Suhrcke et al., 2006), tragically the high cost of care following stroke survival and the ongoing rehabilitation costs are undertaken by the family, placing the family under severe financial pressure (Daniel et al., 2009; Bonita and Beaglehole, 1997). Thus not only does a low SES influence the incidence of stroke, but also post stroke independence and QOL (Bravata et al., 2005). It has been noted that up to 60% of low income earning patients compared with 45% of higher income patients with stroke require assistance with ADLs (Zhou et al., 2006; Weir et al., 2005; Avendano et al., 2004; Jakovljevic et al., 2001). Furthermore, declining SES has been shown to significantly influence an inability to walk independently (Weir et al., 2005), which then requires further rehabilitative input, with the associated greater ongoing costs to pay for these services. Thus the influence of SES continues to affect the outcome following stroke, irrespective of the severity of stroke (Zhou et al., 2006; Arrich et al., 2005). The ability to return to work is often compromised following stroke, which inadvertently affects the financial independence of not only the stroke survivor but also their family. This is particularly true for the stroke survivor who was the main breadwinner for the family prior to their stroke. The combined influence of these socioeconomic consequences of stroke, affect the functional recovery and ultimately the stroke survivor's QOL.

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Case fatality rates for stroke are higher in developing countries compared to developed countries, which may be related to limited healthcare facilities and uncontrolled risk factors (Wasserman et al., 2009; Connor et al., 2007; Walker et al., 2000). The available resources for stroke care and rehabilitation are deficient in developing countries, particularly in rural areas. In developing countries, including Africa, 80% of the population live in areas where factors such as limited resources and cultural practices limit access to stroke services (Poungvarin, 1998).

While the socioeconomic impact of stroke in South Africa is not known (Connor and Bryer, 2005), the greater percentages of disability noted thus far (Connor et al., 2004), the extremely poor access for patients to rehabilitation services (Kenge and Anderson, 2006) and their extremely short length of hospital stay (Mudzi, 2009), would verify the importance of providing out patient rehabilitation services to improve independence of stroke survivors.

2.6 THE IMPACT OF STROKE ON DISABILITY

Having presented the incidence of stroke worldwide and in sub-Saharan Africa it must be highlighted that the true burden of stroke lies not only in the high mortality, but also in the high morbidity that leaves up to 50% of stroke survivors chronically disabled (Wilkinson et al., 1997). Stroke morbidity is a leading cause of disability, particularly among the elderly. In the USA stroke is the leading cause of long term disability (Heart Disease and Stroke Statistics, 2007) and reduced QOL. In Canada there are approximately 300 000 people living with the effects of stroke (Heart and stroke foundation of Canada, 2007).

Although comprehensive stroke surveillance data for Africa are lacking, the data that are available shows that the prevalence of disability post stroke in Africa is comparable to the rest of the world, if not higher (Mensah, 2008). Unfortunately in RSA patients with acute stroke are often discharged from hospital without any option of receiving adequate rehabilitation by trained healthcare professionals (Wasserman et al., 2009; Whitelaw et al., 1994; Dewar, 1990). Thus the burden of care, as a result of the associated disability often lies with the family and the healthcare services available outside the hospital sector. In a study based in a rural setting in South Africa, two thirds of the patients or their caregivers did not receive any form of stroke care training or education on or before their discharge (Wasserman et al., 2009). At the three month re-evaluation, 80% of the survivors in this study were left with moderate to severe disability (modified Rankin scale score 3-5); compared to values of 39% of stroke survivors in an urban population- based study in India (Dalal et al., 2008). Positively in the study by Wasserman et al., (2009), 55% of the survivors were independently mobile after three months, compared to only 10% at the time of discharge. These statistics are well below the 65%-90% reported in developed countries (Gresham et al., 1995; Jorgensen et al., 1995; Wade et al., 1987). However, it must be noted that this rural sample selection may have been biased as less severe, milder strokes are less likely to be admitted to hospital in the public healthcare sector in South Africa (Wasserman et al., 2009). Similar findings were noted in the SASPI project as previously mentioned where with 66% of the stroke survivors in this area required assistance with at least one activity of daily living (Connor et al., 2004). This prevalence of stroke survivors who require assistance is much higher than the 22% in New Zealand (Bonita

et al., 1997) and the 26% documented in the USA (Heart Disease and Stroke statistics, 2007; Segal and Whyte, 1997; Gresham et al., 1995). This increased dependence in South Africa compared to the USA or New Zealand may be due to the difficulties encountered in rehabilitation service delivery to stroke survivors in South Africa.

Although patients in these studies showed functional improvement, stroke still had a significant impact on their lifestyle, indicated by their inability to participate in important cultural and social activities after stroke (Wasserman et al., 2009). The literature does indicate that after surviving a stroke at least 50 -55% of stroke survivors will be left with some form of residual disability that will subsequently impact on their QOL (Warlow, 1998; Ashburn, 1997). The residual disability following stroke is vast and includes an inability to walk safely (Perry et al., 1995), dependence on caregivers for certain ADL, problems with communication, an inability to do housework and difficulties in getting out of one's home (Pound et al., 1998). Thus the disabling consequences of stroke go beyond walking and ADLs, and ultimately affect one's functional mobility outside the home in one's community, which impacts on an individual's QOL (QOL).

2.7 THE IMPACT OF LIMITED REHABILITATION RESOURCES

In South Africa these high disability statistics post stroke and the limited rehabilitation services are unfortunately compounded by the significant resource limitations noted in the public healthcare sector (Wasserman et al., 2009; Whitelaw et al., 1994; Dewar, 1990). With the HIV pandemic, the overwhelming medical and financial interest of the nation is justifiably focused on HIV. Non-communicable diseases and stroke are a low priority which is preventing the establishment of stroke units, rehabilitation services and a national stroke campaign that this catastrophic illness deserves (Fritz, 2006; Kengne and Anderson, 2006). Currently patients with stroke in under resourced communities are discharged from hospitals within six to 14 days of having received on average one therapeutic contact prior to their discharge (Mudzi, 2009; Reid et al., 2005; Hale, 2002). Because these patients are discharged so acutely after their stroke, carers become a necessity to cope with the burden of care (Wasserman et al., 2009). It has been recognized that these informal caregivers play an important role in the care of the person with stroke (Schofield and Bloch, 1998). Following their early discharge, the only rehabilitation patients with stroke receive from most public healthcare hospitals, is in the form of group classes (regardless of the patient's level of severity post stroke) provided in clinics that consist of mobility and strengthening exercises carried out in sitting and lying (Mudzi, 2009; Fearnhead, 2006; Hale and Wallner, 1996). At certain clinics, patients will receive one-on-one physiotherapy, if they have sufficient staff. Unfortunately these sessions are quite short,

infrequent and if patients are late for their appointments they miss their sessions (Fearnhead, 2006).

As a result of this situation it was noted in an analysis of physiotherapy attendance at these clinics, that the most common condition treated was hemiplegia due to stroke (Stewart et al., 1994). Subsequent evaluation of these services also indicated that both the physiotherapists and undergraduate physiotherapy students felt ill equipped to deal with the extremely large number of patients with stroke who attend so infrequently (Hale and Wallner, 1996; Stewart et al., 1994). The lack of rehabilitation services for acute and sub-acute patient with strokes, and the increased burden of care as a result of the early discharge from hospital, are of great concern.

2.8 PROGNOSIS FOR RECOVERY POST STROKE

Prognostic studies on recovery post stroke are limited. While many studies show that recovery peaks within the first three months post stroke (Jorgensen et al.,1995; Duncan and Lai, 1997), a number have shown that recovery may continue at a slower pace for at least six months, and with five percent of patients recovering although very slowly for up to one-year (Yagura et al., 2003). The severity of the stroke has been noted to be the most significant predictor of recovery post stroke. This means that the patient with a milder stroke may demonstrate little or no disability, while the patient with a more severe stroke will most likely experience severe disability and deficit even after completion of rehabilitation.

Of particular importance to this study is the recovery of walking function after stroke. Though the burden of stroke is high, 65%-80% of patients regain the ability to walk to some degree, with or without an assistive device (Kwakkel et al., 1999; Segal and Whyte, 1997; Gresham et al., 1995, Jorgensen et al., 1995; Friedman, 1991; Wade et al., 1987) and 48%-58% regain independence in self care (Gresham et al., 1995). Unfortunately, although many initially dependent survivors achieve independent walking, they never achieve walking speeds that are fast enough to efficiently walk independently in the community. It should be noted, that even those with mild and moderate strokes experience limitations with higher physical functioning skills, which impacts on their QOL and ability to return to work (Duncan and Lai, 1997). On average, the level of functional ability achieved is maintained from six months up to three years post stroke (Dombovy et al., 1986). Beyond five years deterioration in function has been noted, relating most commonly to the effect of age and co-morbidities (Stineman and Granger, 1991).

The recovery that is noted post stroke can be defined as either neurological or functional. Neurological recovery is the result of the brain re-organising and repair, while functional is more influenced by rehabilitation (Green, 2003; Dombovy, 1991). The cerebral cortex has the ability to undergo functional and structural reorganization for several weeks and even months in more severe cases post stroke. Rehabilitation post stroke facilitates this process and can shape the reorganization of the adjacent intact cortex (Green, 2003). Further, rehabilitation offers the opportunity of reducing the burden of disability post stroke and ultimately improving the stroke survivor's independence. It is with this objective, that there are numerous studies investigating the effectiveness of different rehabilitation treatment interventions. However, finding a cost effective and appropriate approach to delivering rehabilitation in the Public Healthcare Sector in South Africa remains a challenge.

2.9 THE EFFECT OF STROKE ON QUALITY OF LIFE

It is frequently stated that residual disability post stroke affects one's QOL. According to the Canadian stroke network (Strokengine, 2010), "quality of life refers to those aspects of life that are important to a person. Although there are individual differences in the extent to which people value particular aspects of life, within a given culture, people appear to be more similar than different. The concept of "health-related quality of life" refers to those aspects of life that are important to an individual and that may be affected, either in a positive or negative way, by health and illness." The WHO (1995) defines QOL as "An individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns". Thus QOL is a broad ranging concept affected by a person's state of health, psychological wellbeing, their level of independence and how they are able to live with their own perceived state of wellbeing and health without limitations in activities, and without restrictions to their participation at home, work and leisure (Carr and Shepherd, 2010).

QOL focuses specifically on what the patient considers important in terms of their subjective state of health. Thus a multidimensional approach is necessary to measure QOL, which includes at least four dimensions: physical, functional, psychological and social health (De Haan et al., 1993). The physical health dimension refers to disease related signs and symptoms and the impact that these have on one's physical functioning. Functional health includes self care, mobility, and the capacity to perform various work and family roles. This functional ability of the stroke survivor influences their perceived QOL post stroke (Naess et al., 2006; Mackenzie and Chang, 2002). The psychological dimension comprises cognitive and emotional functioning and the subjective perceptions of one's health and satisfaction with life.

Depression, as an example, influences the stroke survivors QOL (Pan et al., 2008; Mackenzie and Chang, 2002). The social dimension considers social and family interaction. Poor social support has been linked to poor QOL post stroke (Carod-Artal and Edigo, 2009; Mackenzie and Chang, 2002). Social support involves both physical and emotional aspects, making family involvement essential from an early stage (Mackenzie and Chang, 2002). It has been noted that a large network and perceived social support appear to be associated with greater functional gains as well as lower levels of depression (Meijer et al., 2004; Tsouna- Hadjis et al., 2000; Glass et al., 1993). Poor social support has been shown to be linked to poor QOL post stroke (Carod-Artal and Egido, 2009; Mackenzie and Chang, 2002). This is believed to be influenced by the functional and cognitive ability as well as the subjective needs of the individual with the stroke (Mackenzie and Chang, 2002) making involvement of the family in the rehabilitation process from early on very important. While persons with mild stroke may not appear to present with any limitations with regards to activities and participation, their QOL in terms of these domains may be affected (Mackenzie and Chang, 2002).

Attention to the concept of QOL post stroke is still increasing in developed countries and receives minimal or no attention in developing countries, largely due to limited resources (Poungvarin, 1998). Functional ability of the stroke survivor is a strong predictor of the patient's perceived QOL post stroke (Hartmen-Maeir et al., 2007; Naess et al., 2006; Mackenzie and Chang, 2002; Mayo et al., 2002). Thus limitations in efficient walking competency and in performing independent ADLs, affect one's physical functioning and have been shown to impact on one's QOL (Hartmen-Maeir et al., 2007; Mayo et al., 2002). Thus considering that social support has a positive impact on functional ability, it stands to reason that empowering the patients' social support network may impact on their QOL (Hilari et al., 2010; Kim et al., 1999). Thus empowering the family and involving the community with skills and knowledge may optimize the functional ability of the stroke survivor (Wasserman et al., 2009; Lemogoum et al., 2005; Clark et al., 2003).

Organised stroke care in dedicated stroke and rehabilitation units, has been found to improve patient functional outcomes and hence better health related QOL post stroke (van Exel et al., 2003). Such units can be set up without extra budget requirements (van Exel et al., 2003). In South Africa while the government has agreed to ensure that each province has a stroke unit (Connor and Bryer, 2005), at this stage these have not as yet been established. An important aspect to consider in this process of providing organized stroke care, could involve exploring alternative ways to provide the benefits of rehabilitation to patients with stroke on an out-patient basis.

2.10 PREDICTORS OF STROKE RECOVERY

2.10.1 Stroke Severity

There is a correlation between stroke severity and potential for improved functional outcome (Kelly et al., 2003; Jorgensen et al., 1995). Persons with more severe strokes undergo cerebral neurological structural and functional recovery for up to six months following injury (Green, 2003). However the patient with a more severe stroke does not improve as much as those with less severe strokes. Duncan et al., (2003) noted considerable evidence for spontaneous recovery independent of rehabilitation in smaller lesions. It is also worth noting that smaller cortical lesions show significant return of lost functions to nearly normal levels as opposed to larger lesions, which show less return of function. While recovery post stroke is a combination of natural spontaneous recovery, compensation and neural plasticity, patients who present with moderate impairment following a stroke, frequently demonstrate more marked improvements with rehabilitation (Ronning and Guldvog, 1998; Stineman et al., 1998; Karla et al., 1993). Similarly, Jorgensen et al., (1999) reported that those with moderate impairment post stroke show the greatest degree of functional change. However it is important to consider that improvement in motor power does not necessarily result in recovery of function. Function may be impeded by sensory deficits, apraxias, an inability to co-ordinate movements, as well as cognitive deficits. Function can also improve without neurological recovery, i.e. improvements in function despite underlying impairments. This type of recovery can continue for several months after neurological recovery is complete (Duncan and Lai, 1997; Nakayama et al., 1994).

2.10.2 Age

Age seems to have a significant but relatively small effect on the speed of recovery and the final outcome, with younger stroke survivors recovering far more quickly. A more complete recovery was noted by Kugler et al., (2003) in the younger patient with stroke. In their study of 2219 patients, patients younger than 55 achieved 67% of a possible maximum improvement as opposed to 50% for patients older than 55 years ($p<0.001$). It has been suggested that the younger patient with stroke has more compensatory ability than the older patient with a comparable neurological impairment. This could account for the greater functional gain frequently seen in younger stroke survivors (Karla, 1994; Nakayama et al., 1994).

2.10.3 Post Stroke Rehabilitation Intensity

From the Copenhagen Stroke study, it was noted that 95% of all patients reached their maximal neurological recovery within 11 weeks and best ADL recovery within 12.5 weeks (Jorgensen et al., 1995). Although there is evidence that most functional recovery occurs within the first three months post stroke (Duncan et al., 1998a, Jorgensen et al., 1999), there is also evidence for the effectiveness of therapeutic intervention that has resulted in gains in strength, balance, mobility and aerobic performance in chronic stroke (Duncan et al., 2011; Texiera Salmela et al., 2001; Dean et al., 2000; Liepert et al., 2000), even where treatment intervention is implemented after six months post stroke (Duncan et al., 2011). Greater intensities of therapy, with increased duration of exercise training time has shown significant improvements in independence in ADL and individual outcomes in terms of strength, upper extremity function and walking speed (Cooke et al., 2010; Galvin et al., 2008; Teasell et al., 2004; Kwakkel et al., 1999; Langhorne et al., 1996). In addition these improvements have demonstrated reduced hospital length of stay (Karla, 1994) and have been maintained for up to six months. However the intensity of these "packages" of physiotherapy post stroke has varied considerably throughout the world. This ranges from patients who are discharged without any rehabilitation as soon as they are medically stable (Mudzi, 2009; Wasserman et al., 2009), to others receiving twice daily in -patient rehabilitation for several weeks (English et al., 2007; Blennerhassett and Dite, 2004; Eich et al., 2004; Nilsson et al., 2001; Richards et al., 1993). The desired or optimal intensity (minutes of therapy per day) recommended for an improvement in individual outcomes in terms of strength, upper extremity function and functional ability is not known. We do know that more time dedicated to learning a specific skill has been associated with acquiring and improving performance in sports (Helsen et al., 1998) and playing musical instruments (Ericsson, 2004). In the same manner, Kwakkel et al., (2004) reported that during the first six months post stroke, to obtain a significant change in ADL and gait speed, an additional 16 hours difference in training time between experimental and control groups is required. Bearing these findings in mind, it stands to reason that we should aim to provide more intensive rehabilitation within the first three months post stroke.

Studies conducted in the sub-acute phase post stroke have ranged from approximately 20 sessions over a four week period, to as much as 50 sessions over a 12 week period (Duncan et al., 2011; Franceschini et al., 2009; Sullivan et al., 2007; Blennerhassett and Dite., 2004; Richard et al., 2004; Duncan et al., 2003; Nilsson et al., 2001). Task training intervention studies in persons with chronic stroke have ranged from 12 sessions to as much as 57 sessions (Olawale et al., 2011; Yang et al., 2006; Pang et al., 2005; Sabach et al., 2004; Dean et al., 2000). The frequency in these trials has also varied, ranging from three sessions per

week (out- patient based studies) to five (in-patient based studies). However for the majority of persons with stroke in South Africa who have been discharged from the hospital, attending rehabilitation as an out -patient three to five times per week is not always feasible, due to transport difficulties and limited availability of rehabilitation services (Thorogood et al., 2007; Connor et al., 2004; Hale et al., 1999).

2.11 THE DELIVERY OF REHABILITATION SERVICES POST STROKE

Rehabilitation offers the best opportunity to reduce the associated burden of care following stroke (Bagg et al., 2002). Thus the objective of rehabilitation following stroke, is to improve the stroke survivor's functional independence and facilitate their return into the community as best as possible. Following stroke proper management during the acute phase will result in less disability and a less negative impact on the healthcare sector and society (McNaughton et al., 2005). The provision of rehabilitation services can be performed in rehabilitation hospitals or a rehabilitation unit within an acute care hospital. In certain instances rehabilitation is performed in nursing care facilities or on an out -patient unit when the patient has been discharged home. The standard manner in providing rehabilitation post stroke differs greatly between countries. This is influenced by the availability of resources both in the acute post stroke phase and the rehabilitation phase. How these services are provided, influence the functional outcome and survival of the person who has sustained a stroke (Dennis and Langhorne, 1998).

Hospital based rehabilitation programmes post stroke are usually the most comprehensive and intensive, and have shown better improvement in outcomes when compared with no care (EBRSR module 4). However patients who have moderate to severe strokes should be rehabilitated in stroke specific units, in a hospital based program for a certain period if they are able to cope with at least three hours of physically demanding activity per day (EBRSR module 4). Significantly better outcomes have been noted with rehabilitation in stroke care units in terms of mortality, institutionalization and level of independence following stroke, when compared with rehabilitation in the general medical ward (Stroke Unit Trialists' Collaboration, 2001; Krespi et al., 2003; Langhorne and Duncan, 2001; Karla et al., 2000). However the delivery of rehabilitation post stroke on an in-patient basis in the public healthcare Sector in South Africa is neglected and not standard practice (Connor et al., 2007; Fritz, 2006; Connor et al., 2004).

With increasing numbers of stroke survivors worldwide and escalating medical costs, there has been some increased interest in exploring out-patient based rehabilitative options, focusing on less expensive alternatives to the hospital based models (Van De Port et al., 2009).

Out patient based rehabilitation can be delivered in different ways, namely:

- Hospital based out -patient rehabilitation
- Community based rehabilitation
- Early supported discharge

The evidence based review of stroke rehabilitation has defined these different forms of rehabilitation (EBRSR module 7). Hospital based out patient rehabilitation is when therapies are provided in an out- patient setting, located within the hospital itself. Community based out patient rehabilitation is provided in the patient's home or a community centre. Early supported discharge provides interdisciplinary rehabilitation in the home or community in lieu of in-patient rehabilitation.

Hospital based out-patient rehabilitation and community based care are both provided in the sub-acute phase of stroke (from 4-8 weeks post stroke until 6 months) and is frequently prescribed following discharge from in- patient stroke rehabilitation units. This differs from early supported discharge (ESD) which facilitates shorter hospital length of stay with associated reduced costs. Early supported discharge caters for patients who would prefer to be at home after a stroke. To date ESD has shown similar outcomes, to conventional in-patient rehabilitation for patients with milder strokes (Rudd et al., 1997; Holmqvist et al., 1998; Mayo et al., 2000; Bautz-Holter et al., 2002). Thorsen et al., (2005) conducted a five year follow-up of the study by Holmqvist et al., (1998) and found no differences between the groups in terms of functional outcome and independence. The length of stay in this study was reduced from 29 days in the control group to 14 days in the intervention group. These reduced in-patient length of stays are then comparable to the average seen in South Africa, except that in South Africa patients are discharged irrespective of their stroke severity.

Internationally it has been suggested that the conventional post acute rehabilitation after stroke has decreased, as a result rehabilitation is often incomplete (Paolucci S et al., 2001). It is noted that the acute stroke management in the USA is 7-10 days in an acute care hospital, after which only 21-28 days in a rehabilitation facility is provided (Duncan et al., 2005). The average length of hospital stay for patients with stroke in high income countries is 28 to 34 days (van Exel et al., 2003; van Straten et al., 1997).

In South Africa and other areas of the developing world where in -patient and out-patient rehabilitation services are extremely limited because of the cost of in-patient rehabilitation and the demand for beds (Rhoda and Hendry, 2006; Hale and Wallner, 1996; Stewart et al., 1994), a resource efficient means of providing physiotherapy interventions aimed at improving

functional outcome must be established. One of the key elements of this improved functional outcome to address in rehabilitation is the ability to walk independently and competently.

2.12 WALKING COMPETENCY IN THE COMMUNITY AFTER STROKE

Walking competency is a term used to describe a certain level of walking ability that allows an individual to participate in the community safely and efficiently (Salbach et al., 2004). To define the specific requirements for competent walking in the community is difficult. Traditionally measuring community ambulation concentrated on the dimensions of mobility, particularly measures of distance and speed (Robinett and Vondran, 1988; Lerner-Frankiel et al., 1986). Perry et al., (1995) expanded this into six functional walking categories; taking into account gait velocity and patients self reported walking ability. Patla and Shumway-Cooke (1999) produced an operational definition of the dimensions of mobility with eight categories, of which the importance of four of these dimensions was highlighted more recently, namely: temporal factors (distance and speed), postural transitions (changing direction), physical load (pushing and pulling a door), and terrain. Gait speed has proven to be effective in discriminating between different levels of community ambulation ability; however it is best used in conjunction with a self reported measure of social integration or community participation (Lord et al., 2004).

Walking competency requires an ability to meet the demands of the environment in which you are walking, an adequate speed to cross a street safely (gait speed), an ability to cover sufficient distances to perform ADLs (walking endurance), a level of balance that allows one to turn and look in different directions while walking and cope with perturbations (functional balance and mobility), and demonstrate an ability to anticipate and avoid obstacles or accommodate to environmental changes/obstacles (Lord et al., 2004; Salbach et al., 2004; Shumway-Cooke A and Woollacott M, 2001; Patla and Shumway-Cooke, 1999; Patla, 1997). Thus survivors of stroke who show improvements in walking are not necessarily competent community walkers, they still present with limitations in their ADLs and this ultimately affects their QOL (Lord et al., 2004). While trying to define the specific needs for community walking, a rather rigid and endless list of tasks can be documented, which fails to include the impact of the environmental changes of our world, that impact on the complexity of the task and bear associated risks while walking. For example, walking to the local store for bread on undeveloped sand roads, a common feature in Africa, when it is sunny and dry poses quite a different challenge to one's walking than when it is raining, muddy and misty. Thus the ability to safely maintain balance on a slippery floor surface with limited visibility poses a far greater risk in terms of competently completing the task successfully.

The reported speed required for community ambulation by Carr and Shepherd (2003), which is considered fast enough as a pedestrian for most environmental and social contexts is 1.1m/s to 1.5m/s. Lerner-Frankiel et al., (1986) additionally highlighted the importance of examining community mobility in more detail. They noted a minimum requirement of an ability to walk 300m, an ability to walk at 1.3m/s for approximately 13 to 27m in order to cross a street at traffic lights and additionally the ability to negotiate an 18-20cm curb independently.

Although much of the literature suggests that the prognosis for walking recovery is quite favourable, in due course (Kwakkel et al., 1999; KNGF Guidelines, 2004) it is worth noting that only 30% of the patients who achieve independent walking achieve a walking speed and distance appropriate to their age (Wade and Hewer, 1987). It has also been noted that only seven percent of those discharged from rehabilitation after a stroke (Hill et al., 1997), achieve a walking speed and distance that meet the criteria for community walking. Gait velocity values typically displayed by functionally independent patients with stroke of the highest level of community walkers is approximately 0.8m/s. Compared to normal population values of 1.3m/s (Perry, 1992) and the values suggested for community ambulation of 1.1.-1.5m/s (Carr and Shepherd, 2003) this speed clearly represents a functional compromise. A speed of 0.8m/s may be adequate for a person with stroke to perform typical community activities, however it is less than the normal gait speed ability required to cross a wide commercial street within the traffic signal time allocation (Salbach et al., 2001; Lerner-Frankiel et al., 1986). Thus the measurement of gait speed may be helpful in discriminating between limited and full community ambulation (Lord et al., 2008)

In the South African context, a person with stroke would need to be able to walk sufficient distances to the nearest taxi rank to get to the clinic for medication and check ups. Taxi ranks are by nature extremely crowded congested areas with people rushing to and fro. This environmental context requires efficient dual tasking (integrate walking with other tasks), safe and efficient walking through the crowds and to the ability to ensure the correct taxi is caught. Thus the emphasis here is on competent community ambulation, not merely independent walking (Lord and Rochester, 2005; Lord et al. 2004; Salbach et al., 2004; Shumway-Cooke and Woollacott M, 2001; Patla and Shumway-Cooke, 1999; Patla, 1997).

Thus for the majority of stroke survivors walking competently remains a challenge. This lack of community walking competency is of great concern, as without it stroke survivors report that they are confined to their homes, with resultant relative inactivity and extremely poor levels of community re-integration (Lord and Rochester, 2008). A systematic review conducted in 2007 by Van de Port et al., showed inactivity to be a significant factor in determining decline of

mobility. In addition their meta- analysis showed that gait oriented training interventions significantly improved walking endurance and gait speed. A variety of training programmes are used to improve gait in the home and the community that focus on combinations of strength and cardiovascular training in which gait and gait related tasks are practiced using a functional approach (Macko et al., 2005; Salbach et al., 2004; Duncan et al., 2003). Thus the ability to walk competently in the community is an important objective of rehabilitation. Considering the requirements to walk in the community, walking competency could be expressed as the combination of walking endurance, gait speed, functional balance and mobility (Salbach et al., 2004). Measurement of these aspects of walking can provide some useful information on the stroke survivors walking competency.

2.13 GAIT REHABILITATION

There is increasing evidence that the brain retains the ability to reorganise and has plastic potential in adult humans, in the elderly and following a lesion (Merzenich et al., 1990). This neural plasticity can be influenced by training, rehabilitation and the environment. Functional improvement after a brain lesion results from changes in the spared brain sections. The mechanisms involved in this process are varied and beyond the scope of this thesis. What is important to note is that the aspects of an enriching environment found to result in the best improvements in performance were the opportunity for increased use of the affected body part in activities combined with social interaction (Risedal et al., 2002). Walking is the manner in which we transport ourselves from one point to another safely and efficiently, within the home, to transport services, in shopping malls and a multitude of community environments. Walking involves a variety of different terrains, walking up and down slopes, stepping up and down curbs, negotiating uneven and unstable surfaces, changing direction and speed and being able to cope with perturbations. This ability is life enriching and a basic part of our every day lives (Carr and Shepherd, 2010). Walking independently after stroke is the most commonly expressed goal of stroke survivors (Bohannon et al., 1988). The second most important goal of individuals who have sustained a stroke is the ability to walk greater distances (Bohannon et al., 1988). These findings together with the appearance and speed of walking were the four main walking objectives as expressed in the findings by Bohannon et al., (1991). Considering this objective, walking is the activity most affected by stroke with as many as 80% of people with stroke in the acute phase losing this ability (Jorgensen et al., 1995; Friedman, 1991; Wade et al., 1987). Thus the inability to walk is a devastating loss to stroke survivors. In addition the ability to walk competently as outlined above is a prerequisite for most daily living activities (Carr and Shepherd, 2010). While 80% of stroke survivors who are initially unable to walk

achieve independent walking within six weeks and 95% within 11 weeks (Jorgensen et al., 1995), at three months 25%-33% still require assistance or supervision when walking (Jorgenson et al., 1995; Duncan et al., 1994; Richards et al., 1993). These independent walkers also seldom achieve walking speeds that are considered sufficient for community ambulation (Schmid et al., 2007; Lord and Rochester 2005; Lord et al., 2004). A patient centered study of the consequences of stroke revealed the main problem people experience post stroke is related to being completely housebound. This invariably resulted from their inability to walk safely over uneven ground and pavements outside the home, an inability to manage stairs and the lack of grab rails on staircases. Hence being able to walk at a level at which one can manage these tasks efficiently in the community was highly valued (Pound et al., 1998).

Considering this need, it is worth noting that in Soweto in South Africa, only 55% of patients with stroke were able to walk independently at six months post stroke, (Hale et al., 1998) compared with percentages ranging from 65%-80% worldwide (Kwakkel et al., 1999; Segal and Whyte, 1997; Gresham et al., 1995; Jorgensen et al., 1995; Friedman, 1991; Wade et al., 1987). This may be the result of inadequate rehabilitation, which leaves a greater number of stroke survivors disabled in South Africa (Connor et al., 2004).

The walking dysfunction noted post stroke arises not only from the lesion itself, but is also as a result of adaptations that arise from secondary complications of immobility and physical inactivity (Gracies, 2005). These changes include muscle weakness, soft tissue changes with resultant increases in joint and muscle stiffness and loss of motor control in activities. Thus, gait retraining post stroke aims to prevent lower limb adaptive soft tissue changes, increase muscle strength and co-ordination and maximize motor skills (Carr and Shepherd, 2003) to ultimately increase walking velocity, endurance and competency. As stroke survivors start to regain the ability to walk independently, the most consistent finding is that they walk slowly (Turnbull et al., 1995; von Schroeder et al., 1995) at speeds far less than what is optimal for efficient community ambulation (Schmid et al., 2007; Lord and Rochester 2005; Lord et al., 2004). Slow walking can be the result of many factors, namely the inability to generate enough muscle force in the lower limb, in addition the excessive energy costs used per metre cannot be sustained for long periods. Other consistent findings in the post stroke walking ability are an inability to maintain comfortable walking speed for a period of 6 minutes (Dean et al., 2001), and a limited ability to adapt to changing environments (Said et al.,1999).

Many treatment approaches are used to assist the recovery of these impairments that affect walking function post stroke. Ongoing research aims to determine which aspects of a gait rehabilitation programme show improvements in meaningful gait function and performance. Some of these therapeutic approaches will be discussed in this review which were combined to create the programme implemented in this study.

An extremely important consideration when designing a gait rehabilitation programme is the widely accepted finding that positive cortical re-organization post stroke in the human (Liepert et al., 2000) and animal (Friel et al., 2000; Nudo et al., 2001; Nudo et al., 1996) is driven by tasks that are challenging, repetitive and involve active participation. Further, it has been concluded that to facilitate the best possible functional outcome for people post stroke, engagement in intensive task oriented therapy is necessary (Kwakkel et al., 2004; Van Peppen et al., 2004). Considering these findings, it is extremely concerning that there is little or no rehabilitation provided to stroke survivors in the public healthcare sector in South Africa (Mudzi, 2009; Rhoda and Hendry, 2003; Hale and Wallner, 1996; Stewart et al., 1994)

2.13.1 **Strength Training**

Unilateral weakness post stroke is well known and documented. Further, it is considered to be one of the main impairments contributing to post stroke disability (Patterson et al., 2007; Kim and Eng, 2003; Nadeau et al., 1999; Bohannon, 1990). Weakness arises, primarily as a result of the lesion itself, with resultant decreased descending inputs to the motor neuron population, and secondarily as a result of decreased muscle activity and immobility causing skeletal muscle adaptation (Mc Comas, 1994; Farmer et al., 1993) and thus weakness (Canning et al., 1999). The ability of certain muscle groups to generate force, namely the knee extensors, ankle plantar flexors and hip flexors muscles has been positively correlated with improved gait performance (Olney et al., 1991; Bohannon and Andrews, 1990; Nakamura et al., 1988). As there is a correlation between muscle weakness, force generation and gait speed (Patterson et al., 2007; Kim and Eng, 2003), further evidence is sought to determine if changing the torque of certain muscle groups leads to improvement in gait performance and functional tasks (Eng, 2004). However, muscle weakness post stroke is modifiable (Lee et al., 2010; Teixeira-Salmela et al., 1999; Bohannon and Andrews, 1990), and such increases in strength have shown an associated improvement in comfortable walking speed (Bourbonnais et al., 2002; Dean et al., 2000; Teixeira-Salmela et al., 1999). However, these studies have had extremely small sample sizes and have not performed strength training programs in isolation. In addition they have included a component of task oriented gait related training or endurance training, making it difficult to attribute improvements solely to strength training.

