Factors that influence functional ability in individuals with spinal cord injury.

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree

of

Master of Science in Physiotherapy

Johannesburg, 2013

DECLARATION

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

…….. [Signature of candidate]

……01… day of …October……., 2013

DEDICATION

“I have finished the race,

I have kept the faith”

2 Timothy 4:7

ABSTRACT

There is a dearth of published literature that documents the levels of functional ability post spinal cord injury (SCI) resulting in paraplegia, at discharge from in-patient rehabilitation facilities within Gauteng. In addition, the factors that influence functional ability are poorly defined in individuals with paraplegia, at their discharge from in-patient rehabilitation facilities in Gauteng. This necessitated further investigation since it is vital for the rehabilitation of individuals with SCI resulting in paraplegia. The aim of the study was to determine the functional ability and the factors that affect the functional ability in individuals with a SCI resulting in paraplegia, at discharge from rehabilitation facilities in Gauteng. The first objective of the study was to establish the level of functional ability in patients with SCI at discharge from in-patient rehabilitation. The second objective of the study was to describe the physical and demographic factors of the study population. The third objective of the study was to establish the demographic and physical factors that influence the level of functional ability in patients with SCI at discharge from in-patient rehabilitation.

This was a cross-sectional, observational study design. Three instruments were used in this study: a self-designed questionnaire to establish the factors that influence the level of functional ability in patients with SCI at discharge from an in-patient rehabilitation unit; the American Spinal Injury Association (ASIA) classification scale of neurological impairment to describe the level and completeness of the lesion and the Spinal Cord Independence Measure III (SCIM III) to determine the level of functional ability.

The main results of the study were as follows: The average SCIM score in this population was 64.6 (±27.6) with the lowest score being 20 and the highest score being 84. Participants with non traumatic SCI had 16.87% lower SCIM scores than those with traumatic SCI.

After multivariate analysis the following factors were found to influence function: For every one year increase in the age of the participant, there was 0.18% decrease in the SCIM score. For every day increase in LOS, there was a corresponding increase of 0.06% in the SCIM score. With respect to the presence of a pressure sore from the acute hospital, those who had pressure sores had 9% lower SCIM scores than those who did not have pressure sores. Participants with spasticity had 8.3% lower SCIM scores relative to those that did not have spasticity. Relative to participants in government funding classification, workman's compensation participants had 4.82% lower SCIM score followed by the medical aid participants

with 8.07% lower SCIM and the private participants with 10.84% lower SCIM scores. For every unit increase in the ASIA motor score, there was an increase of 1.29% in the SCIM score.

Conclusion: Majority of the participants in this study were discharged from rehabilitation without reaching functional independence. The following categories of patients with SCI may need to be monitored more for functional outcomes during rehabilitation and assisted in order to attain good functional ability: older age, a short rehabilitation length of stay, funded privately, a low ASIA motor score, having a pressure sore or spasticity, and higher level of SCI.

Key words: Functional outcomes, paraplegia, rehabilitation, neurological level, spinal cord injury.

ACKNOWLEDGEMENTS

- A sincere thank you to all of the patients that willingly participated in this project.

- Thank you to Mrs Veronica Ntsiea for being a mentor and supervisor, your guidance and support throughout this process is greatly appreciated.

- Thank you to Dr Steve Olorunju for his assistance and patience throughout the statistical analysis phase of this project.

- I thank my wonderful family for their constant support and never-ending encouragement throughout the entire course of my Masters degree, without you this would not have been possible.

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List of Acronyms

ADL: Activities of daily living

AIS: ASIA impairment scale

ASIA: American Spinal cord Injury Association

LOS: Length of stay

TTA: Time to admission

UTI: Urinary tract infection

SCIM: Spinal cord independence measure

WHO: World Health Organization

ICF: International Classification of Functioning, Disability and Health

FIM: Functional Independence Measure

CHAPTER 1

1. Background and need

1.1 Introduction

Spinal cord injury (SCI) is the term used to describe a physical injury to the spinal cord which disrupts normal spinal cord function (McKinley et al., 2001). SCI in South Africa results principally from gunshot injuries (36%), injuries associated with a motor vehicle collision (25%), stab wounds (20%), and fall from heights (2.4%) (Hart et al., 1994). Traumatic injuries account for 89% of all spinal cord injuries within South Africa (Hart et al., 1994). Incidence of SCI varies depending on age, gender, region, and occupation. The overall annual incidence of SCI internationally ranges between 12.2-57.8 per million (van den Berg et al., 2010).

Spinal cord injuries result in devastating disability which can produce severe functional impairments (Scivoletto et al., 2003). Able bodied functioning adults depend on strong, well-coordinated arms and legs, and a good sense of balance when sitting, walking or moving (van der Putten et al., 2001). Balancing upright when sitting or standing, and simultaneously controlling the skilled movements of the upper limbs during a functional task, poses further difficulty. Normally these functions are carried out automatically; therefore a SCI will have a profound effect on the abilities and functioning of these individuals (Scivoletto et al., 2003).

Since SCI may result in impairment of an individual's physical and psychosocial functioning, it results in disability of major public health significance. The extent and location of damage in the spinal cord caused by a traumatic or non-traumatic injury, influences the severity of the impairments and functional limitations that will be present (Itzkovich et al., 2007). There are basic skills involved in self-care activities and mobility tasks which are needed for higher levels of functioning in individuals with SCI (Itzkovich et al., 2007). Therefore an improvement of these skills is likely to have a considerable impact on the patients' level of disability, independent functioning and consequently their quality of life (van der Putten et al., 2001).

There are many factors that may influence the functional ability of individuals with SCI resulting in paraplegia (Osterhun et al., 2009). Some of these factors are; age at onset of SCI, length of hospital stay including complications such as pressure sores from acute hospitals or rehabilitation hospitals, urinary tract infections, neurological level, gender and race, early versus delayed admission to spinal cord injury rehabilitation units, traumatic versus non-traumatic injuries, and re-hospitalisation during rehabilitation (Osterhun et al., 2009).