Muscle strength training is designed to improve the ability of a muscle group to generate force. In stroke rehabilitation, this improved force generation of the hemiparetic limbs aims to improve functional ability. In the history of physiotherapy there is reluctance to strengthen muscles in patients with stroke as it was believed to increase muscle spasticity (Bobath, 1990). Contrary to this belief research has repeatedly shown that there are no adverse effects of muscle strengthening (Morris et al., 2004; Kim et al., 2001; Sharp and Brouwer, 1997).

Strength training in a non -weight bearing manner is performed with repeated eccentric or concentric contractions where resistance is provided by free weights, weighted gym machines, elastic bands or one's own body weight, with the aim of increasing the muscles' ability to generate and control forces (Saunders et al., 2004). The key elements of a progressive strength training programme are to provide sufficient resistance, and to progressively increase the resistance as the muscle strengthens and to continue the training programme for a minimum of four weeks for the benefits to accrue (Kraemer et al., 2002). In addition strength training can be performed as part of task oriented activities (body weight and limb weight act as resistance) frequently termed functional strength training. The difficulties in this approach are determining if functional gains are due to muscle strength gains, or the task training aspects that increase the control of movement and functional performance in everyday activities that cannot be isolated from the activity. In an older population, small changes in lower extremity strength have shown the necessary changes required to improve balance, motor performance and walking speed (Buchner et al., 1996). A number of high quality randomised control trial (RCT)'s have not shown significant differences advocating strength training to improve functional outcomes (Cooke et al., 2010; Mead et al., 2007; Moreland et al., 2003; Kim et al., 2001). However, most of these RCT's have focused on chronic stroke and all subjects were independent walkers at randomisation, limiting their scope for improvement.

Most strength training studies involve a minimum of twice weekly therapy for 4-12 weeks. Unfortunately due to the variety of interventions implemented, the variety of intensities and diversity in the use of outcome measures, conclusive results regarding the effectiveness of strength training programs are not possible (Eng and Tang, 2007; Ada et al., 2006; Morris et al., 2004; van Peppen et al., 2004). The studies that have shown improvements in walking speeds following strength training, had sample sizes too small to be representative of the population (Bourbonnais et al., 2002; Dean et al., 2000; Teixeira-Salmela et al., 1999). More recently there has been an interest in combinations of strength and endurance training programmes, in which gait related tasks are practiced using a functional approach (Macko et al., 2005; Salbach et al., 2004; Duncan et al., 2003). When the strength training programme

was task oriented in nature significant between group differences were noted in gait speed, gait endurance, step test and timed up and go (Yang et al., 2007). However these improvements may be attributable to the tasks themselves that were practiced and not the strength training.

An important finding in Sullivan et al's., (2007) RCT was that an ambulatory training programme (with a limited strengthening component) proved to be more effective in improving walking speed than the non gait- specific strengthening programme (with resistance cycling). This supports the evidence that strength training performed by repetitive practice of gait related activities is more beneficial than programmes that are centred on strength training in non-functional activities (van de Port et al., 2007). Considering the limited evidence advocating strength training in non functional activities, the effectiveness of this approach (often used in the public sector in RSA) compared with other approaches needs to be evaluated in RSA.

2.13.2 **Balance Training**

Postural control or balance involves the regulation of movement of body segments over the supporting joints within one's base of support. Balance is task and context dependent and cannot be separated from the actions performed and involves all levels of the neuromuscular system (Mackinnon and Winter, 1993). Balance enables us to perform everyday actions effectively and efficiently.

The ability to maintain control of one's body over a base of support that is either static or mobile is a subconscious complex neuromuscular and mechanical process performed during functional tasks such as walking. Balance is an integral part of performing a task successfully that must be learned along with the task and becomes more effective with training (Carr and Shepherd, 2010; Shumway-Cooke and Woollacott, 2007; Carr and Shepherd, 2003).

In everyday life, we are often challenged by unstable surfaces, external forces and perturbations under conditions where one needs to maintain balance in various positions, for example standing up or sitting down on a bus, picking up a child or being bumped in a crowd in a shopping mall or church gathering. In these situations postural adjustments occur in response to the perturbations that threaten our balance. Poor postural control has been identified as one of the problems with mobility post stroke, arising as a result of the impairments noted in the sensory, motor and cognitive systems (de Haart et al., 2004; Pohl et al., 2004). In fact improvement in balance has been identified to be the strongest predictor of distance gained in walking, in those who walk less than 213m on the six minute walk test

(6MWT) less than three months post stroke (Pohl et al., 2004). Specific impairments that can affect balance include decreased muscle strength, limited endurance, poor co-ordination, disturbed sensory and perceptual processes and cognitive dysfunction. The executive functions of self regulation and concentration on a challenging task, while suppressing reactive behaviour and incorporating memory are functions that may be affected post stroke. These impairments may result in risk taking and impaired attention and contribute to increased falls (Carr and Shepherd, 2010).

A deficit in balance has been associated with decreased levels of walking activity and may be an important factor contributing to post stroke de-conditioning (Michael et al., 2005). In a cross sectional correlation study of chronic stroke survivors, balance was shown to be a predictor of walking ability in terms of walking speed and distance covered (Goljar et al., 2010; Au-Yeung et al., 2009; Yelnik et al., 2008). Although these strong correlations between balance and functional walking exist, there are limited therapeutic interventions in terms of training balance that have significantly impacted on functional balance measured with the Berg balance scale (BBS), functional mobility measured with the “timed-up and go” (TUG), comfortable gait speed measured with the 10 metre walk test (10MWT) or walking endurance (Goljar et al., 2010; Au-Yeung et al., 2009; Yelnik et al., 2008).

To improve a person’s balance requires the opportunity to move and practice tasks independently without compensating with the use of the upper extremity for balance. Without the use of the upper extremity, active anticipatory postural adjustments and on going postural corrections in a task are encouraged. Under these circumstances the patient’s attention is not specifically focused on their balance per se, but rather directed toward the task itself and ultimately improves balance (Wulf et al., 2004; Wulf et al., 2001). A therapist or caregiver close by may provide some psychological stability and encouragement in spite of the fact that the physical demands of the tasks may result in instability. The moment an upper extremity holds onto an external support the underlying postural adjustment mechanisms are changed which prevents improvement in balance control. Small modifications in the activity may need to be made to allow for success in performance in a task (Liepert et al., 2000) which ultimately reduces the demands of the task (and the need to use the upper extremity for balance) but still presents a challenge which facilitates the desired postural balance adjustments.

Exercises that are adequately challenging in standing, performed with sufficient dosage and without reliance on the upper extremity are a way of improving balance during everyday gait related activities (Sherrington et al., 2008). Developing a skill in an action that is challenging

requires the acquisition of balance control (Carr and Shepherd, 2010). Lord et al., (2007) further emphasized, that effective exercise programmes for preventing falls consist of challenging and progressive exercises, performed in weightbearing positions that minimize the use of the upper limbs for support. By practicing a variety of tasks/actions in different environments the patient has the opportunity to regain some of the postural control skills for balance without thinking about how they did it (Carr and Shepherd, 2010). A key component of training balance in functional gait related tasks that are adequately challenging for the patient is that psychological stability, encouragement and safety are constantly provided by a therapist or a caregiver.

2.13.3 **Cardiovascular Endurance Training**

Stroke survivors continue to live with substantial residual physical impairment (reduced mobility, balance and muscle weakness). This contributes to their decreased levels of activity and relatively passive lifestyle (Jorgensen et al., 1999; Mayo et al., 1999). In addition, it has been noted that deconditioning after acute brain lesions may to some extent be a result of the associated relatively inactive nature of the rehabilitation programmes (Mackay-Lyons and Howlett, 2005; Kelley et al., 2003). By its nature, acute rehabilitation involves low- intensity exercise and activities that do not stress the cardiovascular system adequately to induce a training effect (Mackay-Lyons and Makrides, 2002). Level of physical activity and functional walking ability (Wade et al., 1987) are positively related to aerobic capacity (Talbot et al., 2000; Fujitani et al., 1999; Berthouze et al., 1995). Aerobic capacity, defined by the America College of Sports Medicine (ACSM), is the product of the capacity of the cardiorespiratory system to supply oxygen (i.e. cardiac output) and the capacity of the skeletal system to utilize oxygen (i.e. arterial venous oxygen difference). As a result of physical inactivity post stroke and the resultant deconditioning, there is a reduction in a person's aerobic capacity (Raven et al., 1998).

Peak oxygen consumption (VO_2), is a measure of aerobic capacity. It has been found in acute stroke sufferers, that they have a low VO_2 indicating their relative lack of physical fitness prior to the stroke (Mackay-Lyons and Makrides, 2004). In addition it has been found that the peak VO_2 in individuals with stroke is as low as 50-70% of the age and sex matched value of sedentary individuals without stroke (Eng et al., 2004; Mackay-Lyons and Makrides, 2004). As a result it is evident that the patient with stroke not only presents with reduced muscle strength, but is frequently not as physically fit as age matched persons without stroke (Potempa et al., 1995). This puts the stroke survivor at an even greater risk of cardiovascular disease, compounded by their other cardiac, vascular and diabetic pre-existing co-morbidities. Limited

aerobic capacity further contributes to their reduced independence in terms of walking endurance and performing ADLs. The disadvantageous effect of this limited endurance capacity and muscle endurance on functional mobility is frequently compounded by the greater metabolic demands to perform movements with the associated stroke impairments. Thus a programme that focuses on cardiovascular endurance training is frequently advocated, to prevent further secondary disabling conditions (Rimmer and Braddock, 2002).

Stroke survivors with limited VO_2 values perform daily functional activities at a relatively higher exercise intensity to complete the same tasks, when compared with their fitter age appropriate persons without stroke. This reduction in fitness contributes to the limited endurance capacity of chronic stroke survivors to successfully ambulate in the community (Mayo et al., 1999). At one year post stroke, it was noted by Mayo et al., (2005), that the most evident area of difficulty was limited walking endurance as measured by the 6MWT. They found that stroke survivors who were able to complete the test walked an average of 250m, the equivalent to 40% - 50% of the distance required to walk independently in a department or grocery store (Andrews et al., 2010; Lerner-Frankiel et al., 1986) and less than the minimum distance required for community ambulation (Lerner-Frankiel et al., 1986).

Internationally there is increased recognition of the need to work on aerobic exercise in the stroke population (Pang et al., 2006; Eng et al., 2004; Mackay-Lyons and Makrides, 2004). The results of a systematic review conducted by Pang et al., (2006), looking at aerobic exercise following stroke, included seven RCT's with subjects including acute, sub-acute, and chronic stages of stroke. Exercise intensity ranged from 50% - 80% heart rate reserve, duration ranged from 3-5 days per week for 20-40 minutes per session, which follows the guidelines recommended by the American College of Sports Medicine (ACSM) in terms of improving VO_2max. Regardless of the stage of recovery post stroke, the review showed significant evidence for aerobic exercise in terms of improving one's aerobic capacity, walking speed and endurance. Unfortunately the sustainability of these improvements were not established as no follow-ups were conducted. In light of these findings it is necessary to consider including aerobic endurance training when designing a rehabilitation programme for stroke survivors. A study by Macko et al., (2005) bears some consideration even though it had no control group. This study noted that short bouts of activity are as effective as a continuous uninterrupted training session of aerobic endurance training. To improve aerobic capacity as part of a post stroke rehabilitation programme, endurance training stations can be interspersed between gait oriented training tasks. This process would ensure that the rehabilitation programme focuses

on facilitating practice of functional tasks and cardiovascular endurance training when time and resources are limited.

Cycle ergometry (Lennon et al., 2008; Bateman et al., 2001), treadmill walking (Macko et al., 2005; Richards et al., 2004) and repetitive functional activities (Outermans et al., 2010; Duncan et al., 2003; Teixeira-Salmela et al., 1999) are the most common methods used for implementing a cardiovascular training programme. Exercising on a cycle ergometer has the benefit of not requiring as much postural control and balance as the latter two require, and may be more advantageous for people with more severe stroke or with limited balance. Considering that treadmill training has not shown significantly greater results in terms of walking endurance than walking overground, the convenience of walking overground in one's own community can easily and cost effectively be implemented into any stroke rehabilitation programme (Duncan et al., 2011; Olawale et al., 2011; Franceschini et al., 2009; Eich et al., 2004; Richards et al., 2004; Nillson et al., 2001).

2.13.4 **Task oriented Training**

Based on animal studies (Barbeau and Rossignol, 1987) and the increasing evidence from clinical trials, it has been concluded that repetitive task oriented training can induce the desired adaptive cortical plastic changes (Nudo et al., 2001; Nudo et al., 1996) following a neurological lesion. A task oriented approach to therapy is defined as a therapeutic approach to retraining the patient with movement disorders based on the Systems Theory of Motor Control. In the systems theory successful motor behaviour is the product of an interaction between the individual, the desired task (Shumway-Cooke and Woollacott, 2001), and the environment in which the task is performed. As a result task oriented training is the repetitive practice of a task that must be specific to the desired outcome to be achieved (Carr and Shepherd, 2010). Thus the design of the exercises provided is important. As discussed for interventions to be effective in improving functional ability post stroke, focus must be on training functional tasks (van Peppen et al., 2004). Interventions that focus at the impairment level may lead to improvements in those impairments but not translate into improved independence in functional activities (van Peppen et al., 2004). Task oriented training is advocated in stroke rehabilitation to improve performance in ADL such as walking and upper limb reaching to grasp objects (van de Port et al.,2007; Blennerhassett and Dite, 2004; Kwakkel et al., 2004; Salbach et al., 2004; van Peppen et al., 2004; Richards et al., 1999).

Gait task oriented training focuses specifically on gait and gait related activities to promote recovery of independent walking after stroke. Gait related activities have been defined as those

activities often related to walking such as, climbing up and down stairs, turning around, walking quickly, and walking for long distances as required in a large shopping mall, e.g. greater than 300m (Van de Port et al., 2007). In gait task oriented training, extensive repetition of challenging activities in standing and walking positions, are performed. This is in contrast to conventional therapy that involves activities performed in sitting, lying and standing where the main focus is gait preparation (Hesse et al., 2003). Task oriented therapy is designed to strengthen the affected lower extremity, enhance gait balance, speed and endurance, by practicing activities related to walking. This approach has been shown to result in significant improvements in walking competency in people with stroke (Yang et al., 2006; Blennerhasset and Dite, 2004; Salbach et al., 2004; Dean et al., 2000).

Repetitive gait training cannot be underestimated, as walking is the primary objective of the patient and intensive gait training is an ideal task oriented exercise. Gait training can be performed: on a treadmill with or without a harness, over ground, outdoors, around the hospital or clinic grounds, in the community at a mall or nature park or in and around the patient's neighbourhood, making use of the natural environment in which they live. This is often referred to as overground walking and does not make use of technological aids, thus easily implemented where resources are limited (Olawale et al., 2010; Franceschini et al., 2009).

It is becoming widely acknowledged that in task oriented training, the specificity of the task and the intensity of the training with regards to time spent in therapy, are the main determinants of improvement in walking ability (gait speed and endurance) and walking competency after stroke (van de Port et al., 2007; Kwakkel et al., 2004; van Peppen et al., 2004; Richards et al., 1999). Although walking and functional mobility has been shown to improve in numerous studies, no evidence for improvement in health related QOL has been noted with gait task oriented training. Assessing health related QOL has not been included in the majority of gait task oriented training programme studies (Yang et al., 2006; Blennerhasset and Dite, 2004; Salbach et al., 2004; Dean et al., 2000). While only few studies have investigated the effect of task oriented training on QOL in chronic stroke, they have found no significant difference post intervention or at follow up (Marigold et al., 2005; McClellan et al., 2004).

Typically task oriented training sessions can be set up as a series of workstations that a patient works through moving from station to station or patients can train as a group moving from one station to the next. Wevers et al., (2009) in a meta-analysis of six studies (307 participants) reported a significant treatment effect in favour of task oriented training performed as a circuit class on walking distance (0.43;95% CI, 0.17-0.68), gait speed (0.35; 95% CI 0.08-0.62) and

the “timed up and go” test (0.26;95% CI, 0.00-0.51; p=0.047) in chronic stroke. By setting up a task oriented circuit training group, three key features of an efficient and effective physiotherapy training program would be provided (van de Port et al., 2009). Firstly, task stations provide an opportunity to practice in a meaningful intense and progressive manner, were exercises can be suited to each individual patient’s needs. Secondly, it is resource efficient in terms of therapist time as opposed to individual therapy. With that in mind a circuit training class could potentially be more cost effective, since staff to patient ratios could be decreased. Thirdly the dynamics of a group in its supportive nature and by providing social interaction may enhance a client’s adherence to a programme and in so doing increase the ‘dose’ of training (van de Port et al., 2009). They concluded by suggesting that this form of training might be more beneficial when delivered in the sub-acute phase of rehabilitation rather than the chronic stages as the majority of studies have been in persons with chronic stroke. It has been suggested that group circuit training during sub-acute in-patient rehabilitation increases gait speed, improves balance and reduces patient length of stay post stroke, compared with a control intervention (English and Hillier, 2010).

The study by Blennerhasset and Dite, (2004) is one of the first conducted in the sub-acute phase post stroke; where subjects received additional task related training as in -patients over and above the conventional rehabilitation programme. The task related component of the sessions lasted for 50 minutes (10 five minute stations), five days a week for four weeks. As a result this study showed a between group difference in the 6MWT of 116.4m (95% CI, 31.4 to 201.3m). The study by English et al., (2007) was one of the first where task oriented training was provided as the sole form of therapy provided post stroke in an in- patient rehabilitation phase compared with subjects who received individual therapy. While subjects in both groups improved significantly there were no significant between group differences from admission to completion of the four week programme for the primary outcome measures (gait speed, walking endurance and functional balance). However a larger proportion of subjects from the task oriented circuit group achieved independent walking at discharge (p=<0.01). The circuit training provided a significantly greater amount of therapy time with lower staff to patient ratios, suggesting that circuit class therapy may be more cost effective. Two recent in-patient rehabilitation trials have shown significant effects of task oriented circuit training early after stroke on gait speed (Rose et al., 2011; Outermans et al., 2010) and walking endurance (Outermans et al., 2010). While the subjects in the study by Outermans et al., (2010) presented with relatively mild gait deficit at baseline, in contrast the subjects in the study by Rose et al., (2011) presented with severe gait deficit at baseline. Details of task oriented

studies conducted in acute and sub-acute persons with stroke are presented in table 2.1 and chronic stroke in table 2.2 below.

Table 2.1: Gait Task Oriented Training in Acute and Sub-Acute Stroke

Study	N	Age	Time since CVA	Intervention	Exercise Time	Intensity	Outcome measures	Outcome
Blennerhassett and Dite 2004	30	55	43 days	Intervention –LE task training Control- UE task training	50 min	4 wks; five times/wk	6MWT TUG Step test UE function (MAS, JTHFT)	At 4 weeks the task group improved more than the UE training group. 6MWT(p=0.01) and the TUG(p=0.02)
Outermans et al., 2010	43	56	23 days	High intensity task training group versus a low intensity group focusing on balance and motor control of the hemiparetic leg	35 min	4wks; three times/wk	6MWT 10MWT BBS Functional Reach	The task group improved on the 6MWT(p=0.02) and the 10MWT (p=0.03) compared with the low intensity group
Rose et al., 2011	180	68	10 days	Control – conventional individual therapy Intervention- circuit task training	90 min	19-20 days (3-4 weeks); 5 days/week	5MWT BBS FIM Motor score Fugl Meyer	Circuit training showed a significantly greater improvement in gait speed than conventional individual therapy (p=0.03)
Duncan et al., 2011	408	62	63 days	Intervention group1- early locomotor training Intervention group 2 - late locomotor training Intervention group 3 – Home based walking task training	90 min	12-16 weeks; three times per week	10MWT 6MWT BBS Fugl Meyer Physical mobility and participation domains of SIS ADL and IADL	No significant differences among all three groups
English et al ., 2007	68	66	27days	Individual therapy group intervention-individual therapy tailored according to the individual. Circuit class intervention- UE and LE task training circuit	60 min vs 2x90 min	4 weeks; individual therapy group/ daily circuit group 2x/ daily. Both 5x/wk	2MWT 5MWT BBS UE –MAS	No difference between the Individual therapy and circuit training therapy groups. A greater No of subjects walked independently in circuit group
Duncan et al., 2003	20	70	61 days	Control-usual care Experimental- therapist supervised home based task training	90 min	12 weeks; 3 times/wk	6MWT 10MWT BBS Motor Function ADL and IADL	Experimental group showed significant increase in walking speed.
Richards et al., 1993	27	69	10 days	Control 1- conventional therapy Control 2- intervention was delayed but was as intense as experimental group Experimental group- Intense task training	50 min	5 weeks; 10 times/wk	10MWT BBS Motor Function	No significant between group differences for gait speed

Table 2.2: Gait Task Oriented Training in Chronic Stroke

Study	N	Age	Time since CVA	Intervention	Exercise Time	Intensity	Outcome measures	Outcome
Salbach et al., 2004	91	72	228 days	Control- UE task training Experimental- LE task training	50 min	6 wks; three times/wk	6MWT 5m walk TUG BBS	The Intervention group showed greater improvement as follows: 6MWT (40m versus 5m) Comfortable 5m walk (0.14m/s versus 0.03m/s) Maximum 5m walk (0.20m/s versus -0.01m/s)
Dean et al., 2000	12	62	658days	Control-UE circuit task training Experimental- LE circuit task training	50 min	4wks; three times/wk	6MWT 10MWT TUG Step Test Sit to Stand	The experimental group improved significantly more than the control group on the 6MWT and 10MWT.
McClellan and Ada., 2004	26	70.5	5.5 mths	Control- Home based UE task training Experimental- Home based LE task training	Not reported	6 wks; practiced 5 exercises twice daily at home.	Functional Reach (FR) Walking MAS SA-SIP30	After 14 weeks FR improved significantly in the experimental group than the control group. No difference between groups on item 5 of MAS and SA-SIP30.
Marigold et al., 2005	61	68	3.8 years	Experimental-, agility tasks. Control- stretching and weight shifting	60 min	10 weeks; 3 times per week	BBS TUG Step reaction time Nottingham Health Profile	Agility group improved significantly in step reaction time.
Mudge et al., 2009	60	73	4.5 years	Experimental- task training Control- social support and education classes	30 min	4weeks; 3 times per week	6MWT 10MWT Rivermead Mobility Index	Experimental group walked a significantly greater distance on the 6MWT post intervention ($p=0.03$) but not at the follow-up.
Pang et al., 2005	63	65	1881 days	Control- seated UE training Experimental fitness mobility task training	60 min	19 weeks;3 times per week	6MWT Paretic leg strength BBS	Experimantal group showed significantly greater gains in cardiorespiratory fitness, mobility and paretic leg muscle strength
Yang et al., 2006	48	58.5	63.5 months	Experimental- series of 6 task training stations Control- no intervention	30 min	4 wks; three times per week	6MWT Gait speed (GAITrite) TUG Muscle strength (dynamometer) Step test	The experimental group improved significantly more than the control group on all measures of functional gait. 6MWT($p=0.02$) Gait velocity, cadence and TUG($p<0.001$)

During post acute and sub -acute in-patient rehabilitation, task oriented training sessions are invariably five times per week (Rose et al., 2011; Outermans et al., 2010; English et al., 2007; Blennerhasset and Dite, 2004). Out patient based rehabilitation using a task oriented intervention, is usually conducted twice to five times per week (Duncan et al., 2011; Franceschini et al., 2009; Mudge et al., 2009; Sullivan et al., 2007; Richards et al., 2004; Salbach et al., 2004; Duncan et al., 2003; Dean et al., 2000). However, at this stage there have been no studies conducted evaluating the effectiveness of task oriented training, carried out once per week, in communities with extremely limited resources.

Rehabilitation in South Africa is traditionally based on the Bobath concept, as well as some use of strengthening and resistance training, sensorimotor stimulation and compensatory skills training. These training techniques are traditionally performed on a one to one basis (Hale and Wallner, 1996; Stewart et al., 1994). Considering the evidence from task oriented training, and that it can be administered in a circuit with a group of patients with stroke, it stands to reason that implementing this type of therapy may be a more resource efficient means of providing gait rehabilitation to a greater number of people post stroke. Task oriented training can be set up as a circuit of task stations, where people with stroke move from one station to the next after a specified amount of repetitions, or time at each station. There do not appear to be any studies that establish whether a minimal amount of task oriented therapy, as the only form of rehabilitative input in the sub-acute phase post stroke, can significantly improve walking competency in the first six months post stroke.

2.14 CIRCUIT GROUP BASED THERAPY

Circuit group training, (if used correctly) can ensure greater use of the short time allowed for intensive rehabilitation (Carr and Shepherd, 2003) especially where there are high patient to staff ratios. Practicing as a group in an interactive way may increase motivation, by adding a competitive and cooperative component to the practice situation (Mc Nevin et al., 2000). Patients also benefit from the experience of peers and helping each other (De Weerdt et al., 2001). It has been found that exercise classes can be effective and feasible in improving locomotor function in chronic stroke (Teixeira-Salmela et al., 2001; Dean et al., 2000).

Such circuit training can comprise a set of core activities that can be individually adapted and progressed such, that each subject is always challenged to his/her maximum ability (English et al., 2007). This form of training as suggested by Carr and Shepherd (2003) involves a selected set of workstations designed to target multiple levels, namely strengthening, balance and range of movement. In addition it provides the opportunity for repetitive practice of functional

tasks and continual progression of exercises (Wevers et al., 2009; English et al., 2007). Participants' progress is continuously monitored and activities are adapted as required. This definition is consistent with previous descriptions of circuit class therapy (Blennerhasset and Dite, 2004; Carr and Shepherd, 2003; Dean et al., 2000). Circuit training can be run individually; however similarly to group training it has the benefit that two or more participants can train simultaneously. However when run as a group the individuals in the circuit classes do not perform the same task at the same time, but rather move from one exercise station to the next. This definition is also distinct from the concept of group therapy, which is defined as therapy involving more than two participants, usually with a similar degree of functional ability, undertaking the same exercise or activities at the same time. Unlike circuit training this type of group has no individual tailoring or progression of activities.

Mackey et al., (1996) commented that a patient is more likely to practice motor activities with supervision, which highlights the need for specific staff resources to be allocated to facilitating programmes effectively, with two or more group participants. Exercises with the therapist present as opposed to a home programme or independent circuit practice allows for extrinsic feedback which is essential for optimal motor learning (Sidaway et al., 2001; Mc Nevin et al., 2000). Furthermore exercising in a group has been shown to facilitate motor learning by providing the opportunity to combine the observation of others learning a new motor task with the opportunity to practice (Shea et al., 2000). The peer support and social interaction provided by this group environment is additionally beneficial. A circuit training group may be a more efficient way of implementing task oriented training to large numbers of stroke survivors in the developing world where resources are limited. Patients can be challenged to perform at the maximal ability when a family member or caregivers provides valuable psychological stability, encouragement and safety during group training sessions.

2.15 EDUCATION

Provision of information and education to patients with stroke should include their families and caregivers (Karla et al., 2004). Group Education and counseling (Johnson and Pearson, 2000; Rodgers et al., 1999) should be targeted at participants who share similar characteristics. The caregivers should share common attributes such as socioeconomic background (Goodman, 1991). This encourages a sense of belonging and co-operation among the caregivers and providing support to one another. The education group should contain a combination of education and counseling and should be balanced according to the needs of the group (Evans et al., 1988). Thus groups should have a multidimensional approach to assessing and dealing with problems (Grant et al., 1999; van den Heuvel et al., 2002) and should be used with an

emphasis on emotions, information and coping strategies (Visser-Meily et al., 2005). The provision of resources (Mant et al., 1998) and verbal information to patients post stroke and caregivers is extremely important. The problem with this process is that people tend to forget what they are told. The provision of information packages is one way of overcoming this problem, which patients and caregivers appreciate (Smith et al., 2004; Clark et al., 2003; Mant et al., 2000; Mant et al., 1998). Group meetings can be used as education sessions. All these forms of information and education provision have shown a positive benefit; however the provision of information alone appears to have the most limited benefit. There does not seem to be an agreement in the literature on the content of what should be covered during education sessions. However, specifically designing the information to the individual needs of each patient and the primary caregivers enhances the effectiveness of these strategies (Bakas et al., 2009; Hoffmann et al., 2007). Group education sessions may increase stroke specific knowledge while providing the additional benefit of group support and socialization.

2.16 SUMMARY OF LITERATURE REVIEW

The prevalence of stroke is increasing worldwide. The rising burden and consequences will be especially severe in low and middle income countries, which can least afford the associated costs, when these countries' resources are often already stretched to the limit. At CHBH in Soweto a township in Gauteng province in South Africa, most patients are discharged after 6-8 days post stroke, with little or no follow-up physiotherapy or rehabilitation appointments scheduled. As a result rehabilitation ceases at this point, due to limited resources or patient inaccessibility to clinic/rehabilitation services. In light of the fact that there is significant evidence that increased rehabilitation intensity improves ADL functioning and impairment, it is essential we explore and find systematic and cost effective ways in which to utilize rehabilitation services in the RSA. Rehabilitation offers the opportunity to reduce this burden of care. Given the resource intensive nature of many rehabilitation programmes, however, group based therapy may be a means of providing rehabilitation to a greater number of patients at one time. Task oriented therapy, which is designed to strengthen the affected lower extremity, enhance gait balance, speed and endurance, by practicing activities related to walking has been shown to result in significant improvements in walking competency. This form of rehabilitation can be performed in groups (if used correctly), thus ensuring greater use of the short time allowed for intensive rehabilitation especially where there are high patient to staff ratios. It follows that further assessment of the effectiveness of the current treatment programs and a comparison with alternative treatment approaches in developing countries such as the RSA is long overdue. The limited resources available and how infrequently the stroke survivors attend therapy on an out patient basis must also be considered in these future studies.

CHAPTER 3

3. INSTRUMENTATION AND OUTCOME MEASURES

3.1 INTRODUCTION

The following chapter provides a description of the instruments that were selected for collecting data in this study. This process will present the specific objective followed by the selected outcome measure and where applicable a justification thereof.

3.2 FOR OBJECTIVE 1:

TO ESTABLISH THE EFFECT OF A ONCE A WEEK (FOR SIX WEEKS) OUT PATIENT BASED TASK ORIENTED GROUP CIRCUIT TRAINING PROGRAMME ON FUNCTIONAL WALKING (WALKING COMPETENCY) IN PERSONS WITH SUB-ACUTE STROKE

For this objective it was necessary to determine how to measure walking competency. Walking competency involves a level of functional walking ability that enables a person to navigate in their community proficiently and safely (Salbach et al., 2004). This level of walking ability requires an ability to walk at an adequate speed to cross a street safely (10MWT). In addition it requires the individual to cover sufficient distances (6MWT) for instrumental ADLs such as grocery shopping and clinic visits (Shumway-Cooke et al., 2002). The features of an environment in which individuals participate may interfere with their ability to ambulate successfully. Thus a certain level of balance is required that allows turning and looking in different directions while walking and coping with perturbations. This includes the ability to anticipate and avoid obstacles or accommodate to environmental changes and obstacles (Shumway-Cooke and Woollacott, 2001; Patla, 1997). Shumway-Cooke and Bauer, (2000) highlighted the need to evaluate a person's functional balance (BBS) and mobility (TUG) to comprehensively establish this level of walking competency.

Hence the following outcome measures were selected to evaluate this objective and are presented in more detail below.

- The Six Minute Walk Test (6MWT)
- The Ten Metre Walk Test (10MWT)
- The Berg Balance Scale (BBS)
- The Timed 'up and go' (TUG)

3.2.1 **The Six Minute Walk Test (6MWT)**

The 6MWT can be used as a measure of walking endurance in adults with stroke (Richards et al., 1999; Duncan et al., 1998b). The 6MWT is superior to the two minute walk test (2MWT) at evaluating exercise capacity and is more reflective of the requirements of instrumental ADL's. It is for these reasons that the 6MWT is a commonly used standardized measure of exercise tolerance and functional walking capacity in people with compromised mobility (Eng et al., 2002; Solway et al., 2001; Butland et al., 1982). In addition the 2MWT is less reliable and responsive than the 6MWT (Solway et al., 2001). Thus the 6MWT was selected. For the purposes of this study the physiological measures, namely heart rate and blood pressure were measured before and after the 6MWT to evaluate the functional walking endurance for patients with stroke.

The 6MWT is a test that can be used to measure the functional walking ability of a subject post stroke (Kosak and Smith, 2005). The distance that the subject can walk on a level corridor in six minutes is evaluated. Cones are positioned to mark a 20m distance with turnaround points at each end of the laps. The 6MWT should be undertaken in a quiet level corridor and subjects start from a stationary standing position. Prior to measurement subjects are instructed to walk as far as they can for the six minutes back and forth around the cones. The six minutes are timed with a stopwatch. Six minutes is a long time to walk and subjects are instructed that they may feel quite exhausted; if necessary they are instructed that they can slow down or stop and rest. Documentation should include the speed at which the test was completed (comfortable versus fast). Assistive devices, for example a quadrupod, can be used, but their use must be recorded and remain consistent for all future tests. Individuals should be able to ambulate without any physical assistance although supervision is permitted. Originally developed as a sub maximal measure used to determine functional capacity in individuals with compromised mobility, the 6MWT is now commonly used as a standardised measure of exercise tolerance and walking endurance in stroke (Salbach et al., 2004; Eng et al., 2002; Solway et al., 2001).

3.2.1.1 **Validity and reliability of the 6MWT**

The 6MWT is a tool used for assessing the distance a subject can walk post stroke (Eng et al., 2004; Kosak and Smith, 2005). The validity of the 6MWT as a measure of walking endurance was first shown by Guyatt et al., (1985) in patients with chronic lung disease and chronic heart failure. Further Fulk et al., (2010) evaluated the ability of the 6MWT to predict the amount of home and community walking activity in persons with stroke. A stepwise regression analysis showed that the 6MWT was the only significant predictor of mean steps walked per day ($F_{1,18}$=17.59; p = 0.001) (Fulk et al., 2010).