It is common practice that individuals with paraplegia are admitted to a rehabilitation facility after discharge from the acute hospital. Individuals with SCI receive intensive in-patient rehabilitation to enhance their independence and function with their newly acquired disability. Beginning rehabilitation as soon as possible after an acute SCI has been linked with higher functional efficiency and more favourable level of functional ability (Scivoletto et al., 2005, Sumida et al., 2001), and it is also advisable to begin rehabilitation as soon as possible before complications develop leading to secondary disability (van der Putten et al., 2001).

There is a dearth of published literature that documents the levels of functional ability post SCI resulting in paraplegia, at discharge from in-patient rehabilitation facilities within Gauteng. In addition, the factors that influence functional ability are poorly defined in individuals with SCI resulting in paraplegia, at their discharge from in-patient rehabilitation facilities in Gauteng. This necessitated further investigation since it is vital for the rehabilitation of individuals with SCI resulting in paraplegia.

1.2 Research Question

What factors affect the level of functional ability in individuals with paraplegia at discharge from an in-patient rehabilitation facility?

1.3 Aim of the study

To determine the functional ability and the factors that affect it in individuals with paraplegia at discharge from in-patient rehabilitation facilities in Gauteng.

1.4 Objectives of the study

1.4.1 To establish the level of functional ability in individuals with paraplegia at discharge from in-patient rehabilitation.

1.4.2 To describe the demographic and physical factors of the study population.

1.4.3 To establish demographic and physical factors that influence the level of functional ability in individuals with paraplegia at discharge from in-patient rehabilitation.

1.5 Significance of the study

The most important goal in the rehabilitation of individuals with SCI resulting in paraplegia is to maximize their chance of living a fully independent life post-injury and consequently every therapeutic intervention should be directed towards achieving this good outcome. The knowledge of factors that affect the level of functional ability in individuals with SCI resulting in paraplegia, at discharge from an in-patient rehabilitation unit is not well researched in South Africa. Knowledge of factors that affect the level of functional ability in these individuals at discharge from an in-patient rehabilitation facility will help therapists to determine whether specific intervention protocols need to be introduced for the prevention of negative factors. This study may bring light into the amount of care and dependency that individuals with SCI resulting in paraplegia will face as they are discharged from rehabilitation facilities and re-integrate back into their home life.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Introduction

There is a dearth of published literature that documents the level of functional ability post SCI resulting in paraplegia, at discharge from in-patient rehabilitation facilities within Gauteng. In addition, the factors that influence functional ability are poorly defined in individuals with SCI resulting in paraplegia, at their discharge from in-patient rehabilitation facilities in Gauteng. This necessitated further investigation since this information is vital for rehabilitation of individuals with SCI.

A search of the literature was conducted in order to find information about the level of functional ability post SCI resulting in paraplegia, at discharge from in-patient rehabilitation facilities as well as the outcome measures used to do this. Factors that influence functional ability in individuals with paraplegia at their discharge from in-patient rehabilitation facilities were also included in the literature. The following databases were searched for literature: Cochrane, PeDRO, Cinhal, ebscohost and Pubmed. The following keywords were used in the search: impairments, function, mobility, SCI, pressure sores, spasticity, urinary tract infections, American Spinal cord Injury Association, ASIA impairment scale, Spinal cord independence measure, functional ability, time to admission, gender, and neurological level, length of stay. The literature regarding the functional abilities of individuals with SCI resulting in paraplegia, at their discharge from in-patient rehabilitation facilities, and the factors that may affect function was examined with regard to what the literature disclosed about them and finally, the instrumentation used in this study was examined to ensure that all were valid, reliable and appropriate for the study.

This literature review will be written following this format:

2.2. Incidence, prevalence and epidemiology of spinal cord injuries
2.3. The functional ability of individuals with SCI resulting in paraplegia
2.4. Rehabilitation of individuals with SCI resulting in paraplegia
2.5. Factors that influence the functional ability of individuals post SCI
    2.5.1 Gender
    2.5.2 Age

2.2 Incidence, prevalence and epidemiology of spinal cord injuries

The QuadPara association of South Africa estimates a total of 400-500 new spinal cord injured individuals per year in South Africa (Gore, 2006). No SCI prevalence figures are available for South Africa. The incidence of traumatic spinal cord injuries has been found to be one to two cases per 100 000 inhabitants per year in the western world (van den Berg et al., 2010). The annual incidence of non-traumatic spinal cord injuries in the United States of America may be as high as 8 per 100 000 (McKinley et al., 2001). Incidence of SCI varies depending on age, gender, region, and occupation. The overall annual incidence of SCI internationally ranges between 12.2-57.8 per million (van den Berg et al., 2010).

SCI in South Africa results principally from gun shot injuries (36%), injuries associated with a motor vehicle collision (25%), stab wounds (20%), and fall from heights (2.4%) (Evans, 2002). Traumatic injuries account for 89% of all spinal cord injuries within South Africa (Evans, 2002). Males are more commonly affected than females, with males accounting for 77% of the total SCI population (McKinley, 2007; Eng and Miller, 2008). Male to female ratio has been found to be in the range of 2.5:1 to 5.8:1 in an international study (Eng and Miller, 2008). All ages are at risk of a spinal cord injury. McKinley (2007) defined the average age at time of injury to be 38 years. Traumatic lesions were more frequent in younger persons (<50), and non-traumatic lesions were more frequent in older persons (>50) (Hart and Williams 1994).