The 6MWT is a continuous variable without floor or ceiling effects (Kosak and Smith, 2005). The test re-test reliability of the 6MWT in chronic stroke has been evaluated and is excellent for distance covered in meters, with an intraclass correlation coefficient (ICC) = 0.99 (Flansbjer et al., 2005) and 0.99 (Eng et al., 2004). Similarly in acute stroke, Fulk et al., (2008) found that the test re-test reliability was excellent (ICC = 0.97). Kosak and Smith, (2005) examined the inter- and intra-rater reliability of the 6MWT in 18 inpatient stroke survivors. The intra-rater reliability was found to be adequate (ICC = 0.74) and the inter-rater reliability was excellent (ICC = 0.78). Scivoletto et al., (2011) commented that the track on which the 6MWT is measured must be standardized for all testing.

3.2.1.2 The minimal detectable change (MDC) and minimally clinically important difference (MCID) for the 6MWT

The minimal detectable change is a useful reference value to assist clinical interpretation of outcome measures. While the minimal clinically important difference (MCID) represents the smallest amount of change in a score on an outcome measure that is perceived as beneficial, the minimal detectable change indicates the amount of change in a score that is required to exceed measurement variability or the amount of change on a score that can be considered "real" that is a true change in walking speed due to the intervention, and free from error in measurement. While the MDC is useful it reflects statistical significance, but does not reflect an amount of change that is necessarily clinically significant. Only the MCID reflects a change that is considered clinically meaningful. The MCID for acute stroke and geriatric persons on the 6MWT is 50m (Perera et al., 2006). A distance of ≥ 28m, which is the distance of a pedestrian crossing at a traffic light in a commercial area (Lerner-Frankiel et al., 1986), can also be used as the distance indicating a meaningful improvement in distance walked (Salbach et al., 2004).

3.2.1.3 Normative Data and Responsiveness

Some normal values in a healthy adult population according to age and gender have been investigated, and are presented in table 3.1 below (Steffen et al., 2002).

Table 3.1: Mean Distance in Metres Covered on 6MWT

Age	Male	Female
60-69yrs	572m	538m
70-79yrs	527m	471m
80-89yrs	417m	392m

For patients with incomplete spinal cord injury, the 6MWT is responsive and has the ability to detect walking capacity improvements in patients in the first 6 months post injury (Van Hedel et al., 2005)

3.2.2 **The Ten Metre Walk Test (10MWT)**

To evaluate the subject's speed of walking on inclusion into the study, post intervention and at six months post intervention, the 10MWT was selected. Gait speed that is measured over a short distance of ten metres is one of the most commonly used methods of measuring walking ability (Richards et al., 1999), particularly in light of the fact that gait speed is sensitive to change over time (Salbach et al., 2001; Goldie et al., 1996).

In contrast to the 6MWT, the 10MWT removes the endurance variable, while it provides information regarding the progress in hemiparetic gait, functional walking mobility (Kollen et al., 2006; Perry et al., 1995), and recovery post stroke (Richards et al., 1993; Wade., 1992; Wade et al., 1987). The findings of Perry et al., (1995) identified three clinically meaningful gait speed categories that correlated with predicting a subject's level of functional ambulation. Walking at a gait speed of <0.4m/s, is indicative of a severe gait impairment as noted in household ambulators. Walking at a speed of 0.4m/s-0.8m/s is indicative of moderate gait impairments as seen in limited community ambulators. Community ambulators, are those persons without substantial limitations, walking at a speed of >0.8m/s and indicates a mild gait impairment post stroke. Classifying patients according to these categories is reliable (Bowden, 2008). An improvement in one's walking ability that results in a change in a patient's functional walking ability according to this classification has also been found to represent a meaningful improvement (Schmid, 2007). The objective of rehabilitation intervention is to increase functional mobility. To optimally evaluate gait speed requires both comfortable and maximum walking measures, as the ability to walk fast is important in walking competently in the community, for example when crossing a busy street. Thus for the purposes of this study comfortable gait speed and maximum gait speed were measured.

The 10MWT is a widely used quick test of measuring gait speed over short distances, namely ten metres, both in the clinic and research setting (Richards et al., 1999; Drouin et al., 1996). Overground gait speed is measured in a quiet corridor, using a stopwatch. Measurement is done in the middle 10m of a 14m walkway, allowing for a 2m acceleration and deceleration at either end of the 10m measure. An average of two repeated measures is recorded and the measurements are conducted in succession, with a short seated rest between measurements (Sullivan et al., 2007; Eng et al., 2002). Subjects are instructed to "walk at a comfortable pace"

for the comfortable 10m measure, and to “walk as fast as you can” for the maximum 10m measurement. Subjects use their usual assistive devices (e.g. stick, quadrupod, walker), and orthotic devices (e.g. ankle-foot orthosis) for all repeated measurements performed. Documentation should include the speed tested (comfortable versus maximum). Velocity is calculated, as distance/time, in m/s. As the measure is timed over 10m the following calculation is used to determine gait velocity.

$$\textbf{10m velocity(m/s)} = \frac{\textbf{10m (distance walked)}}{\textbf{Time taken in seconds(s)}}$$

3.2.2.1 **Validity and reliability of the 10MWT**

The 10MWT is a measure of walking mobility in subjects with neurological disease (Rossier and Wade, 2001). The validity of the 10MWT as a measure of walking ability has been extensively studied (Hsu et al., 2003; da Cunha et al., 2002; Maeda et al., 2000; Roth et al., 1997; Bohannon, 1992). Among persons with stroke there is a significant correlation between the strength of the affected lower extremity and gait speed shown with a Pearson’s correlation coefficient by Bohannon, (1992; $r = 0.67$) and Maeda et al., (2000; $r = 0.42$). Hsu et al., (2003) showed that the strength specifically of the affected hip flexors ($r = 0.57$) and quadriceps strength are positively correlated with comfortable gait speed (Maeda et al., 2000; Bohannon, 1990). da Cuhna et al., (2002) found that gait speed is strongly related to energy expenditure and energy costs of gait (with Pearson’s correlations of $r = 0.80$ and $r = 0.71$ respectively) which are important influences on efficient community ambulation.

The reliability of the 10MWT has been investigated, with good test-retest reliability ($r = 0.95$) shown by Hill et al., (1994) at 2.8 months post stroke. Further Stephens and Goldie, (1999) found excellent test –retest reliability at 3.7 months post stroke with an ICC= 0.97. In chronic stroke Collen et al., (1990) reported an excellent test-retest reliability (ICC = 0.95 to 0.99, tested three times within the single session), excellent intra-rater reliability (ICC = 0.87). Excellent inter-rater reliability has also been shown in chronic stroke populations with an ICC=0.99 (Wolf et al., 1999) showing that the 10MWT has good reliability and validity.

3.2.2.2 **The MDC and MCID of the 10MWT**

In studies where stroke subjects were 1.5 months (Evans et al., 1997) and 3.7 months post stroke (Stephens and Goldie, 1999) the MDC was 0.17 m/s. Similarly in the study by Hill et al., (1994) where subjects mean time since stroke was 2.8 months the MDC was 0.16m/s. In all these studies subjects were sub-acute and greater than six weeks post stroke. An additional study by Tilson et al., (2010) identified the need to determine the magnitude of the MCID that is

associated with improved function when anchored to the modified Rankin scale among persons with stroke. This study reported that within the first 60 days post stroke for those persons with severe gait impairment (e.g. mean gait speed = 0.18m/s) a change of ≥ 0.16m/s in comfortable gait speed measured at post intervention indicated a 60% probability of experiencing a meaningful change in disability level.

3.2.3 **The Berg Balance Scale (BBS)**

As previously mentioned evaluating functional balance post stroke is one of the dimensions highlighted for contributing to walking competency (Shumway-Cooke et al., 2002). The BBS is a functional measure of static and dynamic balance that includes 14 tasks common to everyday life. No specialized training is required to administer the BBS. Equipment and space requirements are minimal; this includes a ruler, stopwatch, chair, and a step or stool. Items vary in difficulty and include static and dynamic activities ranging from sitting balance without back support to standing and balancing on one leg (Berg et al., 1992). The BBS is administered via direct observation of the tasks to be completed. The ability to change positions for example, from one chair to another is also assessed. Scoring is based on a 5 point ordinal scale, ranging from 0-4. A score of 4 indicates the ability to perform independent movements and hold positions for a prescribed time, or performed within a set time frame. A score of 0 is an inability to perform the item. Scores are summed and the maximum achievable total for all 14 items is 56 points. A cut-off score of less than 45 points indicates an increased risk of falling (Berg et al., 1995).

3.2.3.1 **Validity and reliability of the BBS**

Mao et al., (2002) found an excellent relationship between the BBS scores and the balance subscale of the Fugl-Meyer (r = 0.90 to 0.92), at 4 assessment times (14, 30, 90, and 180 days post stroke), indicating excellent concurrent validity. Furthermore Mao et al., (2002) found that the BBS has excellent predictive validity at 14, 30 and 90 days post stroke when predicting the Motor Assessment Scale (MAS) scores at 180 days post stroke (r = 0.82, 0.84 and 0.91 respectively). Wee et al., (1999) found excellent construct validity in acute stroke when correlating admission BBS to admission functional independence measure scores (r =0.76).

Originally Berg et al., (1995) found excellent internal consistency of the BBS in patients with stroke (0.97). Inter-rater reliability in individuals 14 days post stroke was also excellent (ICC =0.95). The sensitivity of the BBS does decrease among severely affected patients as the scale only includes one item relating to balance in a seated position (Mao et al., 2002). In individuals with stroke in a long term care facility the BBS showed excellent inter-rater (ICC =0.98) and intra-rater (ICC =0.97) reliability (Berg et al., 1995).

3.2.3.2 **The MDC and MCID of the BBS**

The MDC in acute stroke for the BBS for individuals who walk with stand-by-assistance is an improvement of 6 points (Stevensen, 2001). The MCID has not been established.

3.2.3.3 **Normative Data and Resposiveness**

Some normal BBS scores have been investigated and are presented in table 3.2 below. These values were established in community dwelling elderly adults (Steffen et al., 2002)

Table 3.2: BBS for Community Dwelling Adults

Age	Gender	N	Mean	SD	95% CI
60-69	Male	15	55	1	55-56
	Female	22	55	2	54-56
70-79	Male	14	54	3	52-56
	Female	22	53	4	52-55
80-89	Male	8	53	2	51-54
	Female	15	50	3	49-52

The BBS has been found to be moderately responsive at detecting changes at less than 90 days post stroke. The greatest responsiveness is between 14 and 30 days Mao et al., 2002) Similar findings have been noted by Wood-Dauphinee et al(1996). The greatest responsiveness of the BBS was between two and 12 weeks post CVA, and the least between six and 12 weeks post CVA.

3.2.4 **The Timed 'Up and Go' (TUG)**

An evaluation of functional mobility with t2he TUG provides an aspect of the ability to transition between a posture, which is one of the dimensions of walking competency discussed above.

The TUG is a physical performance measure used to assess a degree of functional mobility, balance and walking ability, originally developed for use in the elderly person with balance difficulties. First developed by Podsiadlo and Richardson, (1991) it incorporates time to measure and assess basic mobility and balance manœuvres relative to walking and turning. The individual stands up from a chair, walks a distance of three metres to a cone, turns around the cone and walks back to the chair to sit down. The test is performed as quickly and safely as possible. One practice trial is allowed for familiarization with the task. The individual is allowed to use any walking aids and assistive devices (which must be kept consistent in future testing), but no physical assistance is permitted.

3.2.4.1 **Validity and reliability of the TUG**

Ng and Hui-Chan (2005) evaluated the validity of the TUG and found excellent negative correlations between the TUG and gait speed in patients with stroke (r = 0.98 and r = 0.99, respectively). An excellent correlation between the TUG and the distance covered during the 6MWT with a Pearson's correlation coefficient of (r = -0.96) was shown by Guyatt et al., (1985). These correlations are negative, because the TUG is measured by the time taken to complete the task thus a decrease in the score indicates an improvement while higher scores are an indication of a lower level of performance. Flansbjer et al. (2005) found excellent correlations between the TUG and the other gait performance measures (comfortable gait speed, fast gait speed, climbing up and down stairs and the 6MWT) with correlation coefficients ranging from r = -0.84 to r = -0.92 ($p<0.001$). Taken together with the results from the study by Ng and Hui-Chan, (2005), the TUG appears to be a valid measure for use in patients with stroke.

Podsiadlo and Richardson (1991) first reported excellent test-retest reliability of the TUG in frail elderly patients (ICC = 0.99). More specifically patients with chronic mild to moderate stroke, excellent test-retest reliability of the TUG in 50 subjects (ICC = 0.96) was established by Flansbjer et al., (2005). Moreover excellent inter-rater reliability was found for the TUG (ICC = 0.98) by Podsiadlo and Richardson, (1991).

3.2.4.2 **The MDC and MCID of the TUG**

While the MCID has not been established, the MDC was calculated from the findings of Flansbjer et al., (2005) in chronic stroke where an improvement of 2.9s in the time taken to complete the TUG represents the least improvement required to exceed measurement variability.

3.2.4.3 **Normative Data**

Some useful data that has been investigated with the TUG are cut0off scores indicating that a person is at risk of falling. In community dwelling adults this value was noted to be a time greater than 13.5 seconds to complete the TUG (Shumway-Cook et al, 2000). For an older stroke population this value ws similar and noted to be a time greater than 14 seconds (Andersson et al, 2006).

3.3 **FOR OBJECTIVE 2:**

"TO ESTABLISH THE EFFECT OF A ONCE A WEEK (FOR SIX WEEKS) OUT PATIENT BASED TASK ORIENTED GROUP CIRCUIT TRAINING PROGRAMME ON WALKING ENDURANCE"

For this objective the 6MWT described above was used.

3.4 **FOR OBJECTIVE 3:**

"TO ESTABLISH THE EFFECT OF A ONCE A WEEK (FOR SIX WEEKS) OUT PATIENT BASED TASK ORIENTED GROUP CIRCUIT TRAINING PROGRAMME ON GAIT SPEED"

For this objective the 10MWT described above was used.

3.5 **FOR OBJECTIVE 4:**

"TO ESTABLISH THE EFFECT OF A ONCE A WEEK (FOR SIX WEEKS) OUT PATIENT BASED TASK ORIENTED GROUP CIRCUIT TRAINING PROGRAMME AT SIX MONTHS POST INTERVENTION"

To determine if patients maintained any gains attained at six months after the intervention, all subjects were requested to return for re- evaluation of all selected outcome measures. They were therefore measured at baseline, post intervention and at a period of six months later.

3.6 **FOR OBJECTIVE 5:**

"TO ESTABLISH THE EFFECT OF THE PROGRAMME ON SELF-REPORTED PHYSICAL FUNCTIONING"

Many stroke survivors continue to experience limitations in their ADLs post stroke. The impact of limited physical functioning and disability is associated with a decrease in QOL (Hartmen-Maeir et al., 2007; Mayo et al., 2002).

3.6.1 **Stroke Impact Scale (SIS 16)**

The Stroke Impact Scale (SIS) is a self reported, stroke specific QOL measure that aims to establish how a patient's health status is impacted as a result of stroke. The SIS16 is a short form of the scale developed using Rasch analysis (Duncan et al., 2003). It consists of 16 items from four of the physical functioning domains namely; strength, hand function, mobility and ADLs/ IADLs with the purpose of measuring the impact of physical function on disability post

stroke (Duncan et al., 1999). In the SIS 16, each item is reported on 5 point Likert scales in terms of the difficulty the patient has experienced in the past two weeks in completing each item. A score of 1 equates to an inability to complete the task, while a score of five equates to no difficulty experienced in executing the task. The following algorithm is used to summate and generate the score.

$$\textbf{Transformed Score} = \frac{\textbf{(Actual raw score – lowest possible raw score)}}{\textbf{possible raw score range}} \textbf{ x 100}$$

The SIS 16 measure is quick to administer and requires no training. It is freely available with instruction for scoring and administering on the Website for the University of Kansas Medical Center (ph.kumc.edu/sis/documents/SIS_admin_guide.pdf).

To ensure that the SIS 16 was linguistically and culturally adapted to the sample population, it was decided that for this study translation into both Sotho and Zulu would be appropriate as these are the most commonly spoken languages of the population of this study. The SIS 16 questions and the response options were professionally translated from the original USA English into both Sotho and Zulu. Some differences in terms of the cultural meaning were identified and reconciled with the cross cultural and translation steps as advocated by the Mapi project team (MAPI, 2007). Details of the linguistic validation are in Chapter 4.

3.6.1.1 **Reliability and validity of the SIS 16**

The SIS 16 is a measure of physical functioning after stroke, that has shown aspects of validity and reliability (Duncan et al., 2003; Edwards and O 'Connell, 2003; Lai et al., 2003). It has also been noted that the SIS16 is better at capturing the impact of physical functioning and social wellbeing in patients with stroke than the SF36 (Lai et al., 2003). The SIS 16 has also been validated for use with a proxy (Duncan et al., 2002).

3.6.1.2 **The MDC and MCID of the SIS 16**

In sub-acute stroke the estimated MCID value of the SIS 16 is between 9.4 and 14.1 (Fulk et al., 2010). The MDC has not been established.

For the purposes of administering the SIS16 in this study population, the questionnaire had to be linguistically validated into both Zulu and Sotho. This process was conducted in Study 1, the details of which are presented in the next chapter, Chapter 4.

CHAPTER 4

4. STUDY 1: LINGUISTIC VALIDATION

4.1 INTRODUCTION

This chapter will present the process of linguistically validating the SIS 16. The SIS16 was the outcome measure selected for objective five of this study namely: “to establish the impact of the programme on the subject’s health status in terms of physical functioning”.

Although many languages are spoken in South Africa, the vast majority of the patients who attend CHBH, CMJAH and HJH are of Sotho and Zulu ethnic descent. While younger generations in South Africa are largely fluent in English, rural migrants and older persons frequently do not speak English. It was, thus, necessary to translate and validate the SIS16 into both Sotho and Zulu.

In the SIS 16 (Original version: Appendix S) each item is reported on five point Likert scales in terms of the difficulty the patient has experienced in the past two weeks in completing each item. A score of one equates to an inability to complete the task, while a score of five equates to no difficulty experienced in executing the task. A more detailed review of the SIS16 was presented in Chapter 3 (Outcome Measures).

The aim of the linguistic validation process of the SIS16 was to produce a Zulu and Sotho version, that the subjects could understand, that had the equivalent meaning to the original English source version. This process thus had to include the 16 questions and the five response options. Significant differences in terms of cultural meaning were identified and reconciled with the cross -cultural and translation steps advocated by the Mapi project team (MAPI, 2007) Figure 4.1 below shows the steps that were taken in the linguistic validation process which was performed over a 10 week period.

4.2 OBJECTIVE OF STUDY 1

To develop a linguistically valid Zulu and Sotho version of the SIS16.

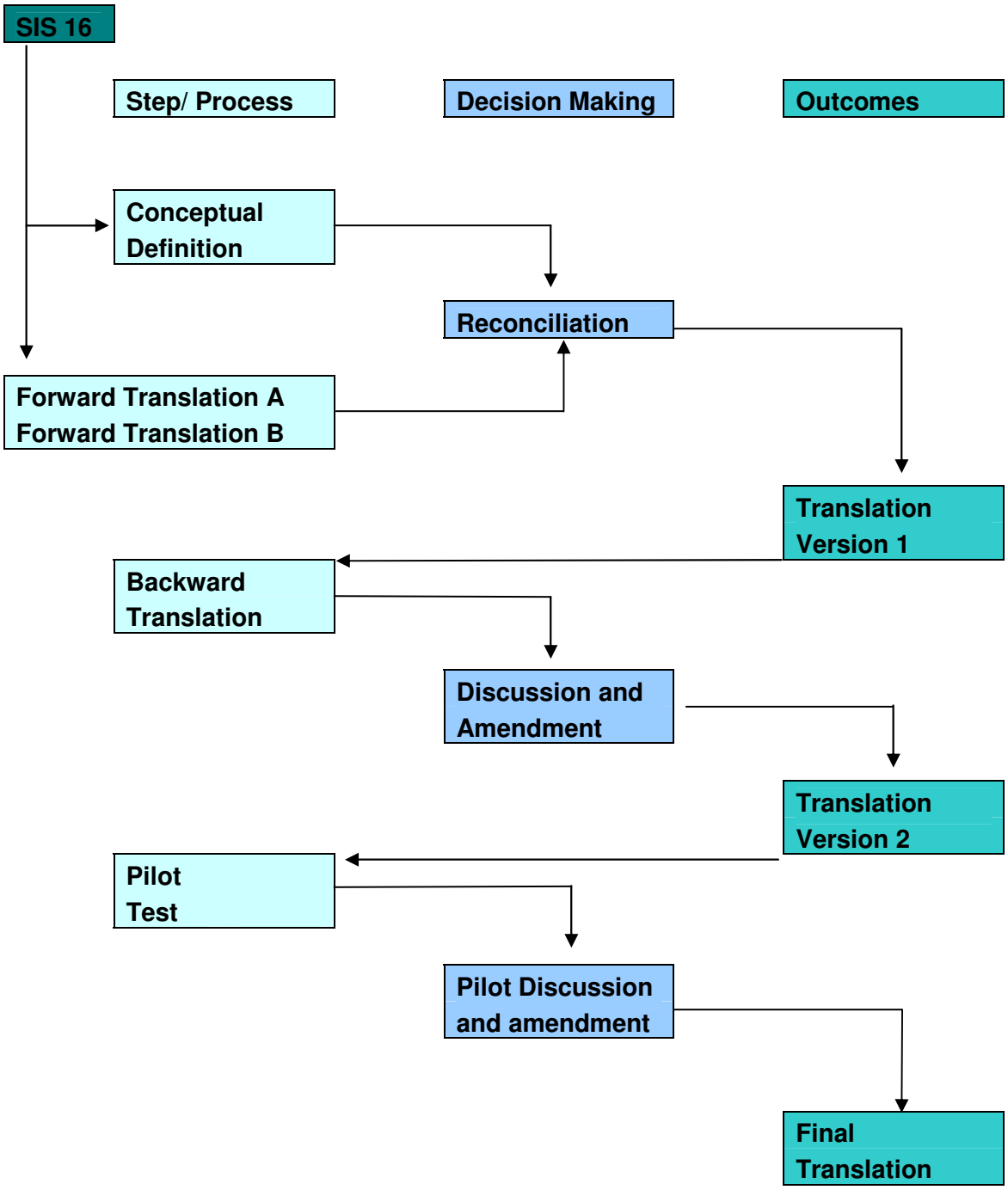


Figure 4.1: Flow Chart of SIS16 Linguistic Validation Process

(Mapi, 2007)

4.3 CONCEPTUAL DEFINITION

Clarification of each item on the SIS16 was checked with the guide for administration of the SIS Version 3.0 (full version of SIS). Questions that required clarification are presented in Table 4.1 below.

Table 4.1: Items Clarified

Original source version of SIS 16	Clarification
b) Bathe yourself?	Wash yourself, but does not include getting into the bath
c) Get to the toilet on time?	The physical ability to get to the bathroom fast enough
d) Control your bladder (not have an accident)?	Dribbling is considered an accident
e) Control your bowels (not have an accident)?	Constipation does not constitute an accident
g) Go shopping?	Refers to any type of shopping and does not include getting there
o) Get in and out of a car?	Refers to the car you ride in most
p) Carry heavy objects with your affected hand? (e.g. bag of groceries)	If subject has not been to grocery store this refers to carrying anything heavy in the affected hand.

4.4 FORWARD TRANSLATIONS

The aim of this step was to obtain consensus on one translation Version 1 of the SIS 16 in both languages. Two independent Zulu and two independent Sotho forward translations of the SIS16 were produced by professional translators. The two Sotho forward translations were made by two independent professional translators sourced from Manuku language services in Pretoria, South Africa. Manuku language services are a professional linguistic translation company based in South Africa. One Zulu forward translation was produced by Manuku services and the second from the linguistics department at the University of Johannesburg.

4.5 RECONCILIATION

The two translators, the researcher and a professional rehabilitation nursing sister (who spoke both languages) were involved in a reconciliation meeting. The two forward translations were tabled to obtain consensus on one single forward translation Version 1 of the SIS 16 in both Sotho and Zulu.

4.5.1 Sotho Reconciliation

There are numerous Sotho dialects in South Africa. The two independent forward translations received from Manuku services were influenced by these dialects. The most significant differences between the two translations were related to certain words in the questions being either a Tswana Sotho dialect versus a Sotho (Southern Sotho) dialect. It was decided that Sotho was a more appropriate choice of dialect for the Soweto area as it is the more common dialect spoken in this area. Table 4.2 below highlights the main differences that were discussed and reconciled at the meeting. The highlighted words of the original version are the sections that were different between the two translations. The wording in English under translation A and B are the English translations or relevant meaning of the relevant translated version. The √ indicates the version that was selected for the single forward translation version 1.

Table 4.2: Major Difference Noted between the 2 Forward Sotho Translations A and B

Original source version of SIS 16	Translation A	Translation B
a) Dress the top part of your body?	Translation in this version refers to the "top part of your body" √	Translation in this version refers to "your body"
c) Get to the toilet on time?	Translation in this version means "reach the toilet" √	Translation in this version means "to enter the toilet"
d) Control your bladder (not have an accident)?	Tswana dialect	Sotho dialect√
e) Control your bowels (not have an accident)?	Translation was more respectful √	Translation was too blatant
k) Move from a bed to a chair?	Translation in this version refers to "bed" √	Translation in this version refers to "area were you sleep", not necessarily a bed
m) Climb one flight of stairs?	Translation in this version refers to a "step but not a flight" √	Translation in this version was related more to a steep incline not a flight of stairs
p) Carry heavy objects with your affected hand?(e.g. bag of groceries)	Sotho dialect √	Tswana dialect

√ Indicates the version selected

4.5.2 ZULU RECONCILIATION

Similar to the findings of the Sotho translations, the Zulu language is influenced by the culture and the location of the Zulu speaking community. Originally Zulu speaking people lived in the Kwazulu Natal area. As Zulu speaking people migrated to the Gauteng area, so the language evolved into a more Gauteng Zulu mix which contains some Xhosa in it. This version is referred to as Colloquial Zulu from this point on. Translation A was colloquial Zulu, while translation B was generally more traditional Zulu. Following the reconciliation meeting it was felt that the more traditional Zulu was more appropriate in most cases as it was more respectful, while the colloquial Zulu was often too direct and at times rude. The main differences that were discussed and reconciled are shown in Table 4.3 below. Similarly to Table 4.2 the highlighted words of the original version are the sections that were different between the two translations. The wording in English under translation A and B are the English translations or relevant meaning of the relevant translated version. The √ indicates the version that was selected for the single forward translation Version 1.

Table 4.3: Differences Noted between Forward Zulu Translations

Original source version of SIS 16	Translation A	Translation B
d) Control your bladder (not have an accident)?	The words in this translation were too direct	The words in this translation were more respectful √
e) Control your bowels (not have an accident)?	The word for stomach in this translation was more appropriate, no direct translation of bowels is available √	The word for stomach in this translation was blatant/ rude - no appropriate word for bowel in Zulu
e) Control your bowels (not have an accident)?	Wording in this translation was too blatant/ rude	Wording in this translation was more respectful √
g) Go shopping?	Translation of the words in this version means "going to the shops"	Translation of the words in this version means to "go buy for oneself" √
h) Do household chores (e.g. vacuum, laundry or yard work)?	Translation not clear	Translation more precise in terms of chores around the house √
h) Do household chores (e.g. vacuum, laundry or yard work)?	Wording in this translation was more traditional Zulu √	Wording in this translation had mixed dialects
k) Move from a bed to a chair?		This version had a better word for chair √
m) Climb one flight of stairs?	The translation in this version referred to steps (plural)but not a flight √	The translation in this version referred to a single step

Table 4:3 (Continued)

n) Walk one block?	The translation in this version referred to a long distance √	The translation in this version referred to an individual block (such as a block of wood)
p) Carry heavy objects with your affected hand? (e.g. bag of groceries)	The translation in this version referred to using both hands not just the affected hand	The translation in this version referred to a single hand not both √
p) Carry heavy objects with your affected hand?(e.g. bag of groceries)	This translation was more traditional √	This translation was colloquial

√ Indicates the version selected

4.6 TRANSLATION VERSION 1

Following the reconciliation meeting a translation Version 1 of the SIS16 in Sotho and Zulu was finalized with the consensus of the translators and researcher and can be found in appendices H and J.

4.7 BACKWARD TRANSLATION

A backward translation of Version 1 of the SIS16 into English from the Sotho and Zulu translation Version 1 (Appendix Hand J) was performed to evaluate and determine the quality of the translation. Translation into English was performed by an independent translator who had had no previous contact or knowledge of the previous documents. The translators were sourced from Manuku services.

4.8 DISCUSSION AND AMENDMENT

A comparison of the original English SIS 16 was made with this “backward” translation by the translators, researcher and the professional nursing sister. There were no major problems identified with the backward translations. A few minor language variations were identified. It was felt following discussion that these language variations did not alter the meaning of the questions involved. These can be seen in Table 4.4 below.

Table 4.4: Comparison of Original SIS 16 with Backward Translations

Original source version of SIS 16	Zulu	Sotho
g) Go shopping?	Shop for yourself	Do one’s own shopping
h) Do household chores (e.g. vacuum, laundry or yard work)?	To do housework	To do some work in the house

4.9 TRANSLATION VERSION 2

Following this discussion and amendment meeting there were no changes made to translation Version 1 of the Zulu and Sotho translations. Thus translation Version 2 of the SIS16 in Sotho and Zulu was finalized with a meeting and can be found in appendices H and J.

4.10 PILOT TESTING

A sample of 10 Zulu and 10 Sotho speaking people with stroke living in the central Gauteng area volunteered to participate in a pilot test of the translated Version 2 of the SIS 16. The purpose of this pilot testing was to obtain feedback from person with stroke who represented future users of the questionnaire. Interviews with the 20 chronic subjects with stroke were conducted to assess the clarity, appropriateness, and cultural relevance of the two targeted language versions for the target population. Suggestions from the pilot sample were incorporated into the final translation.

4.11 PILOT DISCUSSION AND AMENDMENT

All 10 pilot subjects lived in the Soweto area and were native Sotho speakers. While there was a combination of the dialect of Sotho spoken in their homes, there was a consensus that Southern Sotho was more commonly spoken in the Gauteng area. Similarly 10 native Zulu speakers were sourced from Soweto for the pilot testing. While the colloquial Zulu is more common in Gauteng, the Zulu sample agreed that traditional Zulu is often more respectful.

4.11.1 Zulu Pilot Discussion and Amendment

It was felt that the clarity, intelligibility and appropriateness of the Zulu translation Version 2 questionnaire was excellent. There was only one question item “n” where intelligibility presented a problem. This question “walk one block?” in the translation refers to a long distance that is not defined. It was suggested that this should be changed to walk to the taxi or walk around a soccer stadium. There is considerable variation in the distances to a taxi and for this reason it was felt that this distance was also too variable. It was decided that for this question “walk around a soccer stadium” would replace “walk one block”.

4.11.2 Sotho Pilot Discussion and Amendment

While the clarity, intelligibility and appropriateness of the Sotho translation Version 2 questionnaire was good, there were a couple of suggestions made. Question “m”, to climb one flight of stairs, the term used *hlwa* (step, not a flight) should be changed to *nyoloha* (more appropriate for a flight of stairs, plural). Similarly to the Zulu translation, question “n” which refers to walking a block, posed a problem as the concept does not exist in the Sotho culture.

It was decided that for this question “walk around a soccer stadium” would replace “walk one block”.

4.11.3 English Linguistic and Cultural Changes

The final translated versions of the SIS16 were used in study 2 and it was necessary to make additional changes during study 2 the details of which can be found in Section 5.3.4.5 of Chapter 5.

4.12 FINAL TRANSLATION

A final copy of the Zulu and Sotho translations of the SIS 16 can be found in Appendix H and J.

CHAPTER 5

5. STUDY 2: PILOT STUDY

5.1 INTRODUCTION

In order to fulfill the objectives of study 3, the subjects were randomly assigned to three intervention groups by a process of concealed allocation. The three groups are:

- Task group: chosen as the primary intervention group
- Strength group: chosen because most hospitals and clinics in RSA run similar “strength “ training interventions
- Control group: chosen for the reasons given in Section 5.4

Therefore the objectives of study 2 are to:

1. select and train the research assistants
2. develop and evaluate the strength and task intervention programmes
3. determine the feasibility of proposed project site
4. evaluate proposed outcome measures and become familiar with their use
5. determine factors that influence out patient subjects’ adherence

The purpose of the following chapter is to present the findings of these objectives for study 2 which was conducted at HJH. This study facilitated the development of the treatment intervention programme used to achieve the objectives of the thesis.

5.2 METHODOLOGY

A brief overview of the methodology used for study 2 is presented below under the following headings:

5.2.1 Ethical clearance and informed consent
5.2.2 Permission to conduct study from involved hospitals in Gauteng
5.2.3 Promoting study awareness
5.2.4 Selection and training of research assistants
5.2.5 Subject recruitment
5.2.6 Assessor blinded baseline evaluations
5.2.7 Subject stratification and randomisation to treatment groups
5.2.8 Treatment interventions
5.2.9 Post intervention outcome measurement evaluations

5.2.10 Discussion with subjects and research assistants regarding specifics of the treatment intervention

5.2.1 Ethical Clearance and Informed Consent

This study was granted ethical clearance from the Human Research Ethics Committee, University of the Witwatersrand: No M070413 (Appendix K). An information sheet was given to subjects either during ward screening or telephonically with a detailed explanation given by the researcher. At this time appointments were booked for the baseline evaluation if subjects agreed to participate in the study. Informed consent (Appendix R) was further explained and then finally signed prior to the baseline evaluation with the researcher.

5.2.2 Hospital Permission

Permission to recruit subjects and conduct the study was obtained from the Chief Executive Officer and the Head of the Physiotherapy Department of HJH prior to commencement of study 2.