A retrospective study was completed on the aetiology of traumatic and non-traumatic spinal cord injuries from January 1988 to December 1993 at Natalspruit hospital in Johannesburg

South Africa. Of those who sustained a traumatic injury, it was as a result of the following: gunshot wound 40.6%, motor vehicle accident 28.2%, stab wounds 22.5%, and falls 2.7% (Hart and Williams, 1994). In this study 'violence related aetiology' of traumatic SCI includes gunshot wounds and stabbings. The violence related aetiology in this study would amount to 63.1% of all traumatic injuries sustained during this period of time (Hart and Williams, 1994). In the year 2000 Hart published an extension to her 1994 study at Natalspruit hospital in Johannesburg South Africa, detailing that traumatic SCI between January 1988 and December 1998 were more common than non-traumatic SCI with; gunshot wounds at 44%, motor vehicle accidents at 25%, stab wounds at 15%, falls at 3 % and other at 5%.

2.3 Functional ability of people with SCI resulting in paraplegia

The impairments that are caused by a SCI, such as loss of sensation, loss of motor function and loss of bladder and bowel function can have a severe impact on an individual's overall level of functioning (Eng and Miller, 2008). To facilitate physical independence after a spinal cord injury and to assist an individual with a SCI to perform their former roles in society, a well-coordinated, comprehensive, outcome orientated and cost effective rehabilitation program is necessary (Landrum et al., 1995).

Rehabilitation should aim to reduce disabilities and handicaps which result from impairments which are caused by trauma or disease (Schonherr et al., 1999). The aim of most rehabilitation programs is to teach individuals with SCI how to achieve an optimal independent and satisfying lifestyle in their own community. Most individuals go home post discharge from rehabilitation and a significant number achieve functional independence (Schonherr et al., 1999).

At discharge from the rehabilitation hospital the individual with a SCI should be able to perform the fullest range of functional activities independently, and to be able to go home as physically independent as possible (Eng and Miller, 2008).

Schonherr et al. (1999), agrees with Eng and Miller, (2008) that individuals with paraplegia can achieve independence in self-care skills, these include having independence in the following:

- All bed mobility skills (rolling, shifting in all directions, moving from supine to sitting).
- Transfers to and from the wheelchair (including bed, toilet, bath, car and floor).
- Upper and lower body washing and dressing.

- All basic wheelchair mobility tasks on indoor and outdoor surfaces (including ramps, uneven surfaces, up and down curbs).
- Bladder and bowel management.

An individual with a high thoracic complete lesion, around T1, still has full innervation of the upper limb musculature and no innervation of the thoracic and abdominal musculature. This individual should functionally be independent in level transfers but may have difficulty maintaining sitting balance (Long and Lawton, 1955). An individual with a mid-thoracic level complete injury, around T6, has a functional gain over the higher level injury as they have complete innervation to the upper limbs as well as the thoracic musculature. Innervation is supplied to the long upper muscles of the back, upper intercostals and transversus thoracis (Long and Lawton, 1955). Due to the innervation of proximal musculature these individuals can be independent in all transfers and self-care tasks and may even ambulate therapeutically with full leg calipers and a walking frame (Long and Lawton, 1955). An individual with a low thoracic lesion, around T12, will still have full innervation of rectus abdominus and oblique muscles of the abdomen. Lower lumbar musculature is still not innervated and these individuals have very few functional and vocational limitations (Long and Lawton, 1955). An individual with a low lumbar and sacral level injury, from L4, will have the added functional assistance of quadratus lumborum and should be independent in all phases of self-care and ambulation (Long and Lawton, 1955).Despite the age of this literature the expected functional outcomes of each level of paraplegia remains the same in both clinical work and functional goal setting in rehabilitation.

A frame work to put the effect of impairments and secondary complications on the different domains of function into perspective, and illustrate them within a larger frame work that incorporates both the person and their expected functional outcome is presented below. This framework is provided by the WHO International Classification of Functioning, Disability and Health (Rauch et al., 2010).

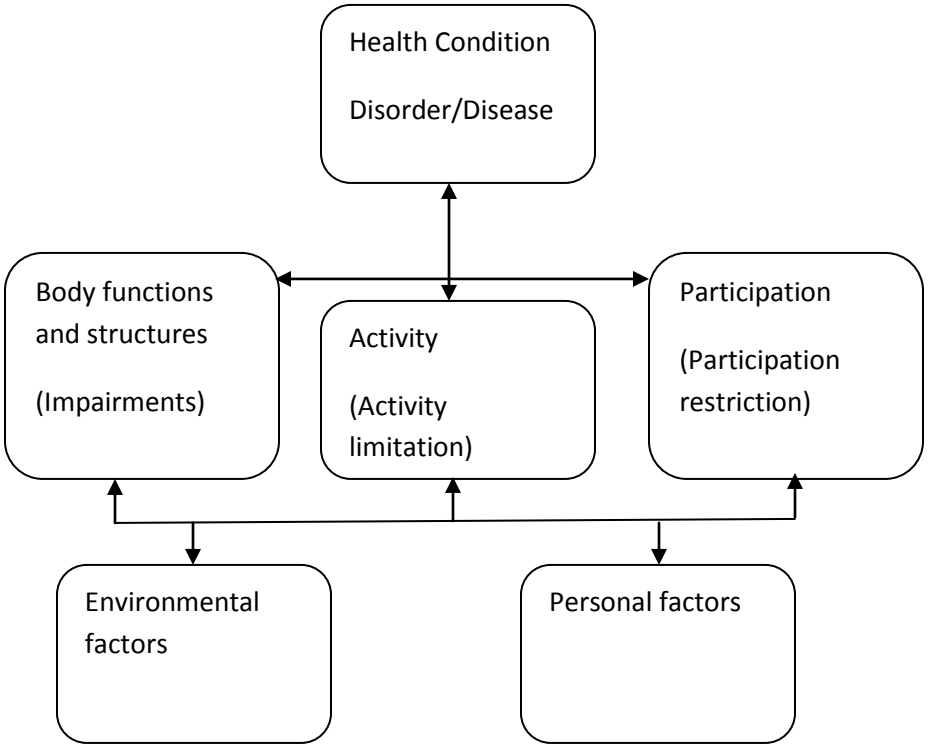

Figure 2.1 Domains of Function

Each one of the domains in Figure 2.1 may influence each of the other domains. There is no linear relationship between domains and one domain may exist in isolation of the others.

After SCI there are key impairments that are linked to specific activity restrictions and therefore participation limitations (Chen et al., 2003). Key impairments that are responsive to rehabilitation intervention and commonly prevent activity restrictions and participation limitations are: poor strength, poor skill, poor joint mobility, pain, poor respiratory function, and poor cardiovascular system fitness (Chen et al., 2003). Rehabilitation aims to prevent the above impairments as well as treat and improve on already existing ones in individuals with SCI so that by discharge from in-patient rehabilitation individuals with SCI are faced with as few as possible, or none of the above impairments (Chen et al., 2003).

2.4 Rehabilitation of people with SCI resulting in paraplegia

In South Africa, spinal cord injuries are managed the following way: individuals with newly acquired spinal cord injuries are admitted into either a private or government public acute hospital where their initial injuries are stabilised, they are then transferred into either a private or government public rehabilitation unit (Henn, 2009).

From the literature it is seen that rehabilitation can be offered in a variety of ways. An individual may have rehabilitation as an in-patient in a rehabilitation hospital, or they may receive rehabilitation on an out-patient basis, or lastly the individual's rehabilitation may be done at a home based care level. An individual with a SCI will partake in a variety multi-disciplinary therapy sessions depending on the individual's impairment and needs (Henn, 2009). Multi-disciplinary rehabilitation management programs are designed to make the most of an individual's physical independence and minimise medical problems and secondary complications (Henn, 2009). These management programs should begin in the initial stabilising phase and continue until discharge from rehabilitation ideally 3-4 months after beginning rehabilitation (Henn, 2009).

Five different levels of outcomes in rehabilitation were described by Landrum, et al (1995):

Level 0- Physiologic instability which is immediately after the onset of injury or illness when there are medical diagnostic and management problems, which need care in an acute hospital setting**.**

Level 1- Physiologic stability First and most basic outcome level, all major medical and physiological problems addressed and appropriately managed.

Level 2- Physiologic maintenance which is the achievement and preservation of immediate and long-term physiologic health within the individual.

Level 3- Residential reintegration which includes performing self-care, mobility, communication, safety and home management at a level which allows the individual to function in their residential setting.

Level 4- Community reintegration which focusses on the achievement of an appropriate level of function within the community. This includes self-management, social interactions, community mobility, home-making capabilities, financial management, as well as self-directed health monitoring and recreational activities.

Level 5- Productive activity, which is the establishment of the individual in productive activities within his/her capacity. This may involve vocational activities and return to work.

Levels 0-2 should be achieved in acute hospitals, level 3 should be achieved through in- or out-patient rehabilitation, and levels 4-5 should be achieved through community based rehabilitation (Henn, 2009). The author feels that this method of measuring rehabilitation outcomes is valuable enough to use throughout the rehabilitation process, as only once an individual has achieved one level may they move on to achieve the following level.

In the acute hospital the initial management of spinal cord injuries can either be surgical or conservative depending on the stability and extent of the injury itself (Longo et al., 2011). During conservative management of injuries and occasionally after surgical fixation of injuries the surgeon will prescribe a TLSO (thoracolumbarsacral orthoses) for 6-12 weeks during the initial healing and stabilisation phase. A TLSO can be used for spinal immobilisation after surgery or after traumatic injury (Longo et al., 2011).

A TLSO is an external apparatus that is applied to the body to correct deformity, reduce axial loading on the spine, limit the motion of thoracolumbar flexion and extension, as well as limit lateral trunk flexion (Jegede et al., 2011). In general, TLSOs extend from the sacrum to above the inferior angle of the scapulae and are used to support and stabilise the trunk post truncal paralysis or post spinal fusion (Longo et al., 2011). TLSOs can increase intra-abdominal pressure (which in turn decreases the load on the spine/intervertebral discs by transmission of the load to the surrounding soft tissues) (Jegede et al., 2011). They also cause an increase in oxygen consumption/energy expenditure making normal activities of daily living more strenuous and difficult (Jegede et al., 2011).

Individuals with SCI receive intensive in-patient rehabilitation to enhance their independence and function with their newly acquired disability (Henn, 2009). Beginning rehabilitation as soon as possible after an acute SCI has been linked with higher functional efficiency and more

favourable level of functional ability (Scivoletto et al., 2005, Sumida et al., 2001). It is also advisable to begin rehabilitation as soon as possible before secondary complications develop leading to secondary disability (van der Putten et al., 2001). Schonherr et al. (1999) reported that a functional improvement after SCI is expected to occur most rapidly during in-patient rehabilitation. Rehabilitation tries to enhance the residual functional abilities of individuals that have acquired a disabling impairment such as a SCI. It includes a multi-disciplinary group of evaluative, diagnostic and therapeutic services rendered by doctors, nurses, physiotherapists, occupational therapists, orthotists, psychologists, social workers and other healthcare workers (Landrum et al., 1995).

It proved difficult to find literature detailing the specific rehabilitation programs for individuals with SCI. Henn (2009), described examples of certain aspects that should be included in a rehabilitation program for individuals with paraplegia:

- Self-care skills, including activities of daily living (ADLs) which are; feeding, grooming, bathing, dressing, and toileting.
- Physical care including nutritional needs, skin care, and prevention of pressure sores.
- Mobility skills, including all functional transfers (wheelchair to bed, floor, car, toilet), and wheelchair dexterity skills (propelling in all directions, ascending a curb)
- Socialization skills, including interacting with others (with and without a disability) at home and within the community.
- Vocational training including work-related skills and possible return to work.
- Psychological counselling to identify problems and solutions for behavioural, and emotional issues,
- Family support including assistance with adapting to lifestyle changes, financial concerns, and discharge planning.
- Education for the patient and family, including training about SCI, home care needs, and possible adaptive needs.