5.2.3 Study Awareness

To facilitate awareness of the study and subject recruitment the following steps were implemented:

- Posters with details of the study and contact details for involvement were placed in all medical wards, Speech, Occupational and Physiotherapy Departments at HJH.
- Presentations by the researcher to all eight medical ward nursing staff, medical ward registrars, speech therapists, occupational therapists and physiotherapists were conducted.

5.2.4 Selection and Training of Research Assistants

For the purposes of this study, four research assistants were recruited to assist with conducting the study.

- Researcher to conduct blinded evaluations and subject recruitment.
- Research assistant 1 to conduct subject randomisation, group allocation and organization of the first intervention appointment.
- Research assistant 2 to conduct the strength training group.
- Research assistant 3 to conduct the task training group.
- Research assistant 4 ran the physiotherapy component of the control group.

Research assistants 1, 2 and 4 were recruited from the physiotherapy staff of HJH.

Research assistant 3 was a post graduate physiotherapy student with four years of clinical experience treating neurological disorders.

Research assistants were individually trained by the researcher prior to the commencement of study 2.

The details of the process of training the research assistants are outlined below.

Step 1: A detailed explanation and discussion of the relevant exercises for each intervention group. Specific attention was given to the objective of each exercise, and focused on the manner in which to progress exercises.

Step 2: The research assistants observed the researcher conducting the relevant stroke group, followed with a time for discussion and questions.

Step 3: The researcher demonstrated all the exercises with a volunteer stroke survivor. The research assistant then similarly demonstrated the exercises with the volunteer to the researcher. The process was repeated a number of times during the workshop until both the researcher and the research assistant were confident with the relevant exercises for the intended intervention group. This procedure was repeated for the task and strength groups.

Step 4: during study 2 contacts were made with the research assistants on a weekly basis to provide support, and to provide an opportunity to clarify any enquiries.

5.2.5 **Study Design**

This pilot study was a stratified randomised controlled trial.

5.2.6 **Subject Recruitment**

All prospective subjects who fitted the inclusion criteria were referred to the researcher for screening for inclusion into the study. For the objectives of this study a sample size power calculation presented in Section 6.5 of Chapter 6 indicated that a total of 48 subjects per group (144 subjects in total) were necessary for study 3. Thus, a total of 14 subjects (10% of the sample size) were recruited for study 2 (Portney and Watkins). The transport costs for all subjects were covered.

Inclusion criteria:

- All patients with a diagnosis of any first ever ischaemic or haemorrhagic stroke of vascular origin, over the age of 18 years.
- Male or Female
- Discharged from in-patient care
- Resident within the Johannesburg metropolitan area
- Less than six months post stroke at the time of recruitment into the study
- An ability to walk at least 10m without physical assistance, with an assistive device, orthosis or supervision if necessary.
- Walking speed over 10m < 1.1m/s (community ambulator,Hill et al., 1997)
- Fully independent walker prior to the stroke
- Medically and neurologically stable at the time of recruitment into the study
- The ability to give informed consent.

Exclusion criteria:

- Transient ischaemic attack
- Stroke caused by metastatic disease
- Uncontrolled cardiac symptoms, pacemaker or other medical condition that may have limited exercise.
- Any pre-existing arthritic or underlying musculoskeletal condition that affects walking
- Independent community ambulation defined as walking > 1.1m/s (Hill et al., 1997)
- No concurrent participation in another study

It was not possible to confirm the diagnosis of stroke with either a CT scan or an MRI. The diagnosis of stroke was done by the neurologist in the ward, according to the WHO definition of stroke, which is recognised to have a greater than 80% accuracy rate (Hand et al., 2006; Engstadt et al., 2000).

5.2.7 **Baseline Evaluations**

The blinded researcher conducted baseline evaluations for all subjects following informed consent. This evaluation was done prior to randomisation. At the baseline evaluation subjects' comfortable walking speed was established. Research assistant 1 was given the walking speed and randomly allocated the subject to one of the groups.

5.2.8 Stratification and Randomisation

Stratification allowed for an equal distribution of subjects of various levels of walking deficit to establish any differences between the groups and the gait deficit strata as a result of the intervention.

Measurement of gait speed has been shown to provide an indication of one's ability to ambulate (Perry, 1995) and is a reliable method of classifying patients (Bowden, 2008):

- Severe Strata, subjects with a severe walking deficit (housebound ambulator) gait speed < 0.4m/s on the 10m walk test.
- Moderate Strata, subjects with a moderate walking deficit (limited outdoor ambulation) gait speed ≥ 0.4m/s < 0.8m/s on the 10m walk test.
- Mild Strata, subjects with a mild walking deficit (community ambulator) gait speed ≥ 0.8m/s (Perry et al., 1995)

Subjects were then randomised into the task and strength groups by a process of concealed randomisation.
Subject randomisation was computer generated and maintained in sealed envelopes. Envelopes were prepared prior to recruitment by a blinded research assistant not involved in the study treatment intervention (concealed allocation).

5.2.9 Interventions

Subjects in the strength and task groups attended the out patient therapy department once a week for six training sessions. For various reasons detailed in Section 5.3.5.3, subjects may have missed one of their intervention sessions. As the intervention in this study consisted of only six sessions, it was decided that subjects had to complete all six sessions. The subjects in the multidisciplinary education (control) group attended the intervention once during the study period. The structure of this group and reasons for its inclusion into the study are discussed later in Section 5.4; endurance training component. Subject attendance and progressions were recorded on log sheets (Appendix P) and kept by the research assistants. The process that resulted in the final selection of exercises that were used in study 3 is presented below in Section 5.3.2.

While the majority of studies conducted with an out patient based sample advocate group task oriented training, three times a week (Salbach et al., 2004; Dean et al., 2000) for six consecutive weeks (McClellan and Ada 2004, Salbach et al., 2004), it was decided that three

times per week in this population in RSA is not feasible. Only one third of the sample of a previous study conducted at CHB attended out patient physiotherapy post discharge (Hale and Eales, 1998). Visits ranged from once a week to once a month with poor attendance attributed to transport difficulties. Because of their disability, lack of financial resources and long traveling distances (Bryer, 2009; Wasserman et al., 2009), patient with strokes in RSA are unable to attend regular clinic rehabilitation sessions. From these studies it becomes clear that such frequency of out patient rehabilitation is not feasible (Bryer, 2009).

5.2.10 **Post Intervention Evaluations**

Post intervention evaluations were conducted after subjects had completed six sessions of the intervention. These evaluations were conducted by the blinded researcher. The evaluations took approximately one to one and a half hours.

5.2.11 **Treatment Intervention Discussion Panel**

After the post intervention evaluations the researcher, a clinical expert, the research assistants and all 5 of the subjects from each group met to discuss and consolidate the exercises that would be used for study 3. The focus of the discussion was to determine if exercises:

- Were challenging and meaningful
- Were novel and stimulating, not boring
- Drove task specific self-confidence through accomplishment of success and performance
- Promoted active patient involvement
- And that there was agreement on the selected exercise progressions

These six focus points are in accordance with the principles of motor learning and plastic cerebral adaptive changes (Mezernick 2005, Winstein 1999). Adjustments were made to exercises following this meeting, with the implementation of these changes made in study 3.

5.3 **RESULTS OF STUDY 2**

The results of study 2 will be presented under the headings of the specific objectives of the study, with specific reference to the problems noted and the steps taken to resolve these for study 3. The data collected from the outcome measures used for the 15 subjects during the pilot study are presented in Appendix A.

5.3.1 **Selection and Training of Research Assistants**

5.3.1.1 **Blinding of evaluator**

The researcher was the blinded evaluator for study 2. As the researcher telephonically contacted prospective subjects for recruitment into the study, and managed the subjects'

adherence to the programme by short message service and telephonic contact, it was felt that blinding for evaluations may have been affected.

To ensure blinding in study 3 a further clinically experienced research assistant was recruited at the end of study 2 to be the blinded assessor for all subject evaluations. The researcher then continued to conduct subject screenings and recruitment from the relevant hospitals, booking of evaluations, ensuring subject adherence to training programmes and dealt with any enquiries. The researcher was then able to run the task intervention group on a weekly basis for study 3.

5.3.1.2 Summary of research assistants' roles for study 3

Due to the changes outlined above some of the research assistant roles changed from study 2 to study 3. The role of the researcher and the assistants for study 3 were as follows:

- The researcher conducted the progressive task intervention group
- Research assistant 1 was blinded to the training interventions, group allocations and conducted all subject evaluations. Subject evaluations were not conducted on any of the treatment intervention days.
- Research assistant 2 prepared concealed stratified random allocation envelopes
- Research assistant 3 ran the strength intervention group
- Research assistant 4 ran the physiotherapy component of the control group

5.3.2 Development of Task and Strength Groups' Intervention

5.3.2.1 Strength group

The strength group's intervention for study 2 consisted of ten open and closed chain isotonic strengthening exercises based on motor relearning (Carr and Shepherd, 1998) typical of the exercises currently run at various clinics. Exercise selection aimed to target the major muscle groups of the lower limb that may limit walking speed and endurance (Bohannon, 1986). Each exercise consisted of three sets of 10 repetitions (Kraemer et al., 2002); and were progressed as detailed below from the easiest to most difficult. Progressive resistance was provided initially with gravity, then free weights, elastic bands and elastic balls. Progressions were determined by the research assistant's professional discretion according to subjects' performance and given feedback from subjects (Dean et al., 2000). Progressions for each exercise are bulleted below and follow in a sequence that gets progressively more difficult from the top to the bottom. Exercises 1 to 4 were performed in supine, while exercises 5 to 10 were performed in sitting and progressions for each exercise were as follows:

Exercise 1: Hip and knee flexion

Alternately bend and straighten legs in supine (20 counts totals: 10 repetitions per leg)

Progressions:

- Sliding sheet (friction free) placed under affected limb
- Remove sliding sheet
- Apply a 1kg wrist/ankle weight
- Apply a 2kg wrist/ankle weight
- Position affected leg over the edge of bed and then flex hip and knee until foot is placed on to bed (progress with weights as before)

Exercise 2: Hip extension, limb loading

Bridging: with both hips and knees flexed, feet positioned together on the plinth, lift buttocks up from bed

Progressions:

- Feet positioned hip distance apart, arms extended on plinth
- Feet placed next to one another
- Feet together, with a ball placed between knees (ball must not fall out from knees)
- Feet together, ball between knees, arms crossed onto chest and not touching plinth
- Place unaffected leg extended on plinth (encourage not to take weight through extended leg)
- Place unaffected leg over affected leg (FAbER position), arms extended on plinth
- Place unaffected leg over affected leg, arms crossed onto chest not touching plinth
- Place both feet on a 25cm diameter ball

Exercise 3: Trunk rotations

With hips and knees flexed and feet together on plinth, roll knees from side to side (20 reps count for 10 each leg per set)

Progressions:

- Therapist cues subject to maintain knees together
- Place a small ball between knees which must not drop during the exercise
- Place a pen between knees as above
- Increase the speed of rotation and double repetitions in each set

Exercise 4: Hip abduction/adduction

Knees extended, abduct and adduct affected leg, maintain hip in neutral rotation during movement.

Progressions:

- Place sliding sheet (friction free) under affected limb
- Remove sliding sheet
- Apply a 1kg wrist/ankle weight
- Apply a 2kg wrist/ankle weight
- Starting position in side lying with affected leg on top, maintaining hip rotation and abduct affected leg (progress with weights as above)

Exercise 5: Sitting balance

In sitting reach hands forwards together to touch the floor to right foot then left, sitting upright between sides

Progressions:

- Commence on standardized plinth height with thighs supported
    - Reach down to pick up an object placed in front of feet
    - Reach down to pick up objects placed out of arm's reach
    - Progress by moving objects further out of arm's reach
- Progress by decreasing thigh support
- Progress by increasing height of plinth

Exercise 6: Limb loading, hip and knee extension

In sitting hemiplegic leg positioned on a piece of 5 cm foam, push down as hard as possible on foam to compress foam as much as possible

Progressions:

- Patient is allowed to initially compensate with trunk flexion and rotation
- Encourage/limit trunk flexion and rotation compensations
- Using a 5cm piece of foam with arms crossed on chest and limit trunk compensations
- Progress as before while increasing foam thickness

Exercise 7: Hip flexion

In sitting try to lift hemiplegic knee in a flexed position towards ceiling (hip flexion)

Progressions:

- Initially subject is allowed to compensate with trunk extension
- Encourage/limit trunk extension compensation strategy
- Apply a 1kg wrist/ankle weight
- Apply a 2kg wrist/ankle weight

Exercise 8: Hip adduction

In sitting with a ball placed between knees, adduct knees together trying to squash ball

Progressions:

- Initially squeeze ball
- Isolate movement to affected leg while unaffected leg remains stationary
- Hold squeeze for 5 seconds from eighth repetition of each set
- Hold squeeze for 10 seconds from eighth repetition of each set

Exercise 9: Knee flexion and extension

In sitting slide hemiplegic foot forward and backwards on the floor (knee flexion and extension)

Progressions:

- Place sliding sheet (friction free) under affected foot and encourage movement
- Remove sliding material
- Apply a 1kg wrist/ankle weight when knee extends foot remains in contact with the floor
- Increasing controlled ROM to full knee extension and flexion as much as possible
- Apply a 2kg wrist/ankle weight

Exercise 10: Hip abduction, external rotation

In sitting with resistance band placed around knees pull knees apart (hip abduction/ external rotation)

Progressions:

- For each strength of resistance band complete the two progressions below before proceed to next resistance:
  - Initially place feet hip distance apart then place feet next to one another
  - Progress to holding abduction for five seconds from the eighth repetition

This exercise commences with the red theraband (provides the least resistance) and then proceeds with colour coded theraband progressions until using black (provides the most resistance).

No changes were made to these exercises for study 3. The exercise session lasted approximately 60 minutes.

5.3.2.2 **Task group**

The exercises in the task group focused on improving strength (Dean et al., 2000), balance (Bonan et al., 2004) and task oriented practice (Salbach et al., 2004) in standing and walking.

For all exercises in the task oriented group chairs, tables and walls were used as environmental adaptations to ensure safety and provide support as necessary. Reducing the use of these supports over time formed part of the exercise progressions. Each subject in this group had a caregiver/family member assisting them during intervention sessions to ensure safety and for encouragement. The entire list of nine exercises presented below was used during study 2 on a rotational basis and were predominantly based upon the movement science approach (Carr and Shepherd, 2003). Subjects worked at a total of eight stations for a period of five minutes at each station.

1. Balance Beam Walking: Two parallel lines 30cm's apart marked with insulation tape extending 3m. Subject walks forward between the lines. Chairs and walls were used as support / environmental adaptations.
2. Collecting Balls: From a plinth subject stands up walks forward 2m to a bucket (initially positioned higher and toward midline and progressed lower and further out of reach towards affected side) filled with balls. Subject picks up one ball walks backwards with the ball and places it in a crate positioned at the starting position.
3. Stepping up and over benches: Subject walks forward over 3-4 steps of different heights, alternating which leg steps up onto the step first.
4. Slalom Walking: Subject walks slalom (in an s shape) around 4 cones with supports at their sides for safety.
5. Sideways Walking: Subject stands with their back against the wall and walks sideways left and right for 5m along the wall.
6. Squats: Standing facing the wall. Wall has three taped Velcro® taped lines positioned at a height of 190cm, 210cm and 230cm from the floor. Subject then squats to pick up a postcard from container placed at subject's side and then places the card onto the Velcro® tape on the wall.
7. Ball Kicking: Subject stands facing the wall sides confined with a table and chair if required. Subject kicks the ball against the wall with alternate feet.
8. Stepping over sticks: Four sticks are taped to the floor; environment is adapted to be safe. Subject walks and steps over sticks not stepping on them.
9. Stepping Balance: Subject stands with their back against the wall in a demarcated box. Six markers are set in a semi -circle around the box from left to right. Subject steps one foot out of square onto demarcated target and returns to starting position. Subject then moves onto touching next target with foot. This is repeated with both feet

5.3.2.2.1 **Exercise selection**

Following the completion of study 2 and the discussion described in 5.2.10 the following changes were made to the above exercises used in study 2 for study 3.

For study 2; exercises 1 (balance beam) and 2 (collecting balls) were similar and repetitive, for study 3 they were combined to be more challenging and novel (see study 3; exercise 1).

Study 3: Exercise 1

Positioned between a wall on one side and a plinth and chair on the other side

Walking forward on a straight taped line for 3m to a crate filled with balls. Subject then squats to pick up a ball and walks backwards on the line back to the starting position and places the ball in another crate positioned at the start.

Progressions:

- Reducing and eventually removing use of upper extremity for support
- Crate with balls is initially positioned higher on a bench and progressed to the floor
- Crate is initially positioned in front of the subject and progressed further out of arms' reach towards the affected side

From study 2, Exercise 3 (walking over benches) took up too much space in the gym, and additionally subjects felt they would concentrate better if they practiced stepping up and down one step only and not along a walkway of 3- 4 steps (See exercise 2).

Study 3: Exercise 2

Subject stands positioned with the wall at their side and backrest of a chair for hand support at the other side.

Placing the affected leg on the bench (for the duration of the exercise), subject then steps the unaffected leg up and down off the bench

Progressions:

- Reducing and eventually removing use of upper extremity for support
- Stepping unaffected leg completely over the bench and back
- Increasing step height after completing the previous progressions

From study 2 it was found that for exercises 6 (squats) and 9 (balance stepping) it was felt that the increased time of 7 minutes per exercise (discussed under duration of stations) was

too long for these exercises. It was also noted that they were not sufficiently novel and challenging. As a result these were combined into study 3: exercise 3 below.

Study 3: Exercise 3

Subject stands positioned in a corner in the room, with their back and buttocks touching a wall. A wall with a windowsill was on the right and the backrest of a chair was placed on the subject's left side.

For study 3 this exercise had 2 phases each repeated for a period of 3 ½ minutes.

Phase 1: Squatting. Subject stands in a demarcated box with their back against a wall; feet placed 20cm away from the wall. Subject squats to pick up a postcard (one at a time) placed on a bench in front of their feet. The post card is then placed in a container positioned on the windowsill in the gym.

Phase 2: Stepping. Subject stands as before in demarcated box, then steps the affected foot onto a demarcated target (there are 8 targets) onto the bench placed in front of their feet. Each target on the bench is touched alternately for the 3 ½ minutes (Carr and Shepherd, 2003).

Progressions:

- For phase 1 the postcards are initially positioned centrally in front of the subject's feet and then moved further to the affected side and out of arms reach to a maximum of 30cm from the feet.
- Once subject manages 30cm away from the feet, the unaffected leg is placed on the bench positioned in front of their feet and subject continues to pick up post cards individually
- For phase 2 reducing and eventually removing use of upper extremity for support
- Increasing the bench height

From study 2: exercise 8 (stepping over sticks), it was noted that this exercise took up too much space in the gym and could be simplified by using only one stick to step over and then back. It was also noted in study 2 that shifting the sticks for each subjects stride length became difficult to manage. The revised exercise is detailed below namely exercise 4.

Study 3: Exercise 4

Subject stands with both feet behind a demarcated line, then steps one leg over a stick. The stepping leg returns to behind the demarcated line at the starting position. Repeat with the alternate leg.

Progression:

- Reducing and eventually removing use of upper extremity for support
- Stick distance from demarcated line is positioned further away (McClellan and Ada 2004).
- Once subject has reached their maximum stride length, a stand was used to progress the elevation of the stick from the ground

From study 2: exercise 4 (slalom walking) and exercise 5 (sideways walking) took up too much space in the gym and were removed from the programme. In addition exercise 7 (ball kicking) was also removed as there was not an adequate area in which to set this up.
As a result of exercises being combined and removing the last three mentioned, there were two few exercise stations in the circuit. As a result two new circuit stations were included (see exercises 5 and 6 below).

Study 3: Exercise 5

Subject stands up from a seated position (Cheng et al., 2001; Dean et al., 2000; Engardt et al., 1993)
Progressions:

- Reducing and eventually removing use of upper extremity for support
- Lowering chair height
- Placing the unaffected foot forwards initially and then later onto a step

Study 3: exercise 6

Endurance walking station, which fulfilled the need to increase the endurance training component of the task group's programme discussed later in this chapter in Section 5.4 (Dean et al.,2000; Duncan et al.,1998,). The final six selected exercises used for study 3 with their progressions are presented in below.

5.3.2.2.2 **Final Task Group Exercises for Study 3**

Exercise 1

Walking forward on a line for 3m to a crate filled with balls. Squat to pick up a ball and walk backwards on the line to the starting position. Place the ball in crate positioned at the start.
Progressions:

- Reducing and removing use of upper extremity for support
- Crate with balls is initially positioned higher on a bench and progressed to the floor

- Crate is initially positioned in front of the patient and progressed further out of arms reach towards the affected side

Exercise 2

Placing the affected leg on a bench, step the unaffected leg up and down off the bench

Progressions:

- Reducing and eventually removing use of upper extremity for support
- Stepping unaffected leg completely over the bench and back
- Increasing step height after completing the previous progressions

Exercise 3

Phase 1: Squatting. Subject stands in a demarcated box with their back against a wall; feet placed 20cm away from the wall. Subject squats to pick up a postcard (one at a time) placed on a bench in front of their feet. The post card is then placed in a container positioned on the windowsill in the gym.

Phase 2: Squatting while Stepping. Subject stands as before in demarcated box, with back against the wall, then steps the affected foot onto a demarcated target (there are 8 targets) onto the bench placed in front of their feet. Each target on the bench is touched alternately for the 3 ½ minutes. (Carr and Shepherd 2003).

Progressions:

- For phase 1 the postcards are initially positioned centrally in front of the subject's feet and then moved further to the affected side and out of arms reach to a maximum of 30cm from the feet.
- Once subject manages 30cm away from the feet, the unaffected leg is placed on the bench positioned in front of their feet and continues to pick up post cards individually
- For phase 2 reducing and eventually removing use of upper extremity for support
- Increasing the bench height

Exercise 4

Standing with both feet behind a line, step one leg over a stick (alternating legs)

Progression:

- Reducing and eventually removing use of upper extremity for support
- Stick is positioned further away (McClellan and Ada 2004).
- The height of the stick above the floor increased

Exercise 5

Sitting to standing (Cheng et al., 2001; Dean et al., 2000; Engardt et al., 1993)

Progressions:

- Reducing and eventually removing use of upper extremity for support
- Lowering chair height
- Placing the unaffected foot initially forwards and then later onto a step

Exercise 6

Endurance walking station, which fulfilled the need to increase the endurance training component of the task oriented groups treatment intervention programme discussed later in this chapter in Section 5.4 (Dean et al.,2000; Duncan et al.,1998,).

5.3.2.2.3 **Duration of stations**

For study 2 subjects performed the eight exercises for five minutes each (Salbach et al., 2004; Dean et al.,2000), resulting in 40 minutes of continuous training. There were 10 stations in the above studies while only eight stations with equipment could be set up in the gym space available for study 2. During study 2 it was further noted that the gym was still too small to accommodate all eight stations comfortably with subjects and carers. As a result it was decided to have six stations.

For study 3 subjects spent seven minutes at each of the six workstations, totaling 42 minutes of training time. With the time taken to move from one exercise to the next exercise the circuit took just over 60 minutes.

5.3.2.3 **Multidisciplinary education group (control group)**

The multidisciplinary groups' intervention sessions lasted approximately two and a half hours, this session included education on all aspects of understanding stroke and the cause and management of stroke. Topics covered included:

- Understanding stroke and its risk factors
- Dietary advice with particular reference to foods that influence hypertension, diabetes and hypercholesterolaemia.
- The importance of being active at home including occupational therapy ideas to encourage involvement in the home and community.
- The importance of exercise

A 20-minute exercise session run by research assistant 2 was given, with advice regarding the benefits of frequent exercise and walking. Patients then had tea and chatted among themselves. This is the programme that is offered to stroke survivors at HJH and other surrounding clinics. The reason for including the multidisciplinary group is presented under Section 5.4.

5.3.3 **Project Site Feasability**

5.3.3.1 **Site feasability**

There were severe space shortages in both the physiotherapy and occupational therapy departments at CHB hospital, at the time of implementing study 2, thus, the proposed site for study 2 was moved to HJH.

For study 3 it was decided to continue at HJH as study 2 was successfully run at HJH.

5.3.3.2 **Recruitment feasability**

During ward screenings it was noted that various socioeconomic factors made it extremely difficult for some stroke survivors to attend out patient therapy following their discharge namely:

5.3.3.2.1 Most persons who have suffered a stroke are discharged into the care of their family, as a result of the early discharge from government hospitals (Wasserman et al., 2009, Mudzi, 2009). Very few can afford the costs of employing a carer or there is no carer or relative available on a regular basis to accompany and assist them to their hospital appointments.

5.3.3.2.2 Some subjects were lost to follow up as they returned to their family home (which is frequently in another province) as they have better social support systems available with their family there.

To limit the number of subjects lost to follow up as a result of the above factors, the inclusion criteria for study 3 needed to be revised. Only subjects that were residents within the Johannesburg metropolitan area for the next year were elligable for recruitment.

5.3.4 **Outcome Measures**

The pilot study provided the opportunity for the researcher to become familiar with the selected outcome measures and to test their suitability for the study. Details of the findings are

presented under the relevant measure. For the purposes of achieving objective 4 of study 2 of this thesis, the following outcome measures as described in detail in Chapter 3 were used:

5.3.4.1 Six minute walk test (6MWT)
5.3.4.2 Ten metre walk test (10MWT)
5.3.4.3 Timed up and go test (TUG)
5.3.4.4 Berg balance scale (BBS)
5.3.4.5 Stroke impact scale short form 16 (SIS 16)

During study 2 it was noted that many subjects came for evaluation with a resting blood pressure reading above 180/120 (Enright, 2003). In these instances subjects were sent to the hypertension clinic and a new date was set for the evaluation after they were cleared by their doctor as fit to participate in the study. In light of the fact that compliance and control of blood pressure remains a major challenge in RSA (Wasserman et al., 2009; Lemogoum et al.,2005), it was decided to perform spot blood pressure checks on subjects at frequent intervals during study 3.

5.3.4.1 **The six minute walk test (6MWT)**

The researcher who administered all measurements during study 2 felt that certain subjects walked at a comfortable pace when instruction was not made clear.

For study 3 prior to commencement of the measure, a clear statement was given to subjects to “cover as much distance as you can” during the six minutes of the test.

5.3.4.2 **Ten metre walk test (10MWT)**

There were no problems noted during study 2 with the administration of this measure and this was used in the same way for study 3.

5.3.4.3 **Timed up and go test (TUG)**

During the administration of this test the researcher noted three issues that required standardization for study 3:

5.3.4.3.1 Standardisation of chair
5.3.4.3.2 Demonstration
5.3.4.3.3 Timing technique

5.3.4.3.1 **Standardization of chair**

The researcher noted that subjects appeared to slow down prior to sitting at the end of the test to ensure their safety and control their descent to the chair, which had no armrests. This could have affected the reliability of the time measured. Thus a specific chair was used for all subjects in the study 3.

Dimensions of the chair without armrests were as follows:

- Seat Height: 47cm
- Seat Width: 40cm
- Seat Depth: 47cm

5.3.4.3.2 **Demonstration**

Subjects completed the 6MWT prior to the TUG. During study 2 it was noted that subjects would frequently walk past the beacon and then only remembered to turn so affecting the timing. Thus for study 3 research assistant 1 first demonstrated the TUG to all subjects prior to measurement. In addition, a practice trial (if desired) was permitted.

5.3.4.3.3 **Timing technique**

In the TUG, timing commences when the evaluator says “go”, it was noted that while some subjects rush to start the TUG even starting fractionally before the instruction to “go”, others hesitated for quite a few seconds prior to commencement following the instruction to “go”. This finding could affect accurate time measurement, so it was decided that following the instruction to “go” the researcher only started timing the subject as they demonstrated some initiation of movement of their shoulders away from the chair, rather than on the “go” instruction. Similarly timing was only stopped when subjects’ shoulders made contact with the chair after sitting down. Subjects were informed that they must start and end the task with their shoulders in contact with the backrest of the chair.

5.3.4.4 **Berg balance scale (BBS)**

The dimensions of the chair used for the BBS was standardised in the same manner as stated in the TUG. Similarly the step used for task 12 of the BBS was standardized. The dimensions of the step used were as follows:

- Height: 12cm
- Width: 47cm
- Length: 55cm

5.3.4.5 **Stroke impact scale (SIS 16)**

5.3.4.5.1 **Linguistic changes**

During study 2 it was noted that though the SIS 16 was available in both languages, subjects preferred using the English Version. None of the subjects used either of the translated versions. Although the translated versions were not used in study 2 it was decided that subjects would still be offered the translated versions in study 3.

5.3.4.5.2 **Cultural changes**

Two cultural problems were noted while using the original English Version of the SIS 16.

It was frequently noted that the response options were not easily understood by subjects and were reworded by the researcher for subjects to relate more effectively to them. These response options are presented below with the wording used for the South African Version used for study 3. Table 5.1 shows the original and the South African versions used.

Table 5.1: South African English Adapted Response Options for SIS 16

Original English Version	**Revised South Africa English Version**
Not difficult at all	Easy to do
A little difficult	Little bit difficult to do
Somewhat difficult	Medium difficult to do
Very difficult	Very difficult to do
Could not do at all	Cannot do at all

Similarly it was noted that certain questions were not clearly understood by the subjects and were reworded as follows for study 3:

Table 5.2: SIS16 South African English Wording Adaptations

Original Version	**Revised South African English Version**
To bathe yourself	To wash yourself
Walk one block	Walk around a soccer stadium
Getting in and out of a car	Getting in and out of a taxi

Getting in and out of a car" often referred to a "taxi", which in South Africa is a Volkswagen Kombi type vehicle. These vehicles are higher from the ground than a normal car and may require the subject to have to negotiate themselves past other passengers in the front row to a

space at the rear of the taxi. Thus, these adaptations used in study 2 mentioned above were utilised for study 3. The evaluation form used with these changes can be found in Appendix C.

5.3.4.6 **Post intervention questionnaire**

A post intervention questionnaire was administered at the post intervention evaluation (Appendix O) As the fluctuation in the distance from the transport “drop off” point at HJH was noted, (which is discussed under endurance training component), and not all subjects walked from this point to their therapy sessions, Question 6 “did you walk to the sessions from your drop off point?” was included into the questionnaire. Similarly Question 7 “How far/ often do you walk during the day at home?” and “Have you been to church or shopping weekly? How far did you walk to get there?” were included to determine the distance, length of time and frequency that subjects walked? In addition, it sought to determine the degree of community ambulation that occurred outside of therapy sessions. As community ambulation is task oriented and endurance training in itself, it was necessary to determine the amount of community walking subjects were doing outside of therapy intervention sessions, especially as therapy was only once per week.

5.3.5 **Subject Adherance**

5.3.5.1 **Time of rehabilitation group session**

A time suitable for the majority of the subjects was selected for study 3.

5.3.5.2 **Motivation**

This study relied on relatives/ carers not only to accompany subjects to their appointments but additionally:

- to assist subjects in the treatment sessions with their exercises as previously outlined (ensure safety).
- to assist in motivating subjects to participate and engage in activities as much as possible.

The researcher noted that motivation from the caregivers was difficult to maintain. Thus, for study 3 it was decided to short message service or contact the caregiver or relative telephonically to encourage their adherence to all weekly therapy sessions.

5.3.5.3 **Intervention period**

As mentioned above in Section 5.2.8 for various reasons many subjects may miss their intervention sessions. It was decided that all subjects had to complete six sessions prior to their post intervention evaluation. For the 15 subjects involved in study 2, the average period

for the subjects to complete the six sessions (irrespective of their group) was 11 weeks, from baseline evaluation to post intervention evaluation. This period ranged from seven weeks up to maximum of 17 weeks as seen below. Two subjects died prior to completion of the intervention. The time taken to complete the sessions for the remaining 13 subjects is presented in Table 5.3 below.

Table 5.3: Time Taken to Complete Six Sessions

Subject Number	Number of weeks to complete 6 sessions
1	8
2	8
3	6
4	10
5	17
6	10
7	12
8	9
9	10
10	10
11	7
12	16
13	10
Average Number of weeks to complete 6 sessions	11

Sub-acute stroke survivors attended the neurology clinic, for monitoring of their stroke risk factors and to collect their medication once a month. Thus subjects did not attend their therapy session on this day if it coincided with their monitoring or medication day. This was a reason for subjects missing sessions. The second most common reason for missing sessions was when the relative or caregiver had other commitments and was unable to accompany subjects to therapy on their scheduled day.

For study 3 it was felt that because the treatment intervention is only once per week for six weeks, that all six sessions should be completed prior to the post evaluation after the six sessions. Because the subjects in study 2 took an average of 11 weeks to complete the 6 sessions, for study 3 it was decided that all subjects (task and strength groups) had 12 weeks

in which to complete the six treatment intervention sessions, thus accommodating these difficulties subjects had in attending their intervention regularly. All subjects were evaluated 12 weeks after baseline evaluation.

5.4 ENDURANCE TRAINING COMPONENT

During study 2 it was noted that the physiotherapy department is 250m from the subject car drop off point and 450m from the taxi drop off point at HJH. While certain subjects could walk to the physiotherapy department others were pushed in a wheelchair. As a result the treatment intervention may have been biased by this extraneous variable. Subjects in the strength group may have walked this distance to their sessions while subjects in the task group may have been pushed, which would resulted in those subjects (who walked) receiving extra endurance training irrespective of the intervention group they were in. In light of the evidence that endurance training is a contributing factor to the recovery of walking speed and physical endurance post stroke (Dean et al., 2000; Duncan et al., 1998b; Richards et al., 1993), this problem was noted in study 2. As a result the following four steps were implemented for study 3:

1. The inclusion of a progressive walking endurance home programme for the task group, with a record kept of the walking done at home for these subjects (Appendix P).
2. The inclusion of an endurance walking station in the task group's circuit.
3. The inclusion of a third group (details of control group are in Section 5.3.2.3) to the study that attended one multidisciplinary intervention session during the 12 week period with no other gait training (this group session was already running at the hospital). As subjects only attended this group once during the treatment intervention phase the effect of walking this distance to the intervention on a weekly basis was limited.