Functional goals for each individual in rehabilitation are made according to the functional limitations found in the above aspects; these goals are measured and monitored continuously throughout the rehabilitation process by using objective outcome measuring tools (Henn, 2009).

A higher incidence of complications post SCI during rehabilitation is related to a lower level of physical activity and functional outcome (Noreau et al., 2000; Bloemen-Vrencken et al., 2005).
SCI is frequently followed by complications, which add to the detrimental effect that the loss of motor, sensory and autonomic function have on an individual's health (Haisma et al., 2007). The range of complications that may occur post SCI can be categorised into neurological complications and secondary complications. Where neurological complications result from the actual SCI itself following the interruption of the nervous system (examples: neuropathic pain and spasticity) (Haisma et al., 2007). Secondary complications follow the subsequent loss of sensation and motor control, loss of bladder control or reduced mobility (example: pressure sores) (Haisma et al., 2007). Complications may interfere with, or delay the start of active rehabilitation and may frequently lead to re-hospitalisation during rehabilitation (Haisma et al., 2007). Individuals with a SCI as well as the rehabilitation therapy team should be fully educated about potential complications post SCI in order to prevent the occurrence of these (Haisma et al., 2007). The author agrees strongly with this literature as it is valuable enough to incorporate into clinical practice. If there is adequate education for the individual as well as the rehabilitation team, complications may be prevented before they become a negatively influencing factor on the individuals functioning.

2.5 Factors that influence the functional ability in individuals with spinal cord injury

There is limited literature that captures the range of factors that are likely to influence an individual's functional ability after SCI. Scivoletto et al. (2005) described 27 potential factors that could influence function which are grouped into five domains: health, physical, emotional, social, and equipment. Physical factors included loss of strength, pain, joint stiffness, fatigue, increased weight and health factors which included bowel dysfunction and general medical difficulties (Scivoletto et al., 2005). The nature and the severity of the physical impairments and activity limitations are dependent on the severity and site of the lesion (McKinley et al., 2007). Individuals with a SCI experience loss of sensation and loss of motor function which may affect the individual's daily functioning (McKinley et al., 2007).

2.5.1 Gender

The influence of gender on functional outcome after SCI has not been widely investigated (Furlan et al., 2005). Research suggests that there is a shift in the demographics of acute SCI with an increasing incidence in elderly woman (Furlan et al., 2005). During rehabilitation

hospitalisation 44.7% of men and 52.9% women develop secondary complications without any significant gender-related differences (Furlan et al., 2005). Men with motor complete injuries had higher functional motor scores at discharge from rehabilitation than females (Sipski et al., 2004). Depending on the severity and level of neurological injury, men have been found to perform better than women at rehabilitation (Sipski et al., 2004). Women have been found to have more natural neurologic recovery than men; however, for a specific level of injury and degree of injury, men tend to do better functionally than women at time of discharge from in-patient rehabilitation (Sipski et al., 2004). This difference between women and men that is reported by Sipski et al. (2004) is due to the tendency for women with complete motor injuries to be less independent and require more assistance than men with the same level of injury with mobility and self-care tasks (Sipski et al., 2004).

Another study revealed that there were no significant gender related differences on the FIM functional motor score on admission and discharge from rehabilitation (Greenwald et al., 2001). There was no gender-related difference in acute rehabilitation length of stay, and gender was not a significant factor in the functional outcome after acute rehabilitation (Greenwald et al., 2001). Greenwald et al. (2001) used a matching process in their methodologies to alleviate mediating factors by controlling for age, neurological classification of injury and ASIA motor score. The mediating factors mentioned in Greenwald et al. (2001) are the number of men sustaining SCI's, the young age at which men are likely to sustain a SCI, and the greater severity of SCI in young men. When the abovementioned factors were eliminated by matching the sample there was no significant functional discharge difference between males and females.

The literature reflected contrasting results in studies where men were found to be more functional than women at discharge from rehabilitation, and other studies where gender was not a significant factor in the functional outcome after in-patient rehabilitation.

2.5.2 Age

Scivolletto et al. (2005) found a negative association between increased age and functional ability in their study on individuals who had SCI resulting in paraplegia. They also established that the age of the individual at the onset of disability and the extent of the individual's disability at admission to rehabilitation are strong prognostic factors which may influence the amount of functional recovery that the individual may have (Scivoletto et al., 2005). In individuals with

paraplegia and of an increased age appear to have adversely affect functional outcome and LOS (Cifu et al., 1999).

Dudley-Javoroski and Shields (2006) found a positive correlation between subject age and the number of complications. Osterthun et al. (2009) found that the influence of age on functional outcome may be based on a reduced ability to recover from and also the effect of possible co-morbidities in elderly individuals. This literature reflects that if older individuals are more susceptible to developing complications, and have a reduced ability to recover from complications, that they will be less functional at the end of their rehabilitation (Osterthun et al., 2009). From this it is possible to infer that increased age in individuals with a SCI leads to decreased functional ability.

2.5.3 Traumatic spinal cord injury and non-traumatic spinal cord injury

There are numerous causes for SCI. They can be categorised into traumatic SCI (Motor vehicle accident, falls, violence, sports) and non traumatic spinal cord injury (tumors, stenosis, infections, vascular injuries) (Eng and Miller, 2008). Traumatic spinal cord injuries are more common than non traumatic spinal cord injuries (Eng and Miller, 2008).