The inclusion of a third group, a multidisciplinary education group (control) at HJH was suggested in order to reduce the effect of the endurance walk distance that the subjects walked to the therapy department once a week (task and strength groups). The full structure of this group is presented above under treatment interventions, section 5.3.2.3. An amendment to the study was submitted for ethical clearance to the Human Research Ethics Committee (medical) of the University of the Witwatersrand to allow for the inclusion of the control group (Appendix L).

Following the findings of study 2 as presented above and the suggested changes made a detailed description of the methodology used for study 3 is presented in Chapter 6.

CHAPTER 6

6. METHODS

6.1 INTRODUCTION

The following chapter presents the methodology that was followed when obtaining the data for study 3. The data analyses will additionally be presented.

6.2 STUDY DESIGN

This study was a stratified blocked randomised controlled trial. Group allocation was concealed. Assessor blinded evaluations were conducted at baseline, post intervention and at six months after the intervention had ceased.

6.3 PARTICIPANTS

Stroke was diagnosed by the attending physician, according to the World Health Organization criteria: rapidly developed clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than vascular origin (Hand et al., 2006; Engstadt et al., 2000; WHO report, 1989).

To attain the required sample size for this study, the researcher screened all subjects admitted with diagnosis of stroke in the medical records at all three participating hospitals.

One hundred and forty four subjects were enrolled in study three between January 2009 and April 2011. Nineteen subjects (13.2%) were recruited from CHB Hospital, 21 subjects (14.6%) from Charlotte Maxeke Hospital and 104 subjects (72.2%) from Helen Joseph Hospital. Forty - eight subjects (33.3%) were randomized to the control group, 45 (31.3%) subjects to the strength group and 51 (35.4%) to the task oriented training intervention group. All three hospitals are academic hospitals attached to the University of the Witwatersrand. All subjects were residents in central Gauteng.

6.4.1 Inclusion Criteria

- All subjects with a diagnosis of any first ever ischaemic or haemorrhagic stroke of vascular origin, over the age of 18 years.
- Male or Female
- Discharged from in-patient care
- Resident within the Johannesburg metropolitan area for a period of one year

- Less than six months post stroke at the time of recruitment into the study
- An ability to walk 10m with physical assistance, with an assistive device, orthosis or supervision if necessary.
- Walking speed over 10m < 1.1m/s (community ambulator,Hill et al., 1997)
- Fully independent walker prior to the stroke
- Medically and neurologically stable at the time of recruitment into the study
- Volunteers and has the ability to give informed consent.

6.4.2 **Exclusion Criteria**

- Transient ischaemic attack
- Unable to give informed consent
- Stroke caused by metastatic disease
- Uncontrolled cardiac symptoms, pacemaker or other medical condition that may limit exercise.
- Any pre-existing arthritic or underlying musculoskeletal condition that affects walking

6.5 **SAMPLE SIZE**

As the 6MWT provided the greatest number of subjects for each group required to detect a change as opposed to the other outcome measures, the sample size for study 3 was based on the calculations with the 6MWT. A sample size of 39 stroke subjects in each group had 90% power to detect a difference in mean change from baseline of 28m in the 6MWT. Walking 28m is clinically meaningful as it represents the distance required to cross at a pedestrian crossing (Lerner-Frankiel et al., 1986).

Expecting a 20% drop out rate, 48 eligible subjects were enrolled into each group. Subjects were stratified according to the three levels of walking deficit (Perry et al., 1995) defined by comfortable walking speed: Mild gait deficit (≥ 0.8m/s), moderate gait deficit (0.4-0.8m/s) and severe gait deficit (≤0.4m/s). Stratification, thus ensuring a 40% distribution of the sample with a severe gait deficit, 40% moderate and 20% with a mild gait deficit at baseline. This facilitated data analysis to establish any differences between the intervention groups and between the strata in terms of the effectiveness of the treatment intervention.

6.6 ETHICAL CLEARANCE

Ethical clearance was granted from the Human Research Ethics Committee (medical) at the University of the Witwatersrand (ethical clearance number No; M070413; Appendix K and L). Permission to carry out this study was granted from the relevant participating hospitals (Physiotherapy Head of Department and the hospital Chief Clinical Operations Officers). The following ethical practices were carried out during the process of data collection.

- Informed consent was obtained for all subjects prior to inclusion in the study
- Subjects were reassured and allowed to withdraw from the study at any time during the trial
- Subjects remained anonymous throughout the study by applying a number code system on all data collection forms

6.7 PROCEDURE

The outcome measures used to collect data are discussed in detail in Chapter 3. An overview of the procedure followed for data collection is shown below.

6.8 RESEARCH ASSISTANTS

For the purposes of study 3, four research assistants were recruited to conduct the study.

- The researcher conducted the progressive task oriented intervention groups.
- Research assistant 1 was blinded to the training interventions, group allocations and conducted all subject evaluations. Subject evaluations were not conducted on any of the treatment intervention days.
- Research assistant 2 prepared concealed stratified random allocation envelopes.
- Research assistant 3 ran the progressive strength training intervention group.
- Research assistant 4 ran the physiotherapy component of the control group.

Research assistant one had over 20 years experience in the rehabilitation of subjects with neurological deficits. A training session was held between the researcher and this assistant to clarify the outcome measures used and ensure the procedure was standardised.

Research assistants two and three attended training sessions to develop an understanding of the exercises implemented and the skills to run their intervention group. The researcher demonstrated all exercises and progressions with a chronic stroke volunteer. The research assistant then had the opportunity to demonstrate the exercises to the researcher. Thereafter, contact was made with research assistants on a weekly basis to provide support, and to provide an opportunity to clarify any enquiries. Research assistants were constantly reminded of the importance of progressing activities according to the treatment regime. Similar emphasis was placed on the importance of consistent administration of the class.

6.9 SUBJECT RECRUITMENT

To attain the required sample size the researcher screened all three hospitals on a weekly basis (to recruit subjects) during the study period. A list of subjects admitted with suspected or confirmed stroke diagnosis was provided by the physiotherapist working in the neurology unit at the time. The researcher screened all potential subjects to determine if they fulfilled the inclusion criteria. If they did a detailed explanation of the study and purpose and requirements was performed. Subjects who expressed an interest in becoming involved were given a detailed information sheet to aid explanation. If subjects were interested in being involved in the study, informed consent was sought from the subjects prior to the baseline evaluation. If consent was attained a baseline evaluation appointment was booked with the blinded evaluator.

6.10 RANDOMISATION AND GROUP ALLOCATION

Blocked stratified randomization with concealed allocations (as detailed in section 5.2.8 above) was performed after the baseline evaluations. Once stratified according to their comfortable gait speed, subjects were then randomised into the task, strength and control groups using the computer generated random numbers. The group allocations either task, strength or control group were put into envelopes numbered from 1 to 60 for moderate and severe gait deficit strata and 1 to 35 for the mild gait deficit stratum. Envelopes were kept in boxes for each stratum (prepared by research assistant 2). The next envelope of the relevant stratum was drawn and handed to the subjects by the researcher responsible for the randomisation process, ensuring concealed subject allocation.

6.11 BLINDING AND BASELINE EVALUATIONS

Evaluations were conducted on different days to treatment intervention groups. Demographic information that was sought from the subject can be seen in Appendix B. Following the collection of the demographic data the BBS and the 6MWT were conducted. To allow a period of rest following the 6MWT, the SIS 16 was administered. Once the SIS 16 was completed and subjects confirmed they were not tired the subjects' performance on the10mwt (comfortable and fast) and the TUG were measured.

Following baseline evaluation subjects were randomly allocated to a group via stratified concealed allocation. Each subject was provided an intervention appointment schedule. The researcher booked all post intervention and follow-up evaluations with the blinded evaluator. All completed subject evaluation forms were collected by the researcher after each evaluation, so as to reduce potential biases during subsequent evaluations.

6.12 INTERVENTIONS

All group interventions implemented were developed in study 2. The task, strength and control groups' intervention can be found in Appendix N and M respectively.

6.13 OUTCOME MEASURES

Patients came for scheduled appointments to the out patient physiotherapy department at Helen Joseph Hospital for their baseline evaluations. Post intervention and follow-up evaluations were conducted on an appointment basis in the same out patient physiotherapy department.

Outcome measures are discussed in more detail in Chapter 3. The SIS16 was made available in English, Zulu and Sotho as explained in Chapters 4 and 5.

6.14 DATA ANALYSIS

An intention to treat analysis was used. All demographic data that were obtained from the study sample were analysed with descriptive statistics (means and standard deviations were calculated). Discrete (categorical) variables data e.g. gender, type of assistive device used, are summarised in terms of frequencies and percentages. The Fischer's exact test was used to compare the categorical demographic data among the three groups. Comparisons among the groups at baseline for continuous data were conducted with an analysis of variance (ANOVA).

An analysis of covariance (ANCOVA) with the covariate set to the mean for each measure at baseline was used to analyze the difference noted among groups for the continuous data. The comparisons between the individual intervention groups' mean change scores were calculated with paired *t*- tests. A Fischer's exact test was used to determine if there was an effect as a result of the intervention and the proportion of subjects in each group who deteriorated or achieved a minimally clinically important level of improvement on the 6MWT and the 10MWT post intervention

An ANCOVA with covariate set to the means for each variable was computed to determine if there were any differences noted between the HIV +ve and HIV -ve subjects' change post intervention within each group on the measures of walking competency,

All statistics were calculated using STATA Version 11.1. The significance level was set at $p \leq 0.05$. Following data collection the data were analysed, the results are presented in Chapter 7 (Results).

CHAPTER 7

7. RESULTS

7.1 INTRODUCTION

The following chapter presents the results of study 3. Baseline group comparisons are first presented. Thereafter the data on each group's performance is presented, which is estimated by means of measures of walking endurance, gait speed, functional mobility and functional balance and health status. The analyses of differences among the groups post intervention and after six months with particular reference to the objectives of study 3 are presented in detail. The performance of the HIV +ve and the HIV -ve subjects on the outcome measures over the study period are also presented.

7.1.1 Objectives of Study Three

To establish the effect of:

1. A once a week (for six weeks) out patient based task oriented group circuit training programme on functional walking (walking competency) in persons with sub-acute stroke.
2. The programme on walking endurance
3. The programme on gait speed
4. The programme at six months post intervention
5. The programme on the different severities of gait as determined by the three strata
6. The programme on self-reported physical functioning
7. The programme in HIV positive and HIV negative persons with sub-acute stroke

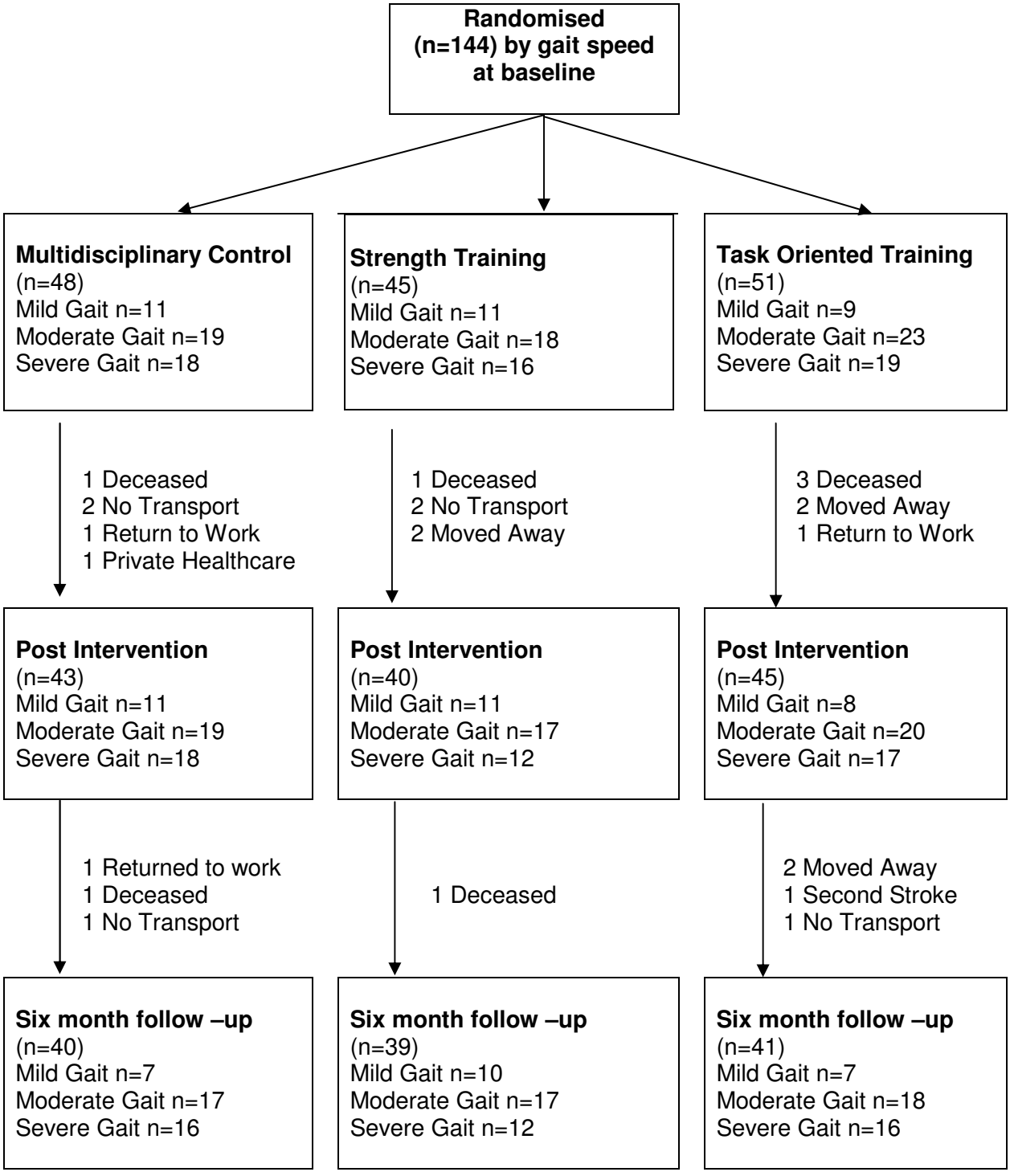


Figure: 7.1: Flow of Subjects over Study Period

7.2 PARTICIPANT FLOW AND HANDLING OF MISSING DATA

The flow of participants through the study and details of the study sample subjects lost prior to completion of the study from recruitment into the study until the six month post intervention follow up are shown in figure 7.1 above. Post intervention data were obtained from 126 subjects (88%) from the original study sample of 144 subjects. At the six month post intervention follow up a total of 120 subjects were re-evaluated (83.3%), resulting in a total of 22 subjects from the original sample not being re-evaluated (16.7%) at six months post intervention. Seven (4.9%) subjects died during the study period. Five (71.4%) of these seven were known to be HIV positive at inclusion into the study.

7.3 DEMOGRAPHICS OF THE STUDY SAMPLE AND GROUP COMPARABILITY AT BASELINE

Baseline characteristics of the subjects for each intervention group are presented in Table 7.1 below.

Table 7.1: Study Sample Characteristics and Group Comparability at Baseline (n = 144)

Characteristic	Control n=48	Strength n=45	Task n=51	Total n=144	p-value
Age (years); mean(sd)	48(±14)	51(±12)	51(±15)	50(20-76)	0.8
Time post CVA at baseline (weeks): mean(sd)	8(±7)	9(±7)	10(±8)	9.5(1-36)	0.4
Hospital length of stay post CVA(weeks): mean(sd)	2.6(±2.4)	2.6(±3.3)	2.4(±2.4)	2.5(0-16)	0.5
Gender: n(%)					0.6
▪ **Male**	22(46)	25(56)	25(49)	72(50)	
▪ **Female**	26(54)	20(44)	26(51)	72(50)	
Side of hemiplegia: n(%)					0.6
▪ **Left**	25(52)	19(42)	26(51)	70(49)	
▪ **Right**	23(48)	26(58)	25(49)	74(51)	
No. walking with an AFO: n(%)					0.2
▪ **Without**	48(100)	44(98)	51(100)	143(99.3)	
▪ **With**	0(0)	1(2)	0(0)	1(0.7)	
No. using assistive device: n(%)					0.06
▪ **None**	21(44)	28(62)	17(33)	66(46)	
▪ **Stick**	10(21)	8(18)	9(18)	27(19)	
▪ **Quadrupod**	15(31)	8(18)	18(35)	41(28)	
▪ **Frame**	2(4)	1(2)	7(14)	10(7)	

Table 7.1 Continued

Employment Status: n(%) ▪ **Employed** ▪ **Unemployed**	 33(69) 15(31)	 33(73) 12(27)	 33(65) 18(35)	 99(69) 45(31)	0.6
Income Level: R/month ▪ **<R1000.00** ▪ **R1000.00-R3000.00** ▪ **>R3000.00**	 15(31) 14(29) 19(40)	 14(31) 18(40) 13(29)	 16(31) 11(22) 24(47)	 45(31) 43(30) 56(39)	0.3
Carer: n(%) ▪ **Relative** ▪ **Unrelated**	 42(88) 6(12)	 41(91) 4(9)	 45(88) 6(12)	 128(89) 16(11)	0.9
6MWT(m)	192 (±116)	193 (±104)	162 (±110)		0.29
Comfortable Gait Speed(m/s)	0.51 (±0.28)	0.5 (± 0.27)	0.44 (±0.28)		0.19
Fast Gait Speed (m/s)	0.70 (±0.39)	0.72 (±0.37)	0.62 (±0.39)		0.41
TUG(s)	28.05 (±22.8)	26.29 (±20.9)	33.88 (±31.1)		0.32
BBS (/56)	42.4 (±11.4)	44.3 (±9.1)	40.0 (±11.8)		0.16
SIS16 (/100)	57.1(±13.8)	59.7 (±12.5)	55.6 (±14.9)		0.34

The average age of the study sample was 50 years, ranging from 20-76 years. Time since stroke at baseline was an average of 8.5 weeks and ranged from 1-36 weeks. Hospital length of stay was on average 2.5 weeks. Only one subject from the study sample used an ankle foot orthosis (AFO) while walking, which was sourced independently and funded privately. Three types of assistive devices were used by the study sample subjects while walking independently. Forty six percent of the subjects walked without an aid, 28% used a quadrupod, 19% used a walking stick, while seven percent used a frame. Sixty nine percent of the subjects were employed at baseline.

There were no statistically significant differences among the three intervention groups in terms of demographics and measures of walking competency at baseline.

7.4 COMPARABILITY OF STRATIFICATIONS AT BASELINE

Following baseline evaluation subjects were stratified according to their baseline gait speed then randomized to an intervention group. As a result, each intervention group had subjects from the three levels of gait speed (severe, moderate and mild gait deficit strata).

The comparability of the three strata (severe, moderate and mild gait deficit speeds) at baseline in terms of their age, time since stroke when recruited into study, hospital length of stay post stroke, gender and the side of hemiparesis, are presented in Table 7.2 below.

Table 7.2: Stratification at Baseline (n =144)

Characteristic	Severe <0.4m/s n = 53	Moderate 0.4-0.8m/s n = 60	Mild >0.8m/s n = 31	p-value
Age (years):mean(sd)	53(±14)	49(±13)	48(±15)	0.21
Time post CVA at baseline (weeks): mean(sd)	11(±7)	9(±8)	7(±7)	0.10
Hospital length of stay post CVA (weeks):mean(sd)	3(±3.4)	2.4± (2.5)	1.7 (±2.1)	0.7
Gender: n (%) **Male** **Female**	 24 (±45.3) 29 (±54.7)	 32 (±53.3) 28 (±46.7)	 16 (±51.6) 15 (±48.4)	0.6
Hemiparetic side: n(%) **Left** **Right**	 25 (±47.2) 28 (±52.8)	 27 (±45) 33 (±55)	 15 (±48.4) 16 (±51.6)	0.7

There were no statistically significant differences in age, time since stroke when recruited into study, hospital length of stay post stroke, gender and side of hemiparesis among the three gait deficit strata at baseline.

7.5 STROKE RISK FACTORS

This section details subjects' risk factors for stroke at baseline. Blood pressure was measured in all the subjects prior to carrying out evaluations of walking competency at baseline, post intervention and follow-up evaluations. Blood pressure data are presented as a distribution of individual values of subjects in each group in figure 7.3 below.

7.5.1 Subjects' Risk Factors for Stroke

The distribution of risk factors for stroke is shown in figure 7.2 below.

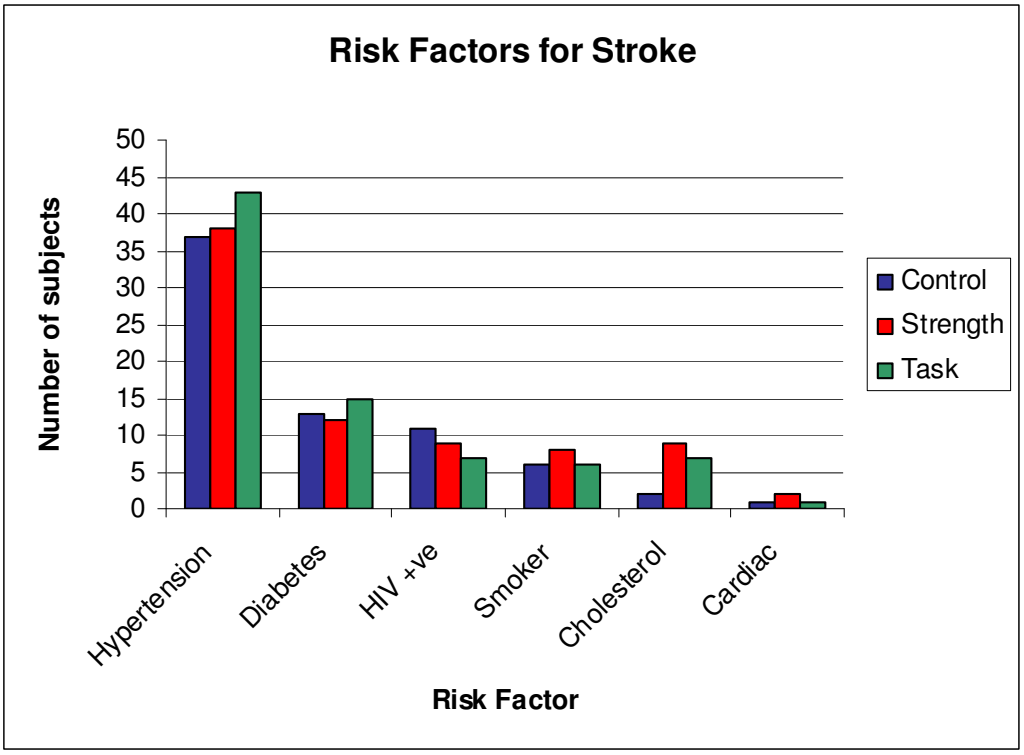
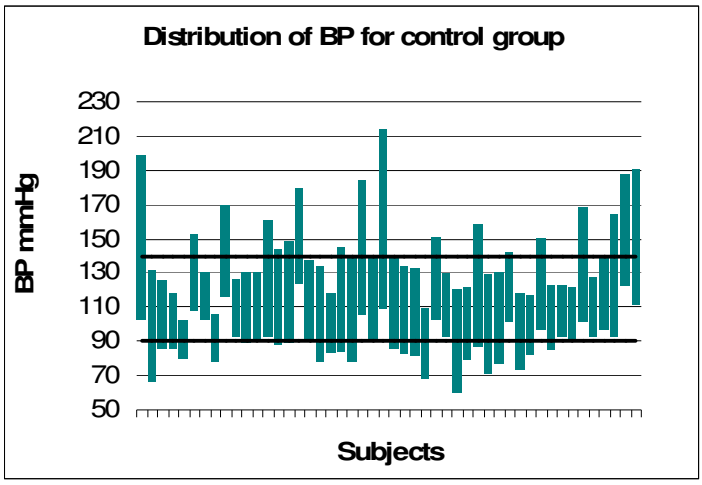


Figure 7.2: Distribution of Risk Factors for Stroke (n =144)

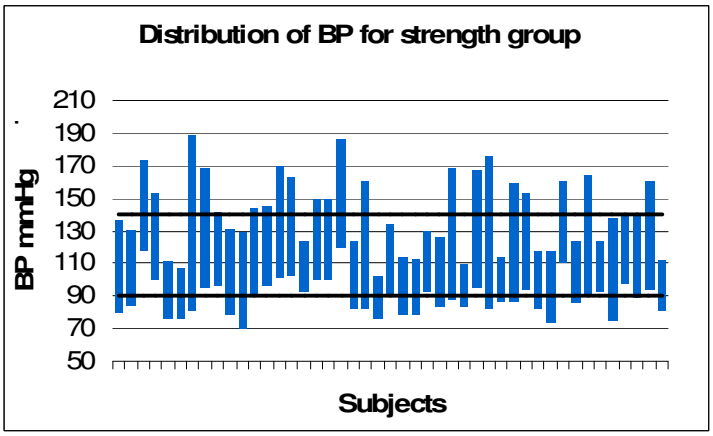
Hypertension was the most common risk factor with 118 (83%) of the subjects in the study sample with known hypertension as a risk factor for stroke at baseline. Hypertension was defined as blood pressure greater than 140/90 mmHg (ref). Diabetes was present in 40 (28%) of the subjects followed by HIV, with 27 (19%) of the sample as known HIV sero-positive status at baseline. There were 11 subjects in the control group with known HIV sero-positive status at the baseline evaluation, and nine and seven subjects in the strength and task intervention groups respectively. All HIV positive subjects were on anti-retroviral treatment.

7.5.2 Systolic and Diastolic Blood Pressure of Study Sample

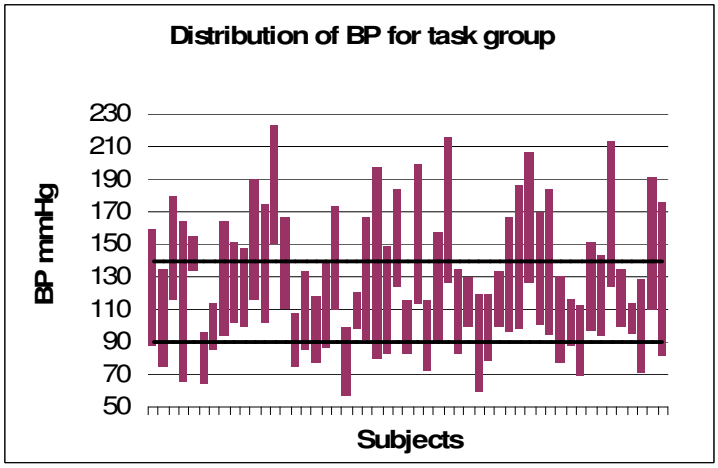
Individual distributions of systolic and diastolic blood pressure for subjects within each group are shown in figure 7.3 below.



n = 48



n = 45



n = 51

Solid black lines indicate the upper and lower limits of so called “normal” blood pressure of 140/90 mmHg

Figure 7.3: Distribution of Subjects’ Blood Pressure by Group (n=144) at Baseline

The upper range of the systolic blood pressure for some subjects in all groups was high, reaching >180mm Hg both at baseline and post intervention in all three groups. Similarly the upper range of the diastolic blood pressure for all groups was high, reaching >120mm Hg in some subjects both at baseline and post intervention. A total of 65 of the 144 subjects (45.1%) were considered to be hypertensive at the baseline evaluation. This posed a problem as some subject's systolic blood pressure while sitting at rest at baseline was > 180mmHg and diastolic blood pressure was > 120mmHg (Enright, 2003). These subjects were then referred back to the clinic prior to continuing with training sessions. These subjects were constantly sent back to physiotherapy for rehabilitation with the doctor's consent to continue even though their blood pressure remained > 180/120 mmHg. It was decided to continue spot checks throughout the study and refer subjects with blood pressure > 180/120mmHg to the clinics for management of hypertension. While some subjects continued training with blood pressure >180/120 mmHg there were no adverse events during the study period.

7.6 PATIENT WALKING COMPETENCY AS MEASURED BY 6MWT, 10MWT, TUG AND BBS

Walking competency, as measured by the 6MWT, the 10MWT, the timed "up and go" (TUG) and the Berg Balance Scale (BBS) for the subjects in the 3 groups are presented in this section. This is followed by the differences noted among the three groups post intervention (objective one. two and three) and at six months after the intervention had ceased (objective four).

The group means for all outcome measures and change over the study period can be found table 7.3 below.

Table 7.3: Subject Performance on Measures of Walking competency at Baseline, Post Intervention and Follow-Up

MEASURE	Control		Strength		Task		P[a]
	Mean	SD	Mean	SD	Mean	SD	
6MWT(m)							
Baseline	192	116	193	104	162	110	0.29
Post Intervention	236	127	268	125	260	136	
Follow-up	251	143	276	131	281	132	
Post-Baseline	44	48.70	70	60.5	103	79.5	<0.001
Follow-up- Baseline	62	72	81	82	122	82	0.003
Comfortable walking speed(m/s)							
Baseline	0.51	0.28	0.55	0.27	0.44	0.28	0.19
Post Intervention	0.64	0.33	0.77	0.29	0.75	0.36	
Follow-up	0.68	0.38	0.8	0.33	0.79	0.36	
Post-Baseline	0.13	0.16	0.2	0.2	0.32	0.22	<0.001
Follow-up- Baseline	0.19	0.22	0.25	0.22	0.36	0.24	0.005
Maximum walking speed(m/s)							
Baseline	0.70	0.39	0.72	0.37	0.62	0.39	0.41
Post Intervention	0.86	0.46	0.96	0.40	0.95	0.47	
Follow-up	0.86	0.5	1.0	0.42	1.0	0.44	
Post-Baseline	0.17	0.18	0.21	0.23	0.35	0.29	0.002
Follow-up- Baseline	0.17	0.18	0.26	0.29	0.40	0.3	0.002

P[a] = p value for comparison of control, strength and task data using analysis of covariance with covariate set to mean for each measure at baseline

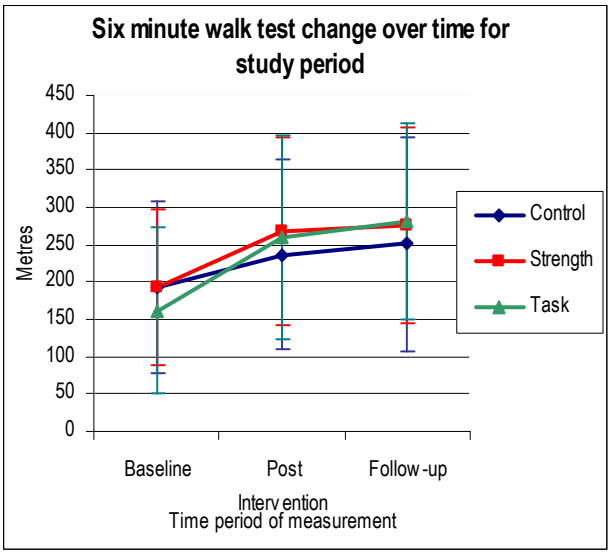
MEASURE	Control		Strength		Task		P[a]
	Mean	SD	Mean	SD	Mean	SD	
Timed "up and go"(s)							
Baseline	28.0	22.8	26.3	20.9	33.9	31.1	0.32
Post Intervention	22.3	19.8	19	16.5	20.7	17.1	
Follow-up	22.4	19.8	19.9	17.3	17.6	12.2	
Post – Baseline	-5.8	7.2	-5.1	10.1	-13.2	16.9	0.020
Follow-up –Baseline	-5.2	8.6	-6.1	10.5	-14	18.3	<0.001

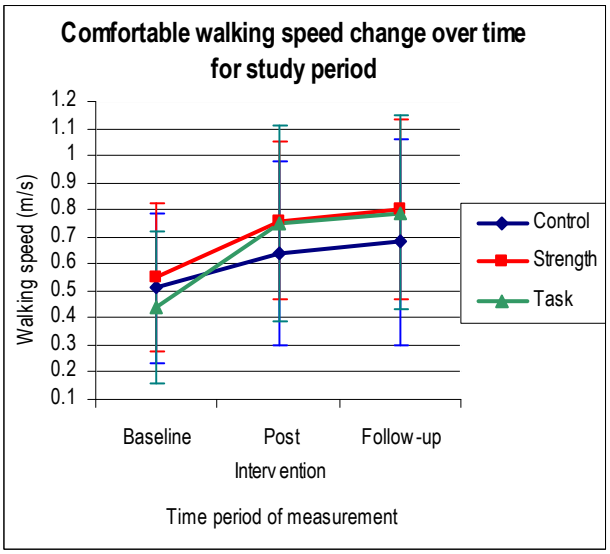
Berg Balance Scale(/56)							
Baseline	42	11	44	9	40	12	0.16
Post intervention	46	10	50	9	49	7	
Follow-up	47	10.7	51	6.7	50	6.7	
Post – Baseline	4.5	4.7	5.4	5	9	7.8	0.001
Follow-up –Baseline	5.0	4.6	7.0	6.2	9.8	8.6	0.002

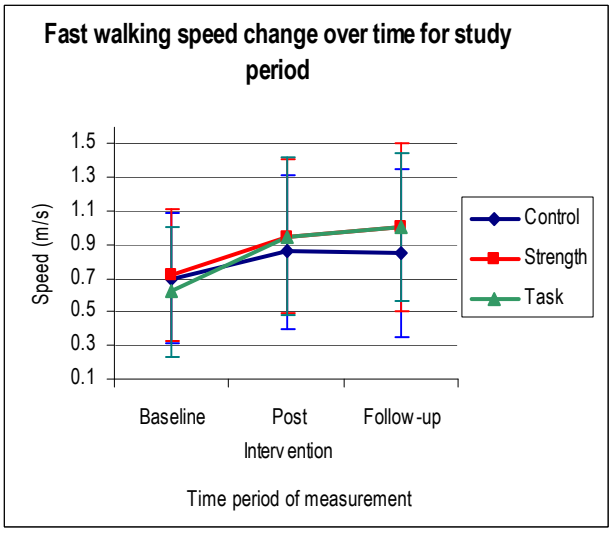
P^a = p value for comparison of control, strength and task data using analysis of covariance with covariate set to mean for each measure at baseline

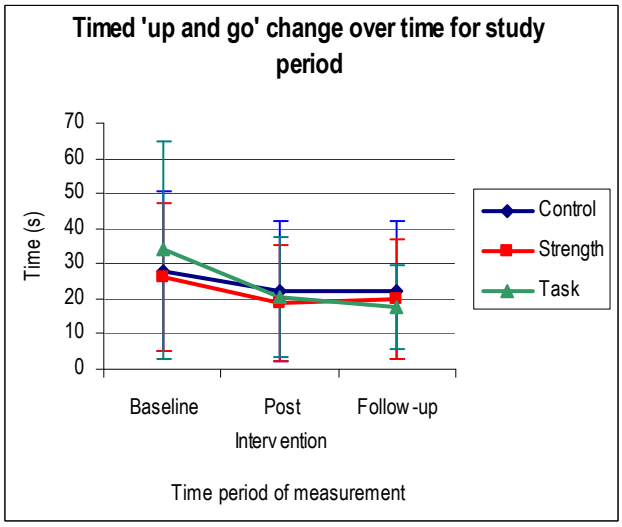
7.6.1 Change Over Time in Patient Walking competency Scores for Study Period

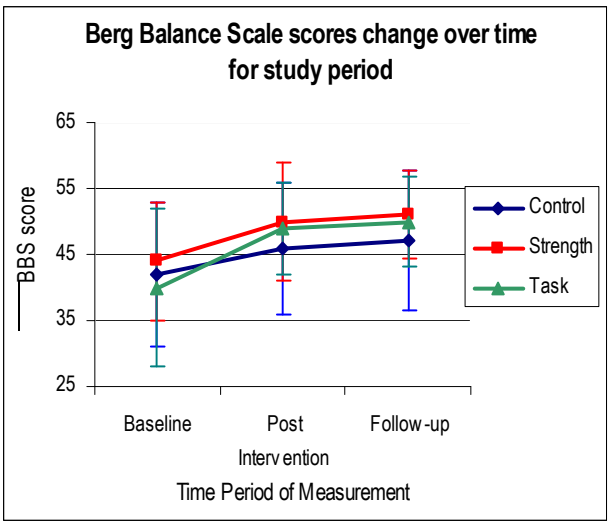
The results are shown on time series plot graphs in figure 7.4 below.











For the TUG above, the time (s) taken to complete the task is shown on the y-axis. Thus a curve that slopes downward represents an improvement in the time taken.

Figure 7.4: Change Over Time in Measures of Walking competency during Study Period (n=144)

All three intervention groups showed improvements in the 6MWT, comfortable and maximum walking speed, TUG and the BBS scores after the interventions. All three groups continued to improve from post intervention to the follow-up on the 6MWT and comfortable walking speed. The task group continued to improve on all the measures between the post intervention and follow-up evaluations.

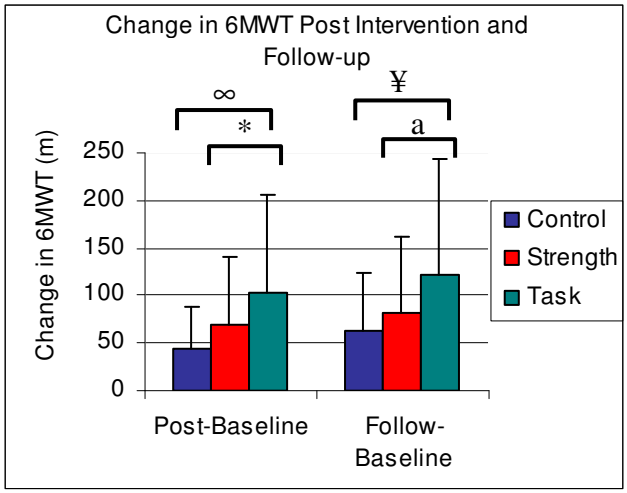
The increase in the distance covered on the 6MWT was on average 64% in the task group and 36% and 23%, respectively, in the strength-training and control groups post intervention.

The change in gait speed from baseline to post intervention in the task group represented a 73% increase in comfortable gait speed while the strength-training and control groups had increases of 35% and 25%, respectively.

An analysis of the differences in performance among the groups for the different measures at the 3 time points is given in Section 7.6.2 below.

7.6.2 Differences in Walking Competency Results among the Groups Post-Intervention and at the Six Month Follow-Up Evaluation

The mean change scores for the measures of walking competency for each intervention group from baseline to post intervention, and from baseline to six months post intervention are shown in figures 7.5 to 7.9 below. Comparisons of these change scores (objective one, two and three), were used to determine if there were statistically and clinically significant differences among the groups in terms of the amount of change from baseline to post intervention and from baseline to follow-up.



∞ = Significant baseline to post intervention changes p <0.001

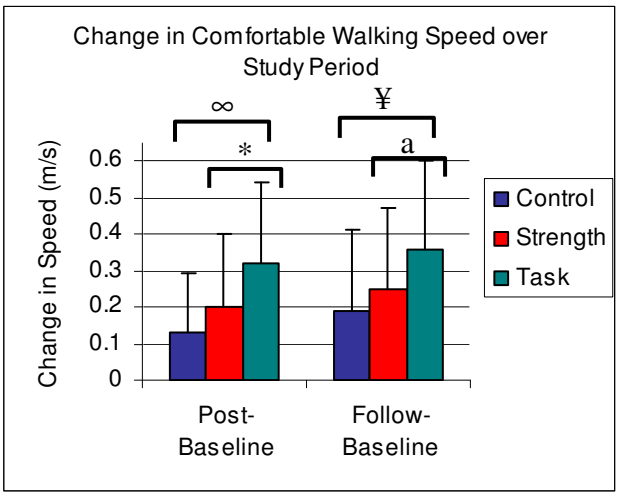
¥ = Significant baseline to follow-up changes p <0.001

* = Significant baseline to post intervention changes p = 0.02

a = Significant baseline to follow-up changes p = 0.02

Figure 7.5: Mean Change by Group in 6MWT (n =144)

The task group had the greatest improvement in performance on the 6MWT. The distance walked was significantly longer than both the strength and control groups post intervention and at the follow up. This group improved a mean of 33m and 59m more than the strength and control groups, respectively, post intervention. At the follow -up six months post intervention the task group improved a mean of 41m more than the strength group and 60m more than the control group. There was no significant difference in the improvement in the distance walked on the 6MWT between the strength and control group post intervention and at follow-up.



∞ = Significant baseline to post intervention changes $p < 0.001$

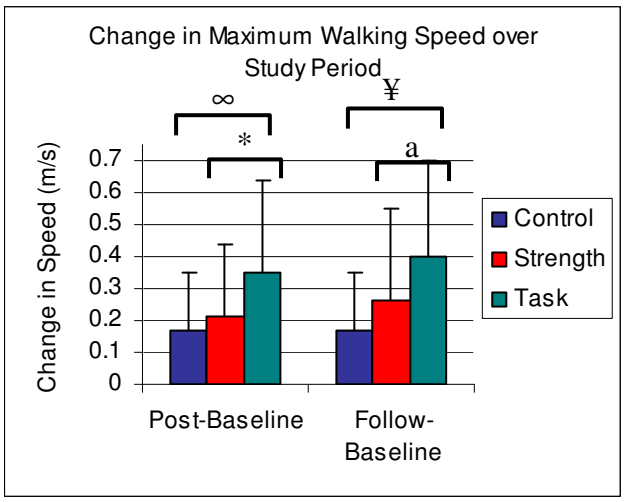
¥ = Significant baseline to follow-up changes $p = 0.006$

* = Significant baseline to post intervention changes $p = 0.002$

a = Significant baseline to follow-up changes $p = 0.03$

Figure 7.6: Mean Change by Group for Comfortable 10MWT (n=144)

All three treatment intervention groups improved in comfortable walking speed over the study period, with the largest gain in the task group. Subjects in the task group increased their comfortable walking speed by an average of 0.12m/s more than the strength group and 0.19m/s more than the control group, post intervention. At the follow up the task group had a significant increase of 0.11m/s and 0.17m/s in comfortable gait speed when compared to the strength and control groups, respectively. There was no significant difference in the improvement in comfortable walking speed between the strength and control group post intervention and at follow-up.



∞ = Significant baseline to post intervention changes $p < 0.001$

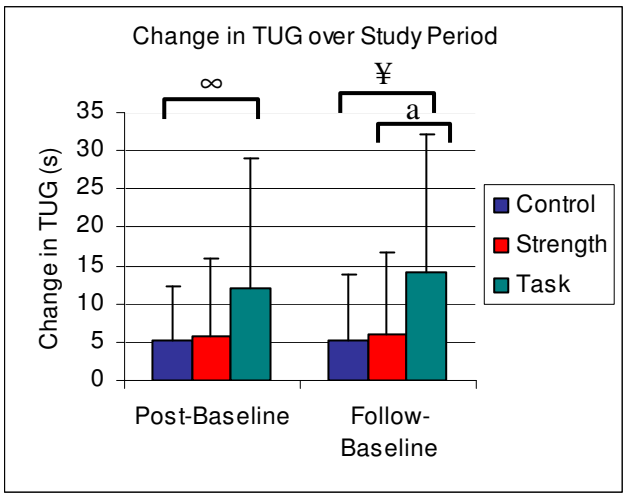
¥ = Significant baseline to follow-up changes $p < 0.001$

* = Significant baseline to post intervention changes $p = 0.01$

a = Significant baseline to follow-up changes $p = 0.03$

Figure 7.7: Change by Group for Maximum 10MWT (n =144)

The task intervention resulted in improvements that were significantly larger than for the other two groups in maximum walking speed post intervention and at follow-up. Post intervention, maximum walking speed for the task group was 0.14m/s and 0.18m/s more than that of the strength and control groups, respectively. At follow up, the increase in maximum walking speed was 0.22m/s and 0.14m/s more than that of the control and strength groups, respectively. There was no significant difference in the improvement in maximum walking speed between the strength and control group post intervention and at follow-up.



Scoring on the timed 'up and go' is according to the amount of time taken to complete the task. The TUG value on the y- axis represents an improvement in time taken to complete the task.

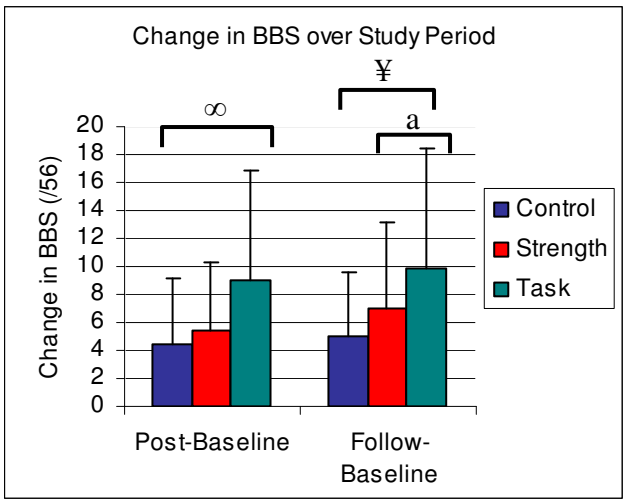
∞ = Significant baseline to post intervention changes p = 0.007

¥ = Significant baseline to follow-up changes p < 0.001

a = Significant baseline to follow-up changes p = 0.002

Figure 7.8: Change by Group for Timed 'Up and Go' (TUG) (n=144)

The task group improved significantly more than both the control and the strength groups on the TUG at the follow –up evaluation. There was no significant difference between the task and the strength group post intervention while the task group improved an average of 6.9s more than the control post intervention. The task intervention group continued to improve at follow-up with an average decrease of 7.9s and 8.8s more than the strength and control groups, respectively. There was no significant difference in the improvement in the time taken to complete the TUG between the strength and control group post intervention and at follow-up.



∞ = Significant baseline to post intervention changes $p < 0.001$

¥ = Significant baseline to follow-up changes $p < 0.001$

a = Significant baseline to follow-up changes $p = 0.02$

Figure 7.9: Change by Group on the Berg Balance Scale (n =144)

The task group improved significantly more than both the control and the strength groups on the BBS at the follow-up evaluation. The task group improved by 4.5 points more than the control group post intervention. There was no difference between the task and the strength group post intervention and they did not improve at follow-up while the task intervention group continued to improve at follow-up with an average increase of 2.8 and 4.8 points more than the strength and control groups, respectively. There was no significant difference in the improvement in BBS between the strength and control group post intervention and at follow-up.

7.7 PERCENTAGE OF SUBJECTS IN THE THREE INTERVENTION GROUPS WHO ATTAINED A CHANGE GREATER THAN THE MCID ON THE MEASURES OF WALKING COMPETENCY POST INTERVENTION

The following analysis sought to determine the number of subjects in each group who, post intervention, had a change in the measures of walking competency that indicated an improvement equal to or great than MCID and thus considered to be a minimal clinically important difference. The references to the respective MCID values selected for each measure can be found in Chapter 3 (Outcome Measures). These results presented as frequencies and percentages are shown in Table 7.3 below.

Table 7.4: Percentage of Subjects in the Three Intervention Groups who Attained a Change Greater than the MCID on the Measures of Walking Competency Post Intervention

Outcome Measure: MCID	Control n = 43 No: (%)	Strength n = 41 No: (%)	Task n = 45 No: (%)	Total n = 144 No: (%)
Δ6MWT(m): ≥ 28m	22 (51.2)	31 (77.5)	40 (88.9)	93 (64.6)
ΔComfortable 10MWT(m/s): ≥ 0.16m/s	13 (30.2)	19 (47.5)	29 (64.5)	61 (42.4)
ΔTUG(s): ≥2.9s	20 (46.5)	28 (68.3)	39 (86.7)	87 (60.4)
ΔBBS (/56): ≥ 6 points	16 (37.2)	19 (46.3)	27 (60.0)	62 (43.1)

As shown in Table 7.3 above, there were subjects from all three intervention groups who improved on the outcome measures more than an amount that is considered clinically meaningful. However a greater proportion of subjects from the task group (88.9%) had a change in the distance covered on the 6MWT, reflecting a clinically important difference ≥ 28m. Similarly a greater percentage of subjects from the task group improved their time taken to complete the comfortable 10MWT (64.5%) and the TUG (86.7%) test post intervention. In addition 60% of the task group subjects improved their functional balance as measured with the BBS, reflected by an increase of ≥ 6 points on the BBS.

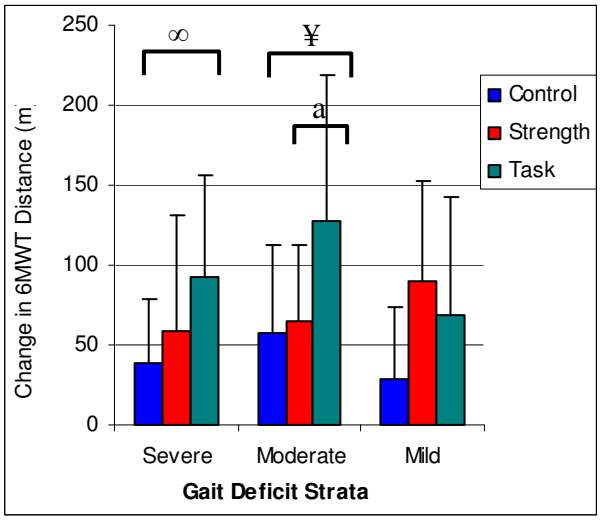
7.8 MEAN CHANGE IN MEASURES OF WALKING COMPETENCY POST INTERVENTION WITHIN EACH STRATUM OF THE INTERVENTION GROUPS

The severity of the walking deficit was determined at baseline in terms of the comfortable gait speed at which the subjects walked. Subjects in stratum 1 who walked at a comfortable gait speed <0.4m/s at baseline had a severe gait deficit (most likely to be household ambulators), those in stratum 2 walked at a speed between 0.4 - 0.8m/s were considered to have a moderate deficit (limited community ambulators), while those in stratum 3 who walked at a speed ≥ 0.8m/s were considered to have a mild gait deficit [community ambulators (Perry et al., 1995)].

The mean change scores for the different measures of walking competency for each stratum from baseline to post intervention are shown in figures 7.9 to 7.13 below. These results, aimed to determine if there was a statistically and clinically significant difference among the strata in terms of the amount of change as a result of the interventions.

7.8.1 Mean Change in 6MWT by Group within Each Stratum Post Intervention

This is illustrated in figure 7.10 below.



∞ = Significant baseline to post intervention changes in severe gait deficit stratum p = 0.01

¥ = Significant baseline to post intervention changes in moderate gait deficit stratum p = 0.009

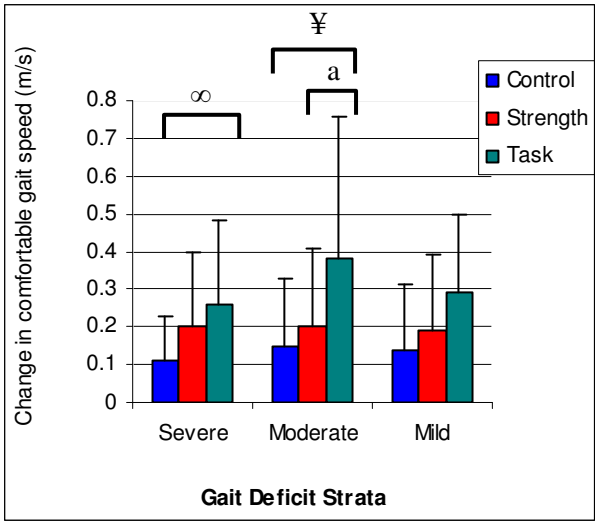
a = Significant baseline to post intervention changes in moderate gait deficit stratum p = 0.03

Figure 7.10: Change in 6MWT by Group within Each Stratum Post Intervention

Subjects with a severe gait deficit in the task group improved 54m more (p = 0.01) than the control group. There was no significant difference, however, in the distance walked between the task and the strength group, or between the strength and the control groups in the severe stratum. The average increase in the distance walked (MCID = 28m) by the subjects in the task group in the moderate stratum was 63m (p = 0.03) and 72m (p = 0.009) more than strength and control groups, respectively, post intervention. There was no significant difference in the improvement in the distance walked among the groups for mild deficit stratum post intervention. In addition there was no significant difference in the distance walked between the strength and control groups for all three strata.

7.8.2 Mean Change in Comfortable Walking Speed (10MWT) by Group within Each Stratum Post Intervention

This is illustrated in figure 7.11 below.



∞ = Significant baseline to post intervention changes in severe gait deficit stratum p = 0.03

¥ = Significant baseline to post intervention changes in moderate gait deficit stratum p = 0.001

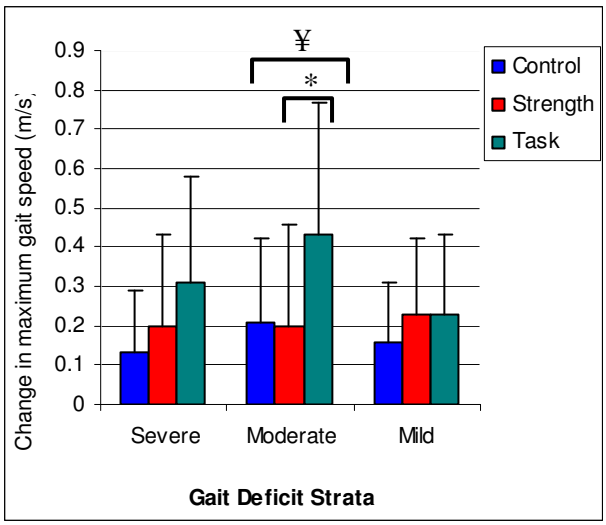
a = Significant baseline to post intervention changes in moderate gait deficit stratum p = 0.01

Figure 7.11: Change in Comfortable Walking Speed in the 10MWT by Group within Each Stratum Post Intervention

In the severe gait deficit stratum the task group improved their comfortable walking speed by 0.25m/s (p = 0.03) more than the control group. There was no significant difference between the task and the strength group in this stratum. The average change in the task group's comfortable walking speed (MCID =0.16m/s) in the moderate stratum was 0.18m/s (p = 0.01) and 0.23m/s (p = 0.001) more than strength and control groups, respectively, post intervention. There was no significant difference in the improvement in comfortable walking speed among the groups for mild deficit stratum post intervention. In addition there was no significant difference between the strength and control groups for all three strata.

7.8.3 Mean Change in Maximum Walking Speed (10MWT) by Group within Each Stratum Post Intervention

This is illustrated in figure 7.12 below.



¥ = Significant baseline to post intervention changes in moderate gait deficit stratum p = 0.02

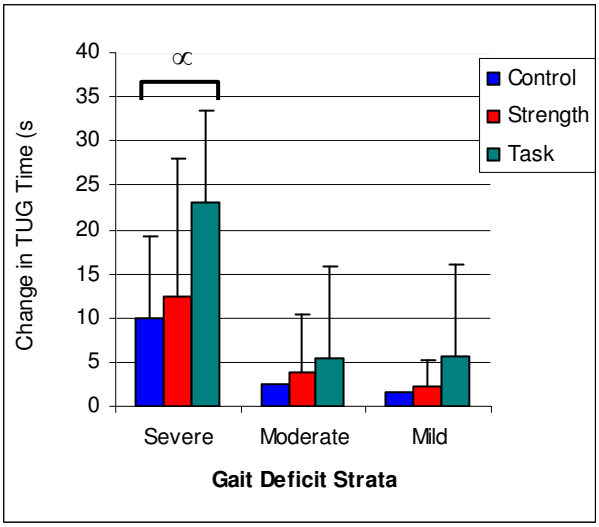
* = Significant baseline to post intervention changes in moderate gait deficit stratum p = 0.02

Figure 7.12: Change in Maximum Walking Speed (10MWT) by Group Within Each Stratum Post Intervention

The average change in the task group's maximum walking speed in the moderate stratum was 0.23m/s (p = 0.02) and 0.22m/s (p = 0.02) more than strength and control groups, respectively, post intervention. There was no significant difference in the improvement in maximum walking speed among the groups for both the severe and mild deficit strata post intervention. In addition there was no significant difference between the strength and control groups for all three strata.

7.8.4 Mean Change in Time to Perform the TUG by Group within Each Stratum Post Intervention

This is illustrated in figure 7.13 below.



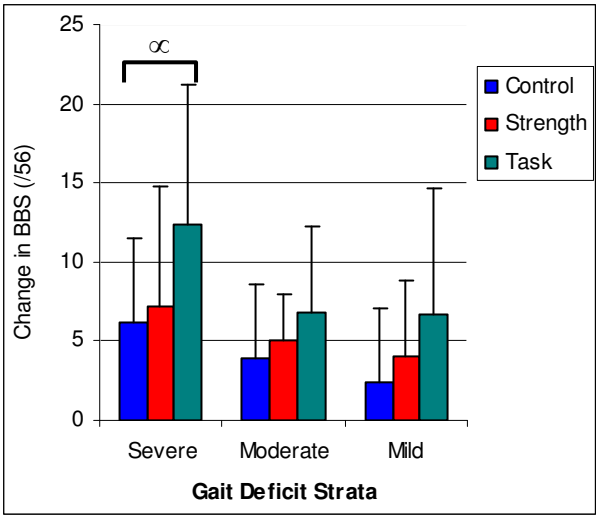
∞= Significant baseline to post intervention changes in severe gait deficit stratum p = 0.04

Figure 7.13: Change in TUG by Group within Each Stratum Post Intervention

Subjects in the severe gait deficit stratum in the task group improved (time decreased) by 13s (p=0.04) more than the control group but did not improve more than the strength group post intervention. There were no significant differences among the groups for the moderate and mild gait deficit strata

7.8.5 Mean Change in Berg Balance Scale score (BBS) by Group within Each Stratum Post Intervention

This is illustrated in figure 7.14 below.



∞ = Significant baseline to post intervention changes in severe gait deficit stratum p = 0.02

Figure 7.14: Change in BBS Score by Group within Each Stratum Post Intervention

Similarly to the TUG there were no significant differences among the groups for the moderate and mild gait deficit strata. In the severe gait deficit stratum the task group (p=0.02) improved their score on the BBS by 6.2 points (MCID =6; Stevensen et al., 2001) more than the control group but not the strength group post intervention.

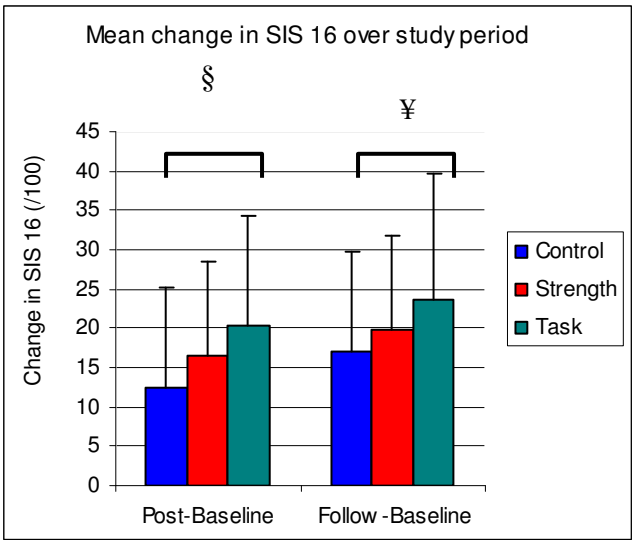
7.9 SUMMARY OF THE IMPACT OF THE INTERVENTIONS ON SELF-REPORTED PHYSICAL FUNCTIONING MEASURED BY THE STROKE IMPACT SCALE 16 (SIS16)

The results in this section focus on objective five, to establish the effect of a once a week task oriented training programme for six sessions on physical functioning post stroke.
The SIS16 scores are given as mean and standard deviation for each group in Table 7.4 below.

Table 7.5: Perceived Quality of Life as Measured by the SIS16 over the Study Period (n=144)

	Control n=48 Mean (sd)		**Strength n=45** Mean (sd)		**Task n=51** Mean (sd)	
SIS 16 Baseline	57.1	13.8	59.7	12.5	55.6	14.8
SIS 16 Post Intervention	69.1	15.9	77.1	14.5	75.5	15.6
SIS 16 Follow-up	73.3	16.0	80.4	14.7	79.0	15.8

All three treatment intervention groups improved their score on the SIS 16 over the course of the study period. Statistical differences among the groups from baseline to post intervention and baseline to follow up are shown in figure 7.15 below.



§ = Significant baseline to post intervention p = 0.007

¥ = Significant baseline to follow -up p = 0.04

Figure 7.15 Stroke Impact Scale between Group Differences Post Intervention

The task group improved 7.71 (p=0.007) and 6.49 (p=0.04) points (MCID 9.4 -14.1 points; Fulk et al., 2010) more than the control group post intervention and at follow-up, respectively. There were no significant differences between the task and strength groups and the strength and control groups post intervention or at the follow-up.

7.10 PERCENTAGE OF SUBJECTS IN THE THREE INTERVENTION GROUPS WHO ATTAINED A CHANGE GREATER THAN THE MCID ON THE MEASURES OF WALKING COMPETENCY POST INTERVENTION

The following analysis sought to determine the number of subjects in each group who, post intervention, had a change in the measures of walking competency that indicated an improvement equal to or great than MCID and thus considered to be a minimal clinically important difference. The references to the respective MCID values selected for each measure

can be found in Chapter 3 (Outcome Measures). These results presented as frequencies and percentages are shown in Table 7.5 below.

Table 7.6: Percentage of Subjects in the Three Intervention Groups who attained a Change Greater than the MCID on the SIS 16 Post Intervention

Outcome Measure: MCID	Control n = 43 No: (%)	Strength n = 41 No: (%)	Task n = 45 No: (%)	Total n = 144 No: (%)
ΔSIS16 (/100): ≥ 9.4 points	24 (55.8)	30 (73.2)	35 (77.8)	89 (61.8)

When looking at impact of the interventions on self-reported physical functioning measured by the SIS 16, a similarly greater proportion of subjects from the strength and the task group improved by 9.4 points on the SIS16 compared with the control group. Fewer subjects from the control group than the strength and task groups had a change in the measures of walking competency that indicated a clinically meaningful improvement.

7.11 SUMMARY OF OUTCOMES POST INTERVENTION AND AT THE SIX MONTHS FOLLOW-UP FOR HIV SERO-POSITIVE PATIENTS

The results of this section relate to objective six to determine if there were any differences in the treatment effect between subjects that were known to be sero-positive (HIV +ve) to the HIV virus and those that were thought to be sero-negative (HIV -ve) to the HIV virus. These results are presented in Table 7.6 below.

Table 7.7: Change Scores (Post – Pre) between HIV +ve (n=27) and HIV -ve (n=101) Subjects' Results within Each Group on Measures of Walking competency (n=128)

Measure	Control (n=43) Post – Pre Mean (sd)	p	Strength (n=40) Post – Pre Mean (sd)	p	Task (n=45) Post – Pre Mean (sd)	P
6MWT (m)						
HIV +ve	47(±50)		91(±54)		90(±78)	
HIV –ve	43(±49)	0.8	64(±62)	0.28	104(±80)	0.7
Comfortable walking speed: 10MWT(m/s)						
HIV +ve	0.14(±0.14)	0.7	0.23(±0.2)	0.4	0.28(±0.18)	0.5
HIV –ve	0.13(±0.16)		0.19(±0.2)		0.33(±0.23)	

Table 7.7 continued

Maximum walking speed: 10MWT(m/s) **HIV +ve** **HIV –ve**	 0.14(±0.16) 0.17(±0.19)	 0.7	 0.22(±0.15) 0.21(±0.24)	 0.6	 0.36(±0.38) 0.35(±0.29)	 0.8
TUG (s) **HIV +ve** **HIV –ve**	 5.9(±7.7) 4.9(±7.2)	 0.9	 0.3(±10.5) 7.2(±6.6)	 0.14	 0.5(±4.6) 13.5(±17.3)	 0.13
Berg Balance Scale(/56) **HIV +ve** **HIV –ve**	 4.6(±6.3) 4.5(±4.3)	 0.9	 5.8(±4.7) 3.9(±5.8)	 0.5	 9.8(±8) 3.4(±2.1)	 0.47

There were no significant differences among the groups in the change scores for the different walking competency measures between the HIV seropositive and HIV seronegative subjects.

Table 7.8: Summary of Significant between Group Differences in Outcome Measures in Study 3

Change in Outcome Measures	Task vs Strength	Task vs Control	Strength vs Control
6MWT(m) **Post – Baseline**	* (p<0.001)	*(p<0.02)	NS
Follow – Baseline	*(p<0.001)	*(p<0.02)	NS
Comfortable Gait Speed(m/s) **Post – Baseline**	*(p<0.001)	*(p=0.002)	NS
Follow – Baseline	*(p=0.006)	*(p=0.03)	NS
Fast Gait Speed (m/s) **Post – Baseline**	*(p<0.001)	*(p=0.001)	NS
Follow – Baseline	*(p<0.001)	*(p=0.003)	NS
TUG(s) **Post – Baseline**	NS	*(p=0.007)	NS
Follow – Baseline	*(p<0.001)	*(p=0.002)	NS
BBS (/56) **Post – Baseline**	NS	*(p<0.001)	NS
Follow – Baseline	*(p<0.001)	*(p=0.02)	NS
SIS1 6 (/100) **Post – Baseline**	NS	*(p=0.007)	NS
Follow – Baseline	NS	*(p=0.04)	NS

* - Asterisk represents the statistically significant between group differences

NS - Represents no significant between group differences

These results for the objectives of the study are discussed in detail in Chapter 8: Discussion.

CHAPTER 8

8. DISCUSSION

8.1 INTRODUCTION

The results of this study will be discussed in detail in this chapter. The main outcomes will be discussed under the following headings to meet the objectives as laid out in Chapter 6:

8.2 The impact of task training on:
8.2.1 Walking competency
8.2.2 Walking endurance
8.2.3 Gait speed
8.2.4 Functional mobility and balance
8.2.5 Health status in terms of physical functioning
8.3 The long term effect of task training six months post intervention
8.4 The impact of stroke severity on recovery
8.5 Findings in HIV +ve subjects post stroke
8.6 Implications of findings for the patient
8.7 Implications of findings for clinical practice in RSA
8.8 Implications of findings for future research in RSA
8.9 Sample size selection and demographics
8.10 Conclusion

8.2 THE IMPACT OF TASK TRAINING

8.2.1 The Impact of Task Training on Walking Competency

In this study we evaluated the use of an out-patient based task oriented group circuit training programme to promote improvements in walking competency which included walking endurance, gait speed, functional balance and mobility in persons in the sub-acute phase of rehabilitation post stroke. This intervention was conducted in the public healthcare sector in South Africa and compared the task group with two control groups: 1) a strength training group and 2) a control group receiving one multidisciplinary education session (referred to as the control group). For stroke survivors living in the community at six months post intervention, the task intervention led to significantly greater gains in walking endurance and gait speed than the other two groups. While post intervention, the task training led to superior gains in functional mobility and balance compared to the control group, it was not superior to the strength group.

The strength and the task groups had the same amount of time engaged in training (60 minutes) and the same number of treatment sessions (6 sessions) during the intervention. These two groups were comparable at baseline and were on average eight weeks post stroke (beyond the initial period of rapid spontaneous recovery; Duncan et al., 2000; Kwakkel et al., 1999). Thus it is clear that the significant differences in walking endurance and gait speed between these two groups likely reflect the greater effectiveness of the task group's programme, and not the mere physical exertion of getting to and from therapy sessions. In contrast, the control group received one three-hour education session, and thus changes in this group were probably due to spontaneous recovery and activities related to daily life (non - directed recovery).