American individuals with non traumatic complete and incomplete paraplegia were found to have lower rehabilitation discharge functional scores than those with traumatic SCI in a study by McKinley et al. (1999). In later studies McKinley et al. (2001) found that individuals with traumatic SCI achieved greater overall functional outcomes when compared to those that were achieved by individuals with non traumatic SCI after rehabilitation. Those individuals with non-traumatic SCI had shorter rehabilitation LOS than those with traumatic SCI (McKinley et al., 2001). Some non-traumatic SCI can be linked with medical co-morbidities necessitating palliative care of the individual and poor medical prognosis, in these instances, rehabilitation LOS is shorter in these individuals when compared to those with traumatic SCI and serves to train caregivers and assign the individual appropriate assistive devices and mobility aids before discharge to palliative care. Individuals with traumatic SCI and a higher degree of disability had almost twice the LOS to those with non-traumatic SCI and a less degree of disability (McKinley et al., 2001). An Individual with a higher degree of disability had slower functional improvements and therefore required a longer time to achieve rehabilitation outcomes and therefore had longer LOS than those with lesser disabilities (Ronen et al., 2004).

The literature shows that individuals with a traumatic SCI have higher functional abilities at discharge from rehabilitation than those individuals who have a non-traumatic SCI.

2.5.4 Severity and level of lesion

Internationally SCI are classified according to the ASIA international standards for neurological classification of SCI (Maynard et al., 1997). According to these standards the neurological level of an injury is defined as the most caudal segment of the spinal cord which has normal motor and sensory function. Depending on the combination of severity of SCI and level of the SCI, an individual's functional ability may, to some extent be determined by the level of injury (Bluvshtein et al., 2011).

A high level paraplegic injury is a SCI between thoracic vertebrae T2-T9, a low level paraplegic injury is a SCI between spinal levels T10-S5 (Long and Lawton, 1955). The main difference between the two groups is that the low level injury group has innervation of all the chest wall and abdominal muscles. Abdominal muscles are used for balance and trunk stability therefore positively influencing the ability to perform activity of daily living tasks and physical mobility skills (Long and Lawton, 1955).

The more muscles that are fully innervated the better strength and balance an individual will have and therefore it is likely that an individual with a lower level lesion will have a higher functional ability than an individual with a higher level of lesion (Schonherr et al., 1999). The abovementioned study also found that patients with permanent complete and sensory incomplete lesions (ASIA A and B) showed substantial functional improvement during rehabilitation (Schonherr et al., 1999).

2.5.5 Time to admission to a rehabilitation hospital and length of stay in a rehabilitation hospital

Time to admission to a rehabilitation hospital

"Time to admission" (TTA) refers to the interval of time (days) between the date of the SCI and the date of admittance into a rehabilitation unit. It varies in different countries and may depend on the clinical course of the acute phase of the injury or the number of available beds in the rehabilitation wards. Rehabilitation can only begin once the individual's acute medical condition

has been stabilised and therefore rehabilitation can be delayed due to an individual's co-morbidities (Scivoletto et al., 2005).

The length of time before admission into rehabilitation and the degree of one's disability whilst in a rehabilitation hospital have been identified as strong prognostic factors influencing the level of functional ability of these individuals, where a longer TTA combined with a higher degree of disability are associated with lower functional outcomes when compared to those with a shorter TTA and lesser degree of disability (Scivoletto et al., 2005). Complications that arise during the acute phase post SCI may lead to an increased acute hospital LOS and therefore an increased TTA to the rehabilitation hospital.

During the acute post-injury phase, there is specialised management of spinal fractures and other injuries as well as the prevention of secondary complications such as pressure sores, deep vein thrombosis and infections (Henn, 2009). When these prevention measures of secondary complications fail at the acute hospital, there is often a delay in the individual being admitted into a rehabilitation hospital (Henn, 2009). Statistics available from a private rehabilitation facility in Johannesburg South Africa show that the time to admission to the rehabilitation hospital is one to two weeks post injury but can be as long as six weeks post injury where medical complications necessitate longer periods of acute care (Henn, 2009). In the study by Henn (2009), 75% of the subjects were admitted into rehabilitation within one month post injury, the other 25% of the study participants were admitted into rehabilitation between 30-56 days post injury. Henn (2009)'s study did not look at associations between the TTA and functional ability at discharge from rehabilitation.

An individual's admission to a rehabilitation facility may also be delayed due to rehabilitation bed unavailability or acute phase medical instability in the acute hospital (Celani et al., 2001). Benefits of short time to admission include shorter hospitalisation and therefore reduced incidences of new secondary complications including pressure sores, contractures and bladder dysfunction (Celani et al., 2001). Celani et al. (2001) found that there was an average time to admission of 55 days after a traumatic SCI, and 167 days for non-traumatic SCI. Similar results were found by Scivoletto et al. (2005) with a TTA of 57 days after traumatic SCI. In the study by Celani et al. (2001) it recommends that patient management before rehabilitation (TTA) should be shortened as much as possible. The lapse of time before an individual's admission into a

rehabilitation center (TTA) determines the length of rehabilitative hospitalisation (LOS) (Celani et al., 2001). A shorter TTA is linked with longer LOS and a longer LOS is associated with a higher discharge functional ability (Celani et al., 2001), therefore it can be inferred that short TTA into rehabilitation may lead to a higher functional ability at discharge from rehabilitation. In contrast to Celani et al. (2001), the study performed by Scivoletto et al. (2005) showed that their subjects with short TTA had shorter LOS but also higher functional efficiency, the authors believe that the better functional ability in their subjects were caused by the effects of early intervention and not the LOS directly.