While the strength group received a more frequent and intensive training compared with the control group, there were no significant differences in terms of walking competency between these two groups over the study period. This is in line with the lack of evidence supporting the relationship between progressive resistance strength training in non -weight bearing tasks and improvements in functional walking ability (Pohl et al., 2002; Kim et al., 2001). This lack of difference could be explained by the fact that therapeutic gains in strength do not automatically result in significant gains in measures of walking performance (van de Port et al., 2007; Morris et al., 2004; Kim et al., 2001). When strength training programmes are conducted in combination with endurance training and with a task oriented approach, significant between group differences have been noted in walking endurance and speed (Yang et al., 2007; Macko et al., 2005; Duncan et al., 2003). Gait task oriented training has the added benefit that it can be designed to promote muscle strengthening when practicing activities related to walking (Hesse et al., 2003; Carr and Shepherd, 1999). In addition, tasks can be designed to enhance gait balance and endurance as done in this study.

Stroke survivors who show improvements in walking are not necessarily competent community walkers (Lord et al., 2004; Perry et al., 1995). The ability to walk competently in the community (community ambulation) has been expressed as the ability to walk at adequate speeds to cross a street safely, with balance control that allows one to turn and look in different directions while walking. This includes the ability to cope with perturbations, demonstrate an ability to anticipate and avoid obstacles and accommodate to environmental changes (Lord et al., 2004; Salbach et al., 2004; Shumway-Cooke and Woollacott, 2001; Patla and Shumway-Cooke, 1999; Patla, 1997). Community ambulation also involves walking outdoors and performing activities that are necessary in order to live independently, e.g. visiting a bank, pharmacy or supermarket (Lord

et al., 2004). Walking competency could thus be expressed as the combination of walking endurance, gait speed, functional balance and mobility. The task group in this study showed a significant improvement in all four of these areas at six months post intervention, thus improving walking competency post stroke. The results of the groups on the measures of walking competency will be discussed below in more detail.

8.2.2 The Impact of Task Training on Walking Endurance

There is some discussion regarding the precise distances required to walk competently in the community (community ambulation), for example distances that are adequate to walk to the bank, pharmacy or supermarket (Lord et al., 2004). On the whole the longest distances required for community ambulation is in large shopping malls or superstores, which is approximately a distance of 600m without needing to sit down (Andrews et al., 2010; Brown et al., 2010). For the purposes of going to the bank, post office or a pharmacy it is felt that a distance of 200m is necessary (Andrews et al., 2010; Brown et al., 2010).

There have been no studies conducted in South Africa to determine the distance and walking speed requirements for community ambulation. In South Africa a large proportion of the population do not own cars and use local taxis to get around the community. As a result they frequently have to cross the street to catch the taxi. Thus a distance of ≥ 28m, which is the distance of a pedestrian crossing at a traffic light in a commercial area (Lerner-Frankiel et al., 1986), can be used as the distance indicating a meaningful improvement in distance walked. Thus this distance was selected as an appropriate measure of a clinically meaningful change in walking endurance for the current study (Lerner-Frankiel et al., 1986).

In this study a greater number of subjects from the task group (88.9%) than the strength (77.5%) and control (51.2%) groups, improved the distance covered on the 6MWT by ≥ 28m, indicating a clinically meaningful improvement post intervention. These results support the findings of previous studies that have shown significant effects of task training on walking endurance in sub-acute stroke (Outermans et al., 2010; Blennerhassett and Dite, 2004; Eich et al., 2004; Duncan et al., 2003).

A circuit task training programme can be an intensive treatment session and may incorporate endurance training. The only rest period subjects got in this study was during the change over time between exercise stations. The task programme in this study included an endurance walking station and a home programme of progressively increasing endurance walking in the

community. These factors combined provided a certain degree of cardiovascular endurance training for the subjects in the task group. The present results support the evidence that cardiovascular endurance training is beneficial in improving one's walking endurance and speed (Pang et al., 2006; Eng et al., 2004). This may have contributed to the greater gains the task group made compared with the other two groups in terms of walking endurance and speed over the study period.

Over the last decade there have been a number of studies exploring the benefits of treadmill training on walking endurance and gait speed as a form of task oriented training with or without body-weight support in sub-acute stroke cohorts (Duncan et al., 2011; Franceschini et al., 2009; Eich et al., 2004; Richards et al., 2004; Nilson et al., 2001;). None of these, however, has shown significant between group differences in favour of treadmill training for ambulant persons with stroke. The present study was conducted at Helen Joseph Hospital (HJH), a public hospital that does not have a treadmill in the physiotherapy department. Although used in many studies, treadmill walking could not be included as one of the circuit stations, because the use of treadmills for gait rehabilitation in South Africa is not a resource- efficient or feasible option. Since previous studies have shown that treadmill training for sub-acute ambulant stroke survivors is not superior to other forms of endurance walking, a continuous over ground walking station, where the distance covered was progressed weekly, was included as one of the circuit stations in this study. As indicated by the significant gains in walking endurance by the task group, this strategy was successful.

8.2.3 **The Impact of Task Training on Gait Speed**

Measurement of gait speed has long been used as an indicator of recovery post stroke (Richards et al., 1992; Wade., 1992; Wade et al., 1987) and more recently used to classify a patient's walking ability into one of three categories (Bowden et al., 2008; Perry et al., 1995):

- < 0.4 m/s severe gait deficit (household ambulators)
- 0.4 - <0.8 m/s moderate gait deficit (limited community ambulators)
- ≥ 0.8 m/s mild gait deficit (community ambulators).

The literature suggests that the prognosis for walking recovery post stroke is quite favourable in due course (Kwakkel et al., 1999). It has also identified that only seven percent of those discharged from rehabilitation after a stroke (Hill et al., 1997), achieve a walking speed that meets the criteria for community walking. In this study, a greater percentage of subjects in the task group (48.9%) changed their walking impairment category post intervention than the

strength (34.1%) and control (25.6%) groups. Only 39.6% of the total number of subjects in this study walked at a speed greater than 0.8m/s post intervention. This finding agrees with the statement that many stroke survivors never achieve walking speeds that are adequate to efficiently become community ambulators (Duncan and Lai et al., 1997).

An increase in comfortable gait speed by 0.16m/s has been shown to represent a minimal clinically important difference [MCID (Tilson et al., 2010)]. In this study a greater number of subjects from the task group (64.5%) than the strength (47.5%) and control (30.2%) groups, improved their gait speed more than the MCID, indicating a clinically meaningful improvement post intervention. These results support the findings of previous studies that have shown significant effects of task training on gait speed in sub-acute stroke (Rose et al., 2011; Outermans et al., 2010; Eich et al., 2004; Duncan et al., 2003).

Given that greater intensities of rehabilitation (in terms of duration and frequency) are usually associated with better outcomes (Kwakkel et al., 2004; Teasell et al., 2004; Kwakkel et al., 1999; Langhorne et al., 1996), it is likely that by increasing the frequency of the task training in this study from once per week to three times a week may lead to; first, a greater number of subjects changing their walking impairment category post intervention, and secondly, more subjects would attain a walking speed post intervention exceeding 0.8m/s, which ultimately reflects independent community ambulation.

Subjects in the task and strength groups in this study had a total of 12 weeks in which to complete six sessions. This appears to be the first study conducted with such a limited rehabilitative intervention post stroke. In addition these subjects did not receive a period of in-patient rehabilitation prior to their inclusion in this study. The intensity of the “package” of physiotherapy post stroke varies considerably throughout the world. This ranges from patients who are discharged without any rehabilitation as soon as they are medically stable (Mudzi, 2009; Wasserman et al., 2009), to others receiving in-patient rehabilitation for several weeks (English et al., 2007; Blennerhassett and Dite, 2004; Eich et al., 2004; Nilsson et al., 2001; Malouin et al., 1993). More time dedicated to learning a specific skill has been associated with improving performance in sports (Helsen-Starkes and Hodges, 1998) and in playing a musical instrument (Ericsson, 2004). In the same manner the findings of Kwakkel et al., (2004) reported that during the first six months post stroke, to obtain a significant change in ADL and gait speed, an additional 16 hours difference in training time between experimental and control groups is required. Considering these findings, no significant difference among the groups in

terms of gait speed in the current study would have been expected. The extremely limited number of sessions of task training in this study nevertheless, resulted in significant improvements in walking endurance and speed post intervention compared to the control group that spent less time engaged in training.

8.2.3.1 **Study Considerations**

There are considerable variations in the total amount of time spent engaged in training among task training studies to date. Sub-acute trials have ranged from 20 sessions to as much as 50 sessions (Duncan et al., 2011; Franceschini et al., 2009; Sullivan et al., 2007; Blennerhassett and Dite., 2004; Richard et al., 2004; Duncan et al., 2003; Nilsson et al., 2001). The frequency of therapy sessions has also varied considerably, ranging from three sessions per week (out patient based studies) to five sessions per week (in-patient based studies). It would have been extremely difficult for a large proportion of stroke survivors in the community in the current study to attend out patient physiotherapy three to five times per week (due to transport difficulties and limited availability of rehabilitation services). In certain instances even once per week was difficult. It is thus remarkable that the meaningful results in this study have shown that even a limited intensity of task training produced significant improvements in walking competency at the six month follow-up, compared with the strength group that received the same intensity of therapy and the control that received about 1/6 of the intervention intensity.

While the treatment intervention in numerous other task training studies (Duncan et al., 2011; Franceschini et al., 2009; Sullivan et al., 2007; Blennerhassett and Dite., 2004; Richard et al., 2004; Duncan et al., 2003; Nilsson et al., 2001) was far more intensive, the subjects with stroke in this study were younger by as much as 10-20 years. Age alone is a significant predictor of total functional independence at discharge (Bagg et al., 2002). Younger stroke survivors have been shown to have a more complete recovery (Kugler et al., 2003). The mean age in the study by Blennerhassett and Dite (55 years) and this study (50 years) was 10 - 20 years less when compared with other studies (Duncan et al., 2011; Rose et al., 2011; Eich et al., 2004; Richards et al., 2004; Duncan et al., 2003; Nillson et al., 2001). The younger age of the subjects in this study, likely explains in part the amount of improvement found in the task group that was greater than that reported in other sub-acute stroke task training studies (Rose et al., 2011; Duncan et al., 2003), and comparable to the improvements reported in studies with higher training intensities (Duncan et al., 2011; Eich et al., 2004; Richards et al., 2004; Nilson et al., 2001).

The younger age in this study supports the findings that stroke occurs at much younger ages in Sub-Saharan Africa, possibly 10-15 years earlier than in developed countries (Connor et al., 2004). The impact of HIV associated vasculopathy is recognized as contributing to the increased prevalence of stroke in younger patients (Tipping et al., 2007) and is an independent risk factor for stroke (Cole et al., 2004). HIV was the third most common risk factor in this study with 27 (19%) of the subjects were HIV +ve at the baseline evaluation, confirming the additional contribution of HIV as a risk factor for stroke and the increased prevalence of younger persons with stroke (Reid et al., 2005).

Length of in-patient rehabilitation post stroke is one of the determinants of functional outcome (Jorgensen et al., 1997). The average patient length of hospital stay in this study was 16-17 days at the three public hospitals in Central Gauteng which was comparable to that found by two previous studies at CHB Hospital (Hale, 2002; Fearnhead, 2006). This length of stay can be explained in part, by the increasing admissions in hospitals due to the HIV/AIDS pandemic, which has resulted in increased pressure for beds (Gilks et al 1998, Colvin et al., 2001; Reid et al., 2005; Veenstra and Oyier, 2006). As a result, patients with stroke are discharged as soon as they are medically stable, irrespective of their functional ability. Consequently the prevalence of stroke survivors who require assistance with ADL's in South Africa is higher compared with more developed countries (Wasserman et al., 2009; Green et al., 2005). This finding has been attributed to the limited delivery of rehabilitation services post stroke (Connor et al., 2004). The duration of acute rehabilitation hospital stays worldwide is under pressure due to the extremely high associated costs. As a result, patient hospital rehabilitation length of stay is decreasing worldwide (van de Port et al., 2009; Duncan et al., 2005; Duncan et al., 2003) which likely hinders the attainment of optimal recovery (Paolucci S et al., 2001). Under these circumstances the benefits of the provision of even limited out patient based task oriented training programmes should be investigated, particularly where resources are limited.

A longer length of hospital stay does not necessarily translate into better functional outcomes for patients with stroke. Factors such as the experience, skill and expertise of therapists, intensity of therapy, length of treatment and patient motivation to participate have a significant impact on outcomes attained (Mc Naughton et al., 2005). The task training group in this study was run by a physiotherapist with 18 years of experience treating patients with neurological injuries. The therapist for the task group constantly cued the subjects to perform the tasks as specified. This therapist ensured that subjects were challenged to perform and train at the highest level possible in addition tasks were progressed to ensure they remained challenging

at all times. In contrast the therapist who ran the strength and control groups was less experienced. Thus the experience and skill of the task groups' therapist may have contributed to the success of this group's improvement in walking competency.

The relatively large gains post intervention in the task training group compared to much more intense task training programs previously published (Duncan et al., 2011; Franceschini et al., 2009; Sullivan et al., 2007; Blennerhassett and Dite., 2004; Richards et al., 2004; Duncan et al., 2003; Nilsson et al., 2001) may also in part be related to the living conditions of the subjects in this study. Due to the apartheid history of South Africa there are numerous stroke survivors living in sub-economic situations. This has resulted in a large proportion of black South Africans needing to walk extremely long distances on a daily basis. From a young age, children walk as far as five km to school on a daily basis. In addition, when requiring transport, people walk distances that may range from 800m to as much as three km to catch a local taxi.

Patients discharged from acute care following a stroke are rarely issued with wheelchairs. As a result, if able to walk at all, they have to walk around their immediate environment for their personal needs. Also, many toilet facilities in South Africa are shared and built outside the houses and often a distance from the house, over uneven ground requiring the stroke survivor to walk outside. Day or night nurses are not employed due to the lack of finances, and the stroke survivor may not have adult care-givers around during the day (Hale and Eales, 1998). To attend to basic daily needs means the stroke survivor has no other alternative than to do the tasks themselves – leading to "enforced" rehabilitation (Hale and Eales, 1998). This may also have contributed to the significant improvements in walking endurance and speed of the task group compared with the strength and control groups.

The design of the task group's exercises in this study aimed to mimic the tasks required to meet the environmental demands of community ambulation. As a result the subjects in the task group may have developed the skills necessary to cope with such environmental demands, thus contributing to their significantly greater gains in endurance and speed post intervention and their continued improvement as seen in the follow-up evaluations. The long term changes in performance and beneficial effect of training are achieved when the conditions of task practice are similar to the task and the conditions in which the transfer of performance is expected (Schmidt and Lee, 2005). Thus this "enforced" practice evident in sub-economic levels of living in South Africa may ensure that the desired tasks are practiced on a more continuous basis.

Another factor that no doubt contributes to the large difference in improvement between the task and control group is the fact that South Africa provides a unique situation where treatment interventions can be compared with a control group that does not receive any other rehabilitative input and has not received any prior to the study. As a result the amount of change following the treatment intervention may appear greater than if compared with a control that is also receiving or has received some previous treatment intervention

Education and social support have a positive impact on functional status, thus empowering the subjects' caregivers which may impact on their QOL (Hilari et al., 2010; Kim et al., 1999). Education can improve knowledge about the consequences of stroke. In addition, it can provide positive solutions to problems they may experience (Rodgers et al., 1999; Houts et al., 1996). Stroke survivors should be encouraged to have their carer, family member or a friend accompany them to therapy sessions. This facilitates the subject's involvement in tasks which may have been unsafe without supervision and assistance. The success of the task group in this study depended on the assistance of the caregivers in the sessions. Caution is necessary when interpreting the role of the caregiver as their role was not evaluated in this study. The caregivers may have been empowered to carry over these tasks and skills by encouraging and training their relatives with stroke to walk outdoors and practice the various tasks at home after the intervention had ceased. This practice could have additionally contributed to the continued increase in functional mobility and balance that the task group made more than the strength group from post intervention to the follow-up. However, the level of knowledge and understanding of the caregivers in this study was not evaluated.

The results of this study (with minimal intervention) is thus of huge importance. In the public healthcare services in South Africa the resources for providing in patient rehabilitation are not available (Mudzi, 2009; Fearnhead, 2006). When patients are able to get to the hospital and clinics for out patient physiotherapy, it is still historically conducted on an individual 1:1 therapeutic basis. This approach is not cost effective or resource efficient. In the community where this study is conducted, even though there are limited resources, task training circuits or groups as performed in this study are not available. A total of six patients can be treated at any one time by one experienced therapist. With the assistance of a community based worker (under the supervision of a skilled therapist) this number could be increased, optimising cost effectiveness. Safety and encouragement during therapy sessions as in this study can be provided by family members, friends and caregivers. Family members and carers who

accompanied the subjects to their therapy sessions in this study were expected to participate in the training sessions. This practice also empowers and encourages the involvement of the family who spend the majority of everyday with the stroke survivor.

These differences among the groups in walking endurance, gait speed, functional mobility and balance at the follow-up, demonstrate that the provision of as little as six sessions of task training (in a developing country, where persons with sub-acute stroke have had no previous rehabilitation) leads to improved walking competency to a significantly greater extent than either a strength intervention of equal intensity, or a control intervention programme consisting of one three-hour education visit in the sub -acute phase post stroke.

8.2.4 The Impact of Task Training on Functional Mobility and Balance

While the improvements in walking endurance and speed are meaningful as previously mentioned walking in the community additionally requires the ability to stand up from a seated position, decide where you are going and turn or change direction while walking (functional balance and mobility). In daily life both in the home and community, situations are frequently encountered that require navigation around furniture in the home or when outdoors in a crowded mall. Turning while walking contributes to falling in the elderly [(with or without stroke) Andersson et al., 2006; Shumway-Cook and Bauer, 2000]. Task training programmes post stroke thus often include turning in selected tasks with the objective of improving this skill as part of improving functional balance and mobility of persons with stroke. Considering that walking competency has been expressed as the combination of walking endurance, gait speed, functional balance and mobility, the results of the latter two must also be considered when investigating the differences among the three groups in this study.

In this study, while the task group did not improve significantly more than the strength group post intervention, it did show significantly more improvement than the strength group in terms of functional mobility and balance (measured with the TUG and BBS respectively) at the follow-up. The lack of a significant difference in functional mobility between the task and strength group post intervention may be due to the fact that the only station which incorporated turning was the endurance walk station. The corridor used for the endurance walk station in this study is over 40m long; limiting the number of turns during this station. The continued improvement of the task group more than the strength group from post intervention to the follow-up evaluation (six months later) may be partly explained by the “enforced rehabilitation” factors discussed above. The “enforced rehabilitation” may have assisted the subjects in the task

group to develop certain skills that provided them with confidence and the ability to walk more outdoors and in the community more frequently.

According to Flansbjer et al., (2005) a clinically meaningful change, for chronic stroke is represented by an improvement of greater than 2.9s on the TUG. At this stage the MCID in sub-acute stroke has not been established. A greater number of the subjects in the task group (86.7%) than the control (46.5%) group improved their time taken to complete the TUG by more than 2.9s post intervention, representing a clinically meaningful improvement. However the completion of the TUG in more than 13.5s (community dwelling adults) and 14s (older stroke persons) is an indication of an individual being at risk of falling (Andersson et al., 2006; Shumway-Cook et al., 2002). When considering these cut-off scores for the TUG, the subjects in the task group (TUG = 17.6s) remained at risk of falling even after the intervention and at the follow-up, ultimately affecting their walking competency.

The minimal detectable change (MDC) on the BBS in acute stroke for persons who walk with stand-by assistance is 6 points (Stevensen et al., 2001). A greater number of the subjects in the task group (60.0%) than in the control (37.2%) group improved their BBS score by more than the MDC representing a clinically meaningful improvement.

Balance has been shown to be a predictor of ambulatory function in terms of walking speed and distance covered (Kollen et al., 2005). Although these strong correlations exist, there have not been any therapeutic interventions in terms of training balance that have significantly impacted on functional outcomes measured (Au-Yeung et al., 2009; Goljar et al., 2010; Yelnik et al., 2008). The BBS has, however, been found to be more informative in persons with stroke with a severe gait deficit (Richards et al., 1999; Salbach et al., 2001). In addition it is more responsive in detecting change in persons with stroke who walk at a speed of less than 0.4m/s. The subjects in the control, strength and task groups in this study walked at a speed of 0.51m/s, 0.55m/s and 0.44m/s, respectively, at baseline. As a result, a ceiling effect on the BBS may have been reached, limiting the responsiveness of the BBS. The finding that the BBS is more responsive to change in more severely affected stroke populations (Richards et al., 1999; Salbach et al., 2001), is supported by the fact that the subjects in the task group, in the severe gait deficit stratum, were the only subjects to demonstrate a significant change more than the control group in functional balance measured with the BBS.

8.2.5 The Impact of Task Training on Self-reported Physical Functioning

Quality of life is a broad concept affected by a person's state of health, psychological wellbeing and their level of independence. How efficiently a person is able to live their life with the impact of their stroke, without limitations in activities, and without restrictions in their participation at home, work and leisure, influences one's QOL (Carr and Shepherd 2010). Many stroke survivors still experience limitations in their ADLs even following intensive rehabilitation. The impact of limited physical functioning and disability is associated with a decrease in one's QOL (Mayo et al., 2002; Hartmen-Maeir et al., 2007). Thus an improvement in physical functioning could result in improved QOL for these stroke survivors as physical functioning has been shown to impact on one's QOL (Mayo et al., 2002; Hartmen-Maeir et al., 2007). In this study QOL was measured by means of the Stroke impact scale (SIS 16).

Over the study period a statistically significant improvement was noted between the task and the control group on the SIS16. The task group's improvements in physical functioning on all the measures of walking competency thus may have impacted on their QOL more than the control group. On the other hand the lack of a change in physical functioning, on all the measures of walking competency, between the strength and control groups could account for the lack of a difference in their QOL measured with the SIS 16. The SIS 16 covers an extremely broad range of physical functioning from low levels such as sitting balance and continence, to higher level tasks such as heavy household chores, shopping and carrying heavy objects in the affected hand. There were no significant differences between the task and strength groups' physical functioning measured with the SIS 16 over the study period. This is not surprising considering that the task intervention activities focused largely on strengthening, balance and endurance components of walking and not community related activities such as shopping. Eight of the 16 items on the SIS 16 are related to other areas of stroke impairment, namely aspects pertaining to continence and use of the hemiparetic upper extremity, which were not addressed in the intervention groups in this study.

There do not appear to be any task oriented training studies that have used the SIS16 to evaluate health status in terms of physical functioning. This makes comparisons with this study difficult. However in an acute stroke population studied by Rose et al., (2011) no significant improvement in QOL (using the full Stroke Impact Scale) following a task oriented intervention programme was found.

8.3 THE LONG TERM EFFECT OF TASK TRAINING SIX MONTHS POST INTERVENTION

Various task training trials have shown improvements in functional walking outcomes at follow-up after rehabilitation; however it remains unclear whether improvements gained are sustained long term after stroke (Kwakkel et al., 2004; Kwakkel et al., 2002). While some studies in chronic stroke task oriented training cohorts have maintained their levels of improvements for a period of six months from baseline (Sullivan et al., 2007; Macko et al., 2005), others have noted that the benefits of task training and other interventions are not always maintained for long periods after the intervention has stopped (Mead et al., 2007; Blennerhassett et al., 2004; Dean et al., 2000). A large proportion of trials have not conducted follow-up evaluations (Olawale et al., 2011; Yang et al., 2006; Pang et al., 2005; Salbach et al., 2004). While at six months post intervention the task group showed significantly greater gains, whether these improvements are maintained beyond 6 months was not evaluated.

Stroke survivors may require additional bouts of therapy intervention after discharge from their initial rehabilitation to maintain their levels of functioning achieved (Dean et al., 2000; Richards et al., 1999), which carries additional costs but in the long run may help preserve independence. The resultant residual physical impairment and limited functional walking ability, contribute to stroke survivors' decreased level of activity and relatively passive lifestyle (Jorgensen et al., 1999; Mayo et al., 1999). A large proportion of stroke survivors report a lack of community walking competency that confines them to their homes (Lord and Rochester, 2008). This relative inactivity and extremely poor level of community re-integration, ultimately contributes to cardiovascular deconditioning (Raven et al., 1998) and a vicious cycle ensues (Jorgensen et al., 1999; Mayo et al., 1999). It is important to note, that the low dose of task training in this study led to a clinically meaningful change in walking competency at six months after the intervention had ceased. As part of the home programme, the subjects in the task group were encouraged to walk in the community for a minimum of 30 minutes continuously on a daily basis. While it was not monitored, it is possible that the task group continued additional community walking as was recommended after the intervention had ceased. The task intervention in this study was not resource intensive, and thus further studies to evaluate its usefulness as a means of providing additional bouts of therapy to maintain functional levels and limit the cardiovascular deconditioning that often ensues post discharge are warranted.

The recent findings of Duncan et al., (2011) noted equal benefit of providing immediate or delayed intervention post stroke. In their study, the late intervention group had significantly less recovery at six months, but following the delayed intervention (provided six months after the

stroke had occurred) there were no differences between the early intervention group and delayed intervention group's walking endurance and speed. Thus the benefits of providing delayed intervention are as effective as when intervention is immediate.

8.4 THE IMPACT OF STROKE SEVERITY ON RECOVERY

The results in this study showed that at the follow-up evaluation there were no significant differences among the groups for the subjects with a mild gait deficit at baseline. This may be explained in part by the fact that there is a ceiling effect influencing the subjects with a mild gait deficit's scope for improvement (Jorgensen et al., 1999). There have been previous studies with significant effects of task training in subjects with mild gait deficit at baseline in the chronic phase post stroke (Yang et al., 2006; Pang et al., 2005; Dean et al., 2000). This may be explained by the greater intensity of training (three times per week) in these studies. The lack of a significant effect may indicate that a more intensive training programme is required to result in a change in walking competency for subjects with a mild gait deficit post stroke.

Salbach et al., (2004) found the greatest gains in walking distance were demonstrated by subjects with a moderate gait deficit. This supports the finding that patients, who present with moderately severe strokes, frequently demonstrate more marked improvements with rehabilitation (Ronning and Guldvog, 1998; Stineman et al., 1998; Alexander et al., 1994; Karla et al., 1993). Similarly in this study the significant effects of the task training on walking endurance and speed, were detected in the moderate gait deficit strata.

It has been commented that while subjects with more severe disability post stroke do improve with rehabilitation they seldom become fully independent in the community (Stineman et al., 1998). Stroke survivors with severe deficits often have more serious co-morbidities which may compound their stroke disability and thus these persons with stroke benefit from long term rehabilitation. These findings may explain the fact that while there was a significant difference among the groups for subjects in the severe gait deficit group at follow-up, this was not the case post intervention, supporting the assumption that subjects with a more severe gait deficit require a longer term approach to rehabilitation.

8.5 HIV FINDINGS

This appears to be the first study examining the effects of a progressive task oriented group circuit training programme in sub acute stroke subjects who are HIV positive (HIV +ve). The results showed that there were no significant differences in the effectiveness of the

interventions between the HIV +ve and HIV negative (HIV -ve) subjects. The HIV +ve and HIV-ve subjects in this study were comparable at baseline on all measures of walking competency. Thus, similarly to the HIV-ve stroke survivors, task oriented training improved walking endurance, gait speed and functional mobility in persons who are HIV +ve. The HIV +ve subjects in this trial were, however, on antiretroviral therapy and had a CD4 count greater than 100 at baseline. Despite their low CD4 counts, there were no adverse events over the study period. However this study was not powered to detect the effectiveness of the task training intervention in HIV +ve cients, for this reason further studies that explore the effictiveness of tasj training in HIV+ve persons with stroke are necessary.

8.6 SAMPLE RISK FACTORS FOR STROKE AND HOSPITAL LENGTH OF STAY

The most common risk factor for stroke in this study was hypertension. A total of 118 (83%) of the subjects in this study cohort were known to have hypertension at baseline. This is higher than the findings in the SASPI study werein hypertension in stroke was the commonest risk factor at 71% (Connor et al., 2005). However, it is in agreement with other study findings from South Africa where hypertension (95%) was the most common risk factor for stroke (Thorogood et al., 2007; Lavados et al., 2007; Hoffman, 1998; Steyn et al., 2001). This adds weight to the statement that as the population adopts a more “westernized” lifestyle there is a danger of huge increases in the incidence of stroke as these changes in lifestyle take their toll (Thorogood et al., 2007). While there has been a decline in the incidence of stroke in high–income countries, this decline has been attributed to a decrease in risk factors. Education was highlighted as the key element in improving risk factors. In the study by Steyn et al., (2001) on the management of hypertension, only 20% of males and 47% of females were aware of their diagnosis. In the Agincourt rural population project site, in a follow up survey of the 154 people found to have hypertension, 37 (24.2%) were on pharmacological treatment, the remaining 117 (75.8%) did not have any treatment (Thorogood et al., 2007). A total of 65 out of the 144 (45.1%) subjects in this study were still hypertensive at the baseline evaluation even though they were on prescribed antihypertensive medication. The low prevalence of awareness, treatment and control of hypertension exposes an extremely serious challenge for stroke prevention in RSA.

The total number of deaths in this study cohort was seven (4.9%), five of whom were known to be HIV positive at baseline. The impact of HIV/ AIDS on the reported deaths cannot be ignored. Sub–Saharan Africa remains the world’s most seriously affected region with AIDS as the leading cause of death with South Africa having the highest number of HIV infections in the

world (UNAIDS, 2008). Forty five (31%) of this study cohort were unemployed at the time of their stroke. A total of 31% of the subjects in this study earned less than R1000.00 (US$125) per month at the time of their stroke. In addition 61% of the cohort earned less than R3000.00 (US$375) per month, clearly indicating the high level of poverty. Declining socioeconomic status has been significantly related to an increase in mortality and an increase in dependence in ADL's, which then requires further rehabilitative input (Jakovljevic et al., 2001; Avendano et al., 2004; Weir et al., 2005; Zhou et al., 2006). While the high level of poverty did not have a direct effect on mortality during the study period, the influence it may have on outcome following stroke and largely independent its severity cannot be ignored (Arrich et al., 2005). The low number of deaths in this study compared with other stroke studies in South Africa (Hale et al., 1999) may also be as a result of the specific inclusion criteria. The ability to walk independently would imply that patients are not bed dependent and thus not as susceptible to the complications associated with bed rest.

As mentioned the average length of in patient hospital stay in this study was two and a half weeks. This is longer than previous reports of hospital length of stay post stroke in South African public healthcare hospitals (Mudzi, 2009; Hale et al., 1999). During the period of 2007-2009 at Chris Hani Baragwaneth Hospital in Soweto most patients were discharged after 6-8 days post stroke (Mudzi, 2009). However 19 subjects (13.2%) were recruited from Chris Hani Baragwaneth Hospital (CHB), 21 subjects (14.6%) from Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) and 104 subjects (72.2%) from Helen Joseph Hospital (HJH). A large proportion of subjects in this study were recruited from HJH. This hospital services a smaller community than CHB and may not have as great a pressure for beds resulting in a slightly longer length of hospital stay.

Stroke units and post stroke rehabilitation facilities are lacking in the public sector in South Africa and are not likely to become common in the foreseeable future. Coupled with the extremely short in- patient stay, patients are discharged into the care of their families. This places considerable responsibility on relatives and family of stroke survivors to become caregivers. A total of 128 (89%) of the subjects in this study were cared for by a relative. Given the limitations of resources both human and financial, training of these caregivers may provide an affordable and effective manner in which to improve stroke survivors' functional ability. Better involvement of caregivers in training programmes and education may be useful in ensuring better outcomes in stroke rehabilitation. The training of caregivers and relatives to help with rehabilitation could reduce the morbidity and mortality following stroke (Langhorne

and Holmqvist, 2007; Langhorne et al., 2005; Fjaertoft et al., 2003). Having the caregivers attend the therapy sessions as in this study encourages participation in the management of the rehabilitation of stroke survivors from the beginning.

8.7 IMPLICATIONS OF A TASK ORIENTED GROUP CIRCUIT TRAINING PROGRAMME FOR THE PATIENT

Patients who have suffered a stroke need to know that attending out patient therapy as little as once a week for six sessions, could improve their walking endurance and gait speed and may result in a meaningful reduction in their level of disability.

Stroke survivors should be encouraged to have their carer, family member or a friend accompany them to therapy sessions. This facilitates the patient's involvement in the various tasks and ensures safety.

8.8 IMPLICATIONS OF A TASK ORIENTED GROUP CIRCUIT TRAINING PROGRAMME ON CLINICAL PRACTICE IN RSA AND OTHER DEVELOPING COUNTRIES

Primary healthcare in South Africa is aimed at making the healthcare system more accessible and affordable to people in the communities in which they reside. While some structures are in place the system needs to be strengthened whereby patients post stroke can be referred to the clinics for rehabilitation with the appropriate task oriented group based circuit training. Thus the following suggestions have been made:

- Task oriented group circuit based rehabilitation programmes need to be established where post stroke rehabilitation services are absent or limited.
- All stroke survivors who are discharged from the public healthcare sector in South Africa once they are medically stable should be referred to out patient physiotherapy for task oriented group circuit based rehabilitation programmes.
- All physiotherapy staff in the public healthcare sector in South Africa should be informed of the significant benefits of task oriented training for the rehabilitation of stroke survivors.
- Training programmes should be run to equip physiotherapy staff working in the public healthcare sector with the skills to run efficient and effective circuit based task oriented training groups.

- Task oriented training should be offered more than once a week to facilitate attendance where clients are unable to attend on a specified day, because they rely on their support system for transport.
- As there is a wealth of literature showing the benefits of task training where patients attend training 2-3 times per week, patients should be encouraged to attend these sessions more frequently if feasible.