Length of hospital stay

Length of stay at one of the rehabilitation hospitals in Johannesburg, for rehabilitation of an individual with complete paraplegia was set at 12 weeks (86 days) baseline to achieve all necessary functional goals (Henn, 2009). It is often found that the funder is not willing to pay for 12 weeks of in-patient rehabilitation and the individual may be discharged from the rehabilitation hospital before they have achieved a reasonable degree of physical independence (Henn, 2009). This in turn places a burden on family of the individual with a SCI as the individual requires an increased level of caring and assistance, which prolongs the process of re-integration into community and family life (Henn, 2009).

Ronen et al. (2004) describes a trend for progressively shorter length of stay in rehabilitation hospitals over the past decade. The higher the level of SCI the longer the LOS, but LOS is dependent on completeness of lesion (Ronen et al., 2004). It has been shown that individuals with incomplete injuries have longer length of stay than those with complete injuries (Ronen et al., 2004). This could be due to individuals with incomplete injuries experiencing neurological change and return of movement, if there are additional neurological levels with complete innervation, more rehabilitation time will be required to maximise the functional gains that come with additional fully innervated muscles (Ronen et al., 2004). Whereas individuals with a complete lesion will not change neurologically and therefore their rehabilitation goals and expected functional outcome remain the same throughout the rehabilitation process (Ronen et al., 2004). Average international LOS values were as follows; 20-74 days in the USA (McKinley et al., 2002), 56-61 days in Australia (New et al., 2005), 91-143 days in Italy (Celani et al., 2001), 150 days in Bangladesh (Sconherr et al., 1996) 154 days in Netherlands (Hoque et al.,

1999), 198-222 days in Spain (Bravo et al., 1993), and 149-285 days in Denmark (Biering-Sorensen et al., 1990).

Length of stay in a rehabilitation unit may influence the functional achievements of individuals with spinal cord injuries (Ronen et al., 2004). Longer LOS is associated with a higher functional gain (McKinley et al., 2002; Ronen et al., 2004). Individuals with a more complicated clinical condition have a slower functional gain and therefore required longer time to achieve rehabilitation outcomes and therefore have a longer length of stay, than those with a less complicated clinical condition (Ronen et al., 2004).

In South Africa patients' medical care and rehabilitation is paid for by one of the following funders; medical aid funds, workman's compensation for injury on duty as defined by the Compensation for Occupational Injuries and Diseases Act (COIDA), government funded, or privately funded by the patient and their family. There is an increasing need to cut expenses by funders and this reduces the length of stay individuals receive in a rehabilitation unit (Ronen et al., 2004). From the above literature it can be inferred that LOS restrictions put in place by funders may negatively impact on the functional ability of an individual with SCI.

A longer TTA combined with a higher degree of disability is associated with lower functional outcomes (Scivoletto et al., 2005), and a longer LOS in a rehabilitation unit is associated with a higher functional gain (McKinley et al., 2002; Ronen et al., 2004).

2.5.6 Spasticity and limited range of movement in lower limbs

Noreau et al. (2000) defined spasticity as a motor disorder that is characterised by a velocity-dependent increase in the tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from hyper-excitability of the stretch reflex. Up to 70% of individuals with SCI develop spasticity that may cause considerable disability (Noreau et al., 2000). Spasticity may take months or years to develop after the acute SCI and it may lead to an increased loss of function and re-hospitalisation (Noreau et al., 2000). SCI results in varying degrees of paresis; this paresis leads to adaptive shortening of muscles that changes the afferent input that is going to the spinal cord. This in turn exacerbates the spasticity and causes the development of contractures, limited range of movement, abnormal positioning and further loss of function (Gracies, 2005).

Light to moderate spasticity may have a positive effect on function post SCI, as spasticity may make it possible for patients with lower limb paresis to attain a standing function and also allow more ease of transfers (Adams and Hicks, 2005). Severe spasticity may contribute to decreased functional ability, contractures (decreased ROM), incorrect posture, pressure sores and pain (Yelnik et al., 2010). Spasticity can prevent functional independence; by preventing transfers, affecting seating, affecting placement of legs in a wheelchair which can lead to pressure sores and pain (Yelnik et al., 2010). Severe spasticity has been shown to have a negative effect on an individual's functional ability post SCI (Yelnik et al., 2010).

The following are non-medical interventions which have been found to decrease spasticity and can begin within the acute phase post SCI, and continue through to the chronic phase post SCI: TENS (Transcutaneous electrical nerve stimulation), rhythmic passive movements neural facilitation techniques, prolonged standing, passive cycling movements or other methods of producing muscle stretch (Kakebeeke et al., 2005 and Kirchblum 1999). The effective clinical management of spasticity requires an individualised and often a combination approach of medical/pharmaceutical and non-medical/pharmaceutical interventions. Botulinum neurotoxin has been found to improve muscle spasticity in individuals with SCI when used on its own or in combination with other interventions (Richardson et al., 2000).

An additional causative factor of reduced range of movement in individuals with SCI could be from the presence of heterotopic ossification. Heterotopic ossification forms through a typical process beginning with the formation of a protein mixture created by bone cells (osteoid) that eventually calcifies within a matter of weeks after an individual's injury (Pape et al., 2001). In the following few months, the calcified osteoid remodels and matures into well-organised trabecular bone, this restricts the range of movement available at the affected joint (Pape et al., 2001). The symptoms of heterotopic ossification may appear 3-12 weeks after the SCI. SCI patients typically present with joint and muscle pain, parasthesias and tissue swelling in the involved area, sometimes accompanied by mild fever (Schuetz et al., 2005). Limited range of movement has been shown to have a negative effect on an individual's functional ability post SCI (Yelnik et al., 2010).

2.5.7 Pressure sores

The prevalence of pressure sores in persons with a SCI varies, but is estimated to range from 8% within the first year post injury to as high as 33% of persons with SCI who reside in the community (Byrne and Salzberg, 1996). The annual incidence rates of pressure sores post SCI range from 20-31% (Byrne and Salzberg, 1996). In a study performed in Dutch rehabilitation units in the Netherlands it was recorded that during acute care or rehabilitation, 34% of the individuals developed at least one pressure ulcer (Verschueren et al., 2011). In the same study the occurrence of pressure ulcers was 36.5% during the acute hospital phase and 39.4% during the functional rehabilitation hospital phase (Verschueren et al., 2011).