8.9 IMPLICATIONS OF A MINIMAL TASK ORIENTED TRAINING PROGRAMME ON FUTURE RESEARCH IN RSA

This is the first task oriented treatment intervention study conducted in South Africa. Considering the significant clinically meaningful results found, further studies are warranted. The following studies could be considered:

- As there is little or no rehabilitation post stroke, further research to evaluate the effectiveness of a minimal task oriented training intervention for non -ambulant stroke survivors needs to be conducted. With the involvement of caregivers tasks performed in sitting can be evaluated. Further research into the effect of increasing the frequency i.e. 2-3 times per week, of task practice on walking competency is certainly warranted.
- Implementing and evaluating the effectiveness of task training groups for upper extremity rehabilitation would ensure a more comprehensive approach to rehabilitation in the public healthcare sector, and would not merely focus on gait rehabilitation.
- While the subjects in this study continued to improve until a period of six months post intervention, and the findings that 21% of stroke survivors start to deteriorate from one to three years post stroke, the effect of booster task training groups to prevent the deleterious effect of inactivity would be advocated.

8.10 CONCLUSION

The major findings and conclusions from this study are presented in Chapter 9.

CHAPTER 9

9. CONCLUSION

9.1 INTRODUCTION

The following chapter will summarise the findings from the study with particular reference to the objectives.

9.2 CONCLUSION

The results of this study indicate that an out-patient based task oriented group circuit training programme improves walking endurance, gait speed, functional balance and mobility in the public healthcare sector in South Africa.

For the rehabilitation of patients in the sub-acute phase post stroke, who are discharged from hospital without any rehabilitation, task training performed as little as once a week for a total of six sessions improved their walking competency.

Not only were these gains significant post intervention, but were maintained to six months thereafter.
In contrast a progressive strength training programme matched for intensity and frequency did not result in a significant improvement greater than a control multidisciplinary education programme.

These findings may be generalized to other sub-acute patient with strokes bearing in mind that the subjects in this study were relatively young, with a mean sample age of 50 years and bearing in mind that the sample population had not receive a period of in-patient rehabilitation prior to their inclusion into the study. Thus replication of this study in South Africa and other developing countries is necessary, to determine if similar results are produced.

A task oriented group circuit programme resulted in a significant improvement in physical functioning both immediately post intervention and at six months thereafter. However these improvements were not clinically meaningful.

Sub -acute patients with stroke that are seropositive to the HIV virus can improve their walking ability as significantly as seronegative HIV persons following a task oriented group circuit training programme.

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APPENDIX A

PILOT STUDY SUBJECT PERFORMANCE ON MEASURES OF WALKING COMPETENCY

MEASURE	Control		Strength		Task	
	Mean	SD	Mean	SD	Mean	SD
6MWT(m)						
Baseline	192	116	193	104	162	110
Post Intervention	236	127	268	125	260	136
Comfortable walking speed(m/s)						
Baseline	0.51	0.28	0.55	0.27	0.44	0.28
Post Intervention	0.64	0.33	0.77	0.29	0.75	0.36
Maximum walking speed(m/s)						
Baseline	0.70	0.39	0.72	0.37	0.62	0.39
Post Intervention	0.86	0.46	0.96	0.40	0.95	0.47
Timed "up and go"(s)						
Baseline	28.0	22.8	26.3	20.9	33.9	31.1
Post Intervention	22.3	19.8	19	16.5	20.7	17.1
Berg Balance Scale(/56)						
Baseline	42	11	44	9	40	12
Post intervention	46	10	50	9	49	7

APPENDIX B

DEMOGRAPHIC QUESTIONNAIRE

Subject Name:	
Subject Code:	
Contact Number:	
Date of Stroke:	
Date of Baseline evaluation:	
Time since CVA (Weeks):	
Length of in-patient stay prior to discharge home :	
Age:	
Gender:	
Side of hemiparesis:	
Uses AFO:	
Type of assistive device: Walking stick Quadrupod Zimmer Frame	
Ischaemic or Haemorrhagic stroke:	
Known co-morbid conditions: Hypertension HIV Smoker Hypercholesterolaemia Cardiac Diabetes	
Employment Status: Employed Unemployed	
Average monthly income: <R1000.00 R1000.00-R3000.00 >R3000.00	
Highest level of education: Completed Grade 7 Completed Grade 12 Completed Diploma or Degree	
Relationship of caregiver to patient:	

APPENDIX C

SIS 16 with South African English

Subject Code:

Evaluation Date:

In the past 2 weeks, how difficult was it to...	Not difficult at all	A little bit difficult	Medium difficult	Very difficult	Could not do at all
a) Dress the top part of your body?	5	4	3	2	1
b) Wash yourself?	5	4	3	2	1
c) Get to the toilet on time?	5	4	3	2	1
d) Control your bladder (not have an accident)?	5	4	3	2	1
e) Control your bowels (not have an accident)?	5	4	3	2	1
f) Stand without losing your balance?	5	4	3	2	1
g) Go shopping?	5	4	3	2	1
h) Do household chores (e.g. vacuum, laundry or yard work)?	5	4	3	2	1
i) Stay sitting without losing your balance?	5	4	3	2	1
j) Walk without losing your balance?	5	4	3	2	1
k) Move from a bed to a chair?	5	4	3	2	1
l) Walk fast?	5	4	3	2	1
m) Climb one flight of stairs?	5	4	3	2	1
n) Walk around a soccer stadium?	5	4	3	2	1
0) Get in and out of car/taxi?	5	4	3	2	1
p) Carry heavy objects (e.g. bag of groceries) with your affected hand?	5	4	3	2	1

APPENDIX D

BERG BALANCE SCALE

Subject Code :

Date of Evaluation :

1. Sitting to standing, without using arms if possible. 4) Able to stand, no hands and stabilize independently. 3) Able to stand independently using hands 2) Able to stand using hands after several tries 1) Needs minimal assistance to stand or stabilize 0) Need moderate or maximal assist to stand	
2. Stand for 2 minutes without holding onto any external support. 4) Able to stand safely for 2 minutes 3) Able to stand 2 minutes with supervision 2) Able to stand 30 secs unsupported 1) Needs several tries to stand 30 secs unsupported 0) Unable to stand unassisted	
3. Sit with arms folded for 2 minutes, feet on floor. 4) Able to sit safely and securely 2 minutes 3) Able to sit 2 minutes with supervision 2) Able to sit 30 secs 1) Able to sit 10 secs 0) Unable to sit without support 10 secs	
4. Standing to sitting, instruct 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 assistance to sit	
5. Please move from this chair (with armrests) to this chair (without armrests) and back again. 4) Able to transfer safely with only minor use of hands 3) Able to transfer safely with definite need of hands 2) Able to transfer with verbal cueing and/or supervision 1) Needs one person to assist 0) Needs 2 people to assist or supervise to be safe	
6. Standing unsupported with eyes closed. Close your eyes and stand still for 10 seconds. 4) Able to stand 10 secs safely 3) Able to stand 10 secs with supervision 2) Able to stand 3 secs 1) Unable to keep eyes closed 3 secs but stays steady 0) Needs help to keep from falling	

The following Items from 7-14 performed in standing unsupported **7. Standing unsupported with feet together. Place your feet together and stand without holding on to any external support.** 4) Able to place feet together independently and stand 1 min safely 3) Able to place feet together independently and stand 1 min with supervision 2) Able to place feet together independently but unable to hold for 30 secs 1) Needs help to attain position but able to stand 15 secs with feet together 0) Needs help to attain position and unable to hold 15 secs	
8. Reaching with outstretched arm. Lift arm to 90degrees. Fingers extended reach forward as far as you can. 4) Can reach forward confidently more than 10 inches 3) Can reach forward more than 5 inches safely 2) Can reach forward more than 2 inches safely 1) Reaches forward but needs supervision 0) Needs help to keep from falling	
9. Pick up object from floor. Pick up shoe placed 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 1-2 inches from slipper and keeps balance independently 1) Unable to pick up and needs supervision while trying 0) Unable to try: needs assistance to keep from falling	
10. Turn to look over your L/R shoulders. Turn to look behind you over your Lt shoulder, repeat to Rt. 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 assistance to keep from falling	
12. Count number of times step stool is touched. Place each foot alternately on the stool; repeat until each foot has touched stool 4x each. 4) Able to stand independently and safely and complete 8 steps in under 20 secs 3) Able to stand independently and complete 8 steps in more than 20 secs 2) Able to complete 4 steps without aid with supervision 1) Able to complete fewer than 2 steps, needs minimal assistance 0) Needs assistance to keep from falling/ unable to try	
13. Standing unsupported, one foot in front of the other. Demonstrate tandem standing. 4) Able to place foot tandem independently and hold 30 secs 3) Able to place foot ahead of other independently and hold 30 secs 2) Able to take small step independently and hold 30 secs 1) Needs help to step but can hold 15 secs 0) Looses balance while stepping or standing	

14. Standing on one leg. Stand as long as you can without holding onto on to an external environment. 4) Able to lift leg independently and hold more than 10 secs 3) Able to lift leg independently and hold 5-10 secs 2) Able to lift leg independently and hold up to 3 secs 1) Tries to lift leg, unable to hold 3 secs, but remains standing independently 0) Unable to try or needs assist to prevent fall	

APPENDIX E

Subject Code :

Date of Evaluation :

Outcome Measure	Evaluation Baseline/ Post Intervention/ Follow-up	
Note Aid used		
SMWT distance		
BP before		
HR before		
HR at 2minutes		
HR at 4 minutes		
HR at 6 minutes		
BP after		
10M walk fast (m/s)	Measurement 1:	Measurement 2:
10M walk comfortable(m/s)	Measurement 1:	Measurement 2:
TUGT(s)		
Berg Balance Scale Total		
SIS16 Score		

Signed:

APPENDIX F

Zulu Forward Translation A

Patient Code :

Evaluation Date :

Kumaviki amabili adlule, bekunzima kangakanani...	**Bekunge nzima neze**	**Bekunzim a kancane**	**Bekunzinya na**	**Bekunzima kakhulu**	**Bengingi khakhoni nhlobo**
a) Ukuzigqokisa ngenhla?	5	4	3	2	1
b) Ukuzigeza?	5	4	3	2	1
c) Ukufinyelela endlini encane ngesikhathi?	5	4	3	2	1
d) Ukuzibamba isinye (ungazichameli)?	5	4	3	2	1
e) Ukuzibamba ngemuva (ungazimosheli)?	5	4	3	2	1
f) Ukuzimela kungasho ukuthi yiwa?	5	4	3	2	1
g) Ukuyozithengela?	5	4	3	2	1
h) Ukwenza imisebenzi yasendlini (isib. ukusebenzisa ivacuum, ukuwasha noma ukusebenza egcekeni)?	5	4	3	2	1
i) Ukuzihlalela kungasho ukuthi yiwa?	5	4	3	2	1
j) Ukuzihambela kungasho ukuthi yiwa?	5	4	3	2	1
k) Ukusuka embhedeni uye esitulweni?	5	4	3	2	1
l) Ukujaha lapho uhamba?	5	4	3	2	1
m) Ukwenyuka izitebhisi?	5	4	3	2	1
n) Ukuhamba ibangana?	5	4	3	2	1
0) Ukugibela futhi uzehlele emotweni?	5	4	3	2	1
p) Ukuphatha izinto ezisindayo (njengamapulasitiki egrosa) ngezandla zakho ezithintekile?	5	4	3	2	1

APPENDIX G

Zulu Forward Translation B

Evaluation Date :

Patient Code :

Kulamaviki amabili andlulile, kube nzima njani ...	**Bekung-enzima**	**Bekunzi-ma kancane**	**Bekucis-he kube-nzima**	**Bekunzi-ma kakhulu**	**Benging-akwazi ukwenza lokho**
a) Ukugqokisa ingaphezulu lomzimba wakho?	**5**	**4**	**3**	**2**	**1**
b) Ukuzigezisa?	**5**	**4**	**3**	**2**	**1**
c) Ukufinyelela endlini yangasese ngesikhathi?	**5**	**4**	**3**	**2**	**1**
d) Ukulawula isinye sakho (ukungaphunyukelwa)?	**5**	**4**	**3**	**2**	**1**
e) Ukulawula amathumbu (ukungaphunyukelwa)?	**5**	**4**	**3**	**2**	**1**
f) Ukuma ngaphandle kokulahlekelwa yibhalansi?	**5**	**4**	**3**	**2**	**1**
g) Ukuya ezitolo?	**5**	**4**	**3**	**2**	**1**
h) Ukwenza umsebenzi wasekhaya (isib. ukukhuculula, ukuwasha noma umsebenti wasegcekeni)?	**5**	**4**	**3**	**2**	**1**
i) Ukuhlala phansi ngaphandle kokulahlekelwa yibhalansi?	**5**	**4**	**3**	**2**	**1**
j) Ukuhamba ngaphandle kokulahlekelwa yibhalansi?	**5**	**4**	**3**	**2**	**1**
k) Ukusuka embhedeni uye esihlalweni?	**5**	**4**	**3**	**2**	**1**
l) Ukuhamba usheshisa?	**5**	**4**	**3**	**2**	**1**
m) Ukugibela isitebhisi esisodwa?	**5**	**4**	**3**	**2**	**1**
n) Ukuhamba isigaba esisodwa?	**5**	**4**	**3**	**2**	**1**
o) Ukungena nokuphuma emotweni?	**5**	**4**	**3**	**2**	**1**
p) Ukuthwala izinto ezisindzayo (isib. izikhwama zegilosa) ngesandla sakho esithintekile?	**5**	**4**	**3**	**2**	**1**

APPENDIX H

Final Zulu Translation

Igama lesiguli :

Patient Code :

Evaluation Date :

Kumaviki amabili adlule, bekunzima kangakanani...	**Bekunge n-zima neze**	**Bekunzi ma kancane**	**Bekunzin y-ana**	**Bekunzi ma kakhulu**	**Bengingi khakhoni nhlobo**
a) Ukuzigqokisa ngenhla?	5	4	3	2	1
b) Ukuzigeza?	5	4	3	2	1
c) Ukufinyelela endlini encane ngesikhathi?	5	4	3	2	1
d) Ukulawula isinye sakho (ukungaphunyukelwa)?	5	4	3	2	1
e) Ukuzibamba ngemuva (ukungaphunyukelwa)?	5	4	3	2	1
f) Ukuzimela kungasho ukuthi yiwa?	5	4	3	2	1
g) Ukuyozithengela?	5	4	3	2	1
h) Ukwenza umsebenzi wasekhaya (isib. ukusebenzisa ivacuum, ukuwasha noma ukusebenza egcekeni)?	5	4	3	2	1
i) Ukuzihlalela kungasho ukuthi yiwa?	5	4	3	2	1
j) Ukuzihambela kungasho ukuthi yiwa?	5	4	3	2	1
k) Ukusuka embhedeni uye esihlalweni?	5	4	3	2	1
l) Ukuhamba usheshisa?	5	4	3	2	1
m) Ukwenyuka izitebhisi?	5	4	3	2	1
n) Ukuhamba ibangana?	5	4	3	2	1
0) Ukugibela futhi uzehlele emotweni?	5	4	3	2	1
p) Ukuphatha izinto ezisindayo (isib. izikhwama zegilosa)ngesandla sakho esithintekile?	5	4	3	2	1

APPENDIX I

Sotho Forward Translation A

Patient Code :

Evaluation Date :

Dibekeng tse 2 tse fetileng, ho ne ho le thata jwang ho…	**Ho se thata ho hang**	**Ho le thata hanyane**	**Ho batla ho le thata**	**Ho le thata haholo**	**K esa kgone ho hang**
a) Apesa karolo e ka hodimo ya mmele wa hao?	5	4	3	2	1
b) Ho itlhatswa?	5	4	3	2	1
c) Ho fihla ntlwaneng ka nako?	5	4	3	2	1
d) Ho laola senya sa hao (ho se maemo a tshohnyetso)?	5	4	3	2	1
e) Ho laola tshebetso ya mala a hao (ho se maemo a kotsi)?	5	4	3	2	1
f) Ho ema o sa lahlehelwe ke taolo?	5	4	3	2	1
g) Ho ya mabenkeleng?	5	4	3	2	1
h) Ho etsa mosebetsi wa lapeng (mohlala: ho fiela, ho hlatswa kapa mosebetsi o boima)?	5	4	3	2	1
i) Ho dula o sa lahlehelwe ke taolo?	5	4	3	2	1
j) Ho tsamaya o sa lahlehelwe ke taolo?	5	4	3	2	1
k) Ho tloha betheng ho ya setulong?	5	4	3	2	1
l) Ho tsamaya ka potlako?	5	4	3	2	1
m) Ho hlwa setepeseng ho ya ho se seng	5	4	3	2	1
n) Ho tsamaya boloko bo le bong?	5	4	3	2	1
0) Ho kena le ho tswa ka koloing?	5	4	3	2	1
p) Ho rwala dintho tse boima (tse kang mokotla wa korosari) ka letsoho la hao le amehileng?	5	4	3	2	1

APPENDIX J

Sotho Forward Translation B

Patient Code :

Evaluation Date :

Dibekeng tse 2 tse fetileng ho ne ho le thata ha kakang ho...	**Ho ne ho se thata hohang**	**Ho ne ho le thatany ana**	**Ho ne ho batla ho ba thata**	**Ho ne ho le thata haholo**	**Ho ne ho sa kgoneh e hohang**
a) Ho ikapesa mmeleng?	5	4	3	2	1
b) Ho itlhatswa?	5	4	3	2	1
c) Ho kena ntlwaneng ka nako?	5	4	3	2	1
d) Ho laola senya sa hao (ntle le ho hlahelwa ke kotsi)?	5	4	3	2	1
e) Ho laola makaka a hao (Ntle le ho hlahelwa ke kotsi)?	5	4	3	2	1
f) Ho ema ntle le ho hloka botsitso?	5	4	3	2	1
g) Ho ya mabenkeleng?	5	4	3	2	1
h) Ho etsa mesebetsi ya lelapa (mohlala. vacuum, ho hlatswa diphahlo kapa ho etsa tshimo)?	5	4	3	2	1
i) Ho dula ntle le ho hloka botsitso?	5	4	3	2	1
j) Ho tsamaya ntle le ho hloka botsitso?	5	4	3	2	1
k) Ho tloha moalong ho ya setulong?	5	4	3	2	1
l) Ho tsamaya ka potlako?	5	4	3	2	1
m) Ho palama mohato o le mong wa ditepisi?	5	4	3	2	1
n)Ho tsamaya boloko bo le bong?	5	4	3	2	1
0) Ho kena le ho tswa koloing?	5	4	3	2	1
p) Ho nka dintho tse boima (mohlala. Mokotlana wa korosara) ka letsoho la hao le amehileng?	5	4	3	2	1

APPENDIX J CONTINUED

Final Sotho Translation

Patient Code :

Evaluation Date :

Dibekeng tse 2 tse fetileng, ho ne ho le thata jwang ho…	**Ho se thata ho hang**	**Ho le thata hanyane**	**Ho batla ho le thata**	**Ho le thata haholo**	**K esa kgone ho hang**
a) Apesa karolo e ka hodimo ya mmele wa hao?	5	4	3	2	1
b) Ho itlhatswa?	5	4	3	2	1
c) Ho fihla ntlwaneng ka nako?	5	4	3	2	1
d) Ho laola senya sa hao (ntle le ho hlahelwa ke kotsi)?	5	4	3	2	1
e) Ho laola tshebetso ya mala a hao (ho se maemo a kotsi)?	5	4	3	2	1
f) Ho ema o sa lahlehelwe ke taolo?	5	4	3	2	1
g) Ho ya mabenkeleng?	5	4	3	2	1
h) Ho etsa mosebetsi wa lapeng (mohlala: ho fiela, ho hlatswa kapa mosebetsi o boima)?	5	4	3	2	1
i) Ho dula o sa lahlehelwe ke taolo?	5	4	3	2	1
j) Ho tsamaya o sa lahlehelwe ke taolo?	5	4	3	2	1
k) Ho tloha betheng ho ya setulong?	5	4	3	2	1
l) Ho tsamaya ka potlako?	5	4	3	2	1
m) Ho hlwa setepeseng ho ya ho se seng	5	4	3	2	1
n) Ho tsamaya boloko bo le bong?	5	4	3	2	1
0) Ho kena le ho tswa ka koloing?	5	4	3	2	1
p) Ho rwala dintho tse boima (mohlala. mokotla wa korosari) ka letsoho la hao le amehileng?	5	4	3	2	1

APPENDIX K

ETHICAL CLEARANCE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Ballington

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M070413**
PROJECT	ToEstablish the Effectof Task Orientated Group Circuit Training on Acute Stroke Rehabilitation in htePublic healthcare Sector....
INVESTIGATORS	Ms M Ballington
DEPARTMENT	Department of Physiotherapy
DATE CONSIDERED	07.05.04
DECISION OF THE COMMITTEE*	APPROVED UNCONDITIONALLY

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 07.05.23 **CHAIRPERSON** .....
(Professors PE Cleaton-Jones, A Dhai, M Vorster, C Feldman, A Woodiwiss)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Stewart A Prof

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX L

ETHICAL CLEARANCE FOR THIRD GROUP

University
of the Witwatersrand,
Johannesburg

Human Research Ethics Committee (Medical)
formerly Committee for Research on Human Subjects (Medical)
Secretariat: Research Office, Room SH10005, 10th floor, Senate House • Telephone: +27 11 717-1234 • Fax: +27 11 339-5708
Private Bag 3, Wits 2050, South Africa

10 November 2008

Mrs M Knox

Sent by e-mail

Dear Mrs Knox

RE: Protocol M070413

This letter serves to confirm that the Chairman of the Human Research Ethics Committee (Medical) has approved your request for a 3rd group to be included in the abovementioned protocol.

Thank you for keeping the Committee informed.

Yours sincerely,

Anisa Keshav (Ms)
Secretary
Human Research Ethics Committee (Medical)

APPENDIX M

STRENGTH GROUP EXERCISES

Exercise 1: Hip and knee flexion

Alternately bend and straighten legs in supine (20 counts totals 10 repetitions per leg)

- Sliding sheet (friction free) under affected limb
- Remove parachute material
- Apply a 1kg wrist /ankle weight
- Apply a 2kg wrist /ankle weight
- Position affected leg over edge of bed and lift on to bed (progress with weights as before)

Exercise 2: Hip extension, limb loading

Bridging: with feet together on the plinth, lift buttocks up from bed

- Feet positioned hip distance apart, arms extended on plinth
- Feet placed next to one another
- Feet together, ball between knees
- Feet together, ball between knees, arms crossed onto chest and not touching plinth
- Place unaffected leg extended on plinth (encourage not to take weight through extended leg)
- Place unaffected leg over affected leg (FAbER position), arms extended on plinth
- Place unaffected leg over affected leg, arms crossed onto chest not touching plinth
- Place both feet on a 25cm diameter ball

Exercise 3: Trunk rotations

With knees flexed and feet together on plinth, roll knees from side to side (20 reps count for 10 each leg per set)

- Cueing to maintain knees together
- Place a small ball between knees which must not drop during the exercise
- Place a pen between knees as above
- Increase speed and double repetitions in each set

Exercise 4: Hip abduction/adduction

Knees extended, abduct and adduct hemiplegic leg, maintain hip in neutral rotation.

- Place sliding sheet (friction free) under affected limb
- Remove parachute material
- Apply a 1kg wrist /ankle weight
- Apply a 2kg wrist /ankle weight
- Starting position in side lying with affected leg on top, maintaining hip rotation (progress with weights as above)

Exercise 5: Sitting balance

In sitting reach forwards to touch the floor to right foot then left, sitting upright between touching

- Commence on standardized plinth height with thighs supported
    - Reach down to pick up an object placed in front of feet
    - Reach down to pick up objects placed out of arms reach
    - Progress by moving objects further out of arms reach
- Progress by decreasing thigh support

Exercise 6: Limb loading, hip and knee extension

In sitting hemiplegic leg positioned on a piece of 5 cm foam, push down as hard as possible on foam to compress foam as much as possible

- Patient is allowed to initially compensate with trunk flexion and rotation
- Encourage/ limit trunk flexion and rotation compensations
- Using a 5cm piece of foam with arms crossed on chest and limit trunk compensations
- Progress as before while increasing foam thickness
-

Exercise 7: Hip flexion

In sitting try to lift hemiplegic knee in a flexed position towards ceiling (hip flexion)

- Initially patients is allowed to compensate with trunk extension
- Encourage/ limit trunk extension compensation strategy
- Apply a 1kg wrist /ankle weight
- Apply a 2kg wrist /ankle weight

Exercise 8: Hip adduction

In sitting with a ball placed between knees, adduct knees together trying to squash ball

- Initially just squeeze ball
- Isolate movement to affected leg while unaffected leg remains stationary
- Hold squeeze for 5 seconds from eighth repetition of each set
- Hold squeeze for 10seconds from eighth repetition of each set

Exercise 9: Knee flexion and extension

In sitting slide hemiplegic foot forward and backwards on the floor (knee flexion and extension)

- Place sliding sheet (friction free) under affected foot and encourage movement
- Remove sliding material
- Apply a 1kg wrist /ankle weight when knee extends foot remains in contact with the floor
- Increasing controlled ROM to full knee extension and flexion as much as possible
- Apply a 2kg wrist /ankle weight

Exercise 10: Hip abduction, external rotation

In sitting with resistance band placed around knees pull knees apart (hip abduction/ external rotation)

- For each strength of resistance band complete the 2 progressions below before proceed to next resistance:
  - Initially place feet hip distance apart then place feet next to one another
  - Progress to holding abduction for 5 seconds from eighth repetition
- Commence with red theraband proceed with color coded theraband progressions until using black

APPENDIX N

TASK GROUP EXERCISES

Exercise 1

Walking forward on a line for 3m to a crate filled with balls. Squat to pick up a ball and walk backwards on the line to the starting position. Place the ball in crate positioned at the start.

Progressions:

- Reducing and removing use of upper extremity for support
- Crate with balls is initially positioned higher on a bench and progressed to the floor
- Crate is initially positioned in front of the patient and progressed further out of arms reach towards the affected side

Exercise 2

Placing the affected leg on a bench, step the unaffected leg up and down off the bench

Progressions:

- Reducing and eventually removing use of upper extremity for support
- Stepping unaffected leg completely over the bench and back
- Increasing step height after completing the previous progressions

Exercise 3

Phase 1: Squatting. Subject stands in a demarcated box with their back against a wall; feet placed 20cm away from the wall. Subject squats to pick up a postcard (one at a time) placed on a bench in front of their feet. The post card is then placed in a container positioned on the windowsill in the gym.

Phase 2: Squatting while Stepping. Subject stands as before in demarcated box, with back against the wall, then steps the affected foot onto a demarcated target (there are 8 targets) onto the bench placed in front of their feet. Each target on the bench is touched alternately for the 3 ½ minutes. (Carr and Shepherd 2003).

Progressions:

- For phase 1 the postcards are initially positioned centrally in front of the subject's feet and then moved further to the affected side and out of arms reach to a maximum of 30cm from the feet.
- Once subject manages 30cm away from the feet, the unaffected leg is placed on the bench positioned in front of their feet and continues to pick up post cards individually
- For phase 2 reducing and eventually removing use of upper extremity for support
- Increasing the bench height

Exercise 4

Standing with both feet behind a line, step one leg over a stick (alternating legs)

Progression:

- Reducing and eventually removing use of upper extremity for support
- Stick is positioned further away (McClellan and Ada 2004).
- The height of the stick above the floor increased

Exercise 5

Sitting to standing (Cheng et al., 2001; Dean et al., 2000; Engardt et al., 1993)

Progressions:

- Reducing and eventually removing use of upper extremity for support
- Lowering chair height
- Placing the unaffected foot initially forwards and then later onto a step

Exercise 6

Endurance walking station, subjects walk contiuously as fast as they can for the full 7 minutes of the station in an 80m corridor (Dean et al.,2000; Duncan et al.,1998,). The distance they covered is recordered. Subjects are then encouraged to increase the distance covered during ever session.

APPENDIX O

POST INTERVENTION QUESTIONNAIRE

1. Do you think the training programme has improved your walking?
2. What was the most beneficial aspect of the training programme?
3. What was not beneficial in the training programme?
4. What do you think you have achieved from this training programme?
5. Do you think you would have achieved the same result without having attended the programme?
6. Did you walk to the sessions from your drop off point?
7. How far/ often do you walk during the day at home? Have you been to church weekly? How far did you walk to get there? Did you practice/ try any of the exercises at home?
9. For what reason did you miss any training sessions ?

APPENDIX P
SUBJECT DATA SHEET

Subject Name: **Subject Code:**

Under Exercises and Homework Record Progression Level Performed

Date of Session:	Rest Time:	Exercise 1:	Exercise 2:	Exercise 3:	Exercise 4:	Exercise 5:	Exercise 6:	Homework

APPENDIX Q

INFORMATION SHEET FOR SUBJECTS

Good Day!

I am Megan Ballington from the Department of Physiotherapy at the University of the Witwatersrand. I am investigating if a specific intensity and type of group exercise programme after stroke will improve the walking performance of people who have suffered a stroke. If you are able to walk just a few metres, no matter how slowly or effortful, I would like to invite you and would be extremely grateful if you or your relative/friend would consider participating in this study.

Why are we doing this study?

You, a family member or friend may have recently suffered a stroke.

This is a devastating for all involved. Research in developed countries Canada and Australia have shown that walking task specific training in groups improves the walking ability of people who have suffered a stroke. In South Africa Rehabilitation is extremely limited and not always possible. We don't know if this treatment approach could be implemented into our healthcare system. There is a team at this hospital running a programme who would like to determine if stroke survivors who attend rehabilitation as out patients would benefit in the same way with improved walking ability as they have in other studies in developed countries.

Who can be considered for inclusion in this study?

If it is a first ever stroke and you are over the age of 18 years.

Your stroke was less than 6 months ago.

You live in the Johannesburg area.

If you are unsafe walking alone you have a friend or family member available to attend every session with you.

No medical condition that prevents you from participating in an exercise programme.

An ability to walk 10m.

You will not be allowed to participate if you have any condition eg cardiac that prevents you participating in an exercise programme.

In addition if you are walking too quickly you will also not be able to participate.

What do we expect from the participants in this study?

This hospital has been selected because there are many stroke survivors who are discharged home very early with little or no rehabilitation. This can be an extremely stressful time for all involved. Out patients don't get a sufficient opportunity to undergo rehabilitation of this nature and intensity. I would like to compare the present therapy services for out patient stroke survivors to this new intense 6 week walking task specific programme.

To do this all participants who agree to be involved in the study will be placed into 1 of 2 groups. The one group will attend out patient therapy (for approximately one hour) once a week for classes that focus on strengthening the affected leg. The other group will attend out patient therapy classes (for approximately one hour) 3 times a week for 6 weeks. We encourage those in this group to attend with a friend/relative or assistant as they will be able to assist and encourage you during training. This group will train with an intense structured circuit class for one hour designed to strengthen your leg, improve balance and practice different aspects of walking.

Records will be kept of your attendance at the groups to assist our data analysis. In addition we would like to measure each participants ability to walk as far as they can in 6 minutes, measure your speed of walking over 10m, asses your balance in standing, getting up from a chair walking a short distance and then coming to sit down again. We would also like to asses your opinion with regards to your quality of life since sustaining a stroke. Certain other factors with may influence the end result achieved after rehabilitation and we would like you to fill in a questionnaire to assess these factors.
A research assistant will do data collection and evaluate your walking ability at the beginning of the study, after the 6 weeks training, following a further 8 weeks after the training has stopped and again at 6 months to see the long term effects of the training programme.

We understand that transport costs may be a concern for you and your relative/ friend so we have arranged that you will be paid R50 each for every visit to the exercise training session to cover your transport costs.

Are there benefits to the participants?

Yes. It is of great benefit to work as a group after any traumatic experience, in this way you all share information and support each other. In addition, at the end of the study we will present our findings (at a meeting with all involved participants), and answer questions that you may have pertaining to therapy recommendations following stroke. It is important to note there are no risks to you by being involved in the study.

May I withdraw from the study?

Yes, certainly. At any time you are allowed to withdraw from the study without having to give any reason. Remember this in a voluntary study and there is no penalty for not taking part or withdrawing from it – you may continue as usual as an out patient at the hospital if your therapist advices it.

What about confidentiality?

Confidentiality will be maintained by the use of a code instead of names in all results. Only the research assistants will have a list of names and codes to enable the code to be linked to a particular participant. This list will be kept by research assistants and locked away in their offices.

If you are able to walk just a few metres and would like to be involved in this rehabilitation project, or you have any further questions please either speak to the physiotherapy department or contact Megan on 0826367463.

If you would like to take part in this study and fit the inclusion criteria, please make an appointment for an evaluation at the out patient physiotherapy department (or call Megan 0826367463), and sign the attached consent form.

I sincerely appreciate your time
Thank you

Megan Ballington
Physiotherapy Department
University of the Witwatersrand
Phone Number: 0826367463 (cell)

APPENDIX R

SUBJECT CONSENT FORM

Task Oriented Group Circuit Training for Rehabilitation of People Affected by Stroke in the Public Healthcare Sector in RSA

Welcome!

I _____agree and would like to be involved in this study for a period of 6 weeks as outlined in the information sheet. I will also be happy to return for the evaluations which will be conducted after completion of the training and at a further 6 months thereafter.

Signature : _____

Date : _____

Hospital : _____

APPENDIX S

Original SIS16

In the past 2 weeks, how difficult was it to...	Not difficult at all	A little difficult	Somewhat difficult	Very difficult	Could not do at all
a) Dress the top part of your body?	5	4	3	2	1
b) Bathe yourself?	5	4	3	2	1
c) Get to the toilet on time?	5	4	3	2	1
d) Control your bladder (not have an accident)?	5	4	3	2	1
e) Control your bowels (not have an accident)?	5	4	3	2	1
f) Stand without losing your balance?	5	4	3	2	1
g) Go shopping?	5	4	3	2	1
h) Do household chores (e.g. vacuum, laundry or yard work)?	5	4	3	2	1
i) Stay sitting without losing your balance?	5	4	3	2	1
j) Walk without losing your balance?	5	4	3	2	1
k) Move from a bed to a chair?	5	4	3	2	1
l) Walk fast?	5	4	3	2	1
m) Climb one flight of stairs?	5	4	3	2	1
n) Walk one block?	5	4	3	2	1
0) Get in and out of a car?	5	4	3	2	1
p) Carry heavy objects (e.g. bag of groceries) with your affected hand?	5	4	3	2	1