Pressure sores are a frequent and potentially life threatening complication of SCI that have the potential to interfere with the physical well-being and overall functioning of an individual (Verschueren et al., 2011). A pressure sore is developed after an externally applied pressure is applied for a prolonged period of time (Verschueren et al., 2011). Less extensive pressure sores of stage I and II, according to the EPUAP Wound Classification System, comprise 75% of total number of ulcers, leaving 25% for more severe stage III and IV (Verschueren et al., 2011). Pressure sores remain among the most common secondary conditions after SCI, and are also among the leading causes for unplanned re-hospitalisations of people with SCI, resulting in longer hospital stays and prolongs the period of time to achieve functional goals (Chen et al., 2005).

Maintenance of already existing pressure sores includes the individual avoiding any pressure to that area until the sore is fully healed (example: if an individual has a sacral pressure sore they will not be allowed to sit or lie supine until the wound is fully healed). This may delay the individual's functional ability as it leads to prolonged periods of immobility, increased LOS, funders refusing to pay for further rehabilitation, as well as a delay in the correct seating of the individual and their acquisition of wheelchair skills (Chen et al., 2005).

2.5.8 Urinary tract infection (UTI)

UTI's are responsible for major morbidity and mortality in individuals with a SCI. They are one of the most common medical complications that are experienced by individuals with a SCI (Opperman, 2010). UTI's can intensify the experience of disability; threaten the survival, long-term health, dignity, mobility and independence of an individual with a SCI (Opperman, 2010).

After a SCI it has been found that an individual will experience between 1.82 and 2.6 symptomatic UTI's per year (Opperman, 2010).

Factors that may be responsible for a high incidence of UTI's in the SCI population include; neurogenic bladder, stagnant residual urine, incomplete voiding, catheter use, invasive procedures without antibiotic prophylaxis and raised intravesical pressure (Opperman, 2010).
Signs and symptoms of UTI in SCI include fever, discomfort or pain over the kidney and lower back area, urinary incontinence, autonomic hyperreflexia, increased spasticity, cloudy urine with an increased odour, malaise, lethargy, or a sense of unease (Garcia et al., 2003). These will lead to an individual being reluctant to participate in physical rehabilitation sessions, be around other people, have less physical activity, and as a result this may negatively impact on the overall functioning of the individual (Garcia et al., 2003).

2.5.9 Pain post SCI

Pain post SCI can be divided into two categories: musculoskeletal pain and neurogenic pain. Musculoskeletal pain is nociceptive pain originating from bone, joint or muscle structures following trauma or overuse. Neurogenic pain is defined as pain at or below the level of injury, originating from SCI or trauma (Haisma et al., 2007). It has been shown that pain is often a severe complication of SCI (Dudley-Javoroski and Shields, 2006).

There are two unique types of longstanding neuropathic pain which can be recognised in individuals with spinal cord injury. The first is segmentally distributed pain at the level of the lesion which is due to nerve root entrapment or direct segmental deafferentation (Sjolund, 2002). The second is pain in the body below the level of the lesion, often with late onset; this is evoked by the original spinal lesion, or by secondary changes at higher levels of somatosensory systems (Sjolund, 2002). The prevalence of pain amounts for 60-70% and is rated to be severe in 20-40% of cases (Cairns et al., 1996; Rintala et al., 1998).

Studies have described an incidence of pain post SCI from 48-94%, and estimates that disabling severe pain ranges between 11-34% post SCI (Cairns et al., 1996). In another more recent study it was found that pain after SCI can range from 35%-73% of individuals post injury (Nash et al., 2008). It has been shown that it is the severity of pain and not paralysis that stopped individuals from functioning independently and stopped their social activity (Turner et

al., 2004). In one study, the timing of the development of pain in 901 individuals with a spinal cord injury was studied, it was reported that the pain started immediately after the SCI in 34% of people (Turner et al., 2004). This would mean that during the individuals in-patient rehabilitation stay, pain may be a limiting factor on an individual's achievement of goals and therefore may negatively affect the functional ability of the individual at discharge from in-patient rehabilitation (Turner et al., 2004). Pain after a SCI has been found to start within the first six months following the injury (Turner and Cardenas, 1999). Sjolund, (2002) reported that up to 60% of individuals with post-traumatic paraplegia suffer from severe, continuous, lancinating pain. Pain can be as important as absent movement and mobility, in causing decreased functional ability (Sjolund, 2002).

Shoulder pain is one of the most common types of musculoskeletal pain that follows a SCI. It is often the result of increased physical demands on the upper limbs, or over use of the upper limbs as the individual with SCI compensates for loss of lower limb functioning (Curtis et al., 1999). Shoulder pain is exacerbated by placing increased physical demands on the shoulders as an individual with paraplegia does during activities of daily living and mobility tasks such as transfers and wheelchair dexterity. This may lead to the individual being reluctant to participate fully in ADL's and mobility tasks to try and avoid pain and therefore be less functional than individuals with no pain (Curtis et al., 1999).

2.6 Review of instrumentation

2.6.1 American Spinal Injury Association (ASIA) classification

The ASIA classification scale of neurological impairment is used in SCI rehabilitation to describe the level and completeness of the lesion (Maynard et al., 1997). These standards are endorsed by the International Spinal Cord Society. Both the motor and sensory components are tested clinically during an examination (Maynard et al., 1997). The term paraplegia refers to an impairment or loss of motor and/or sensory function in the thoracic and lumbar segments of the spinal cord (Maynard et al., 1997). Motor function is measured according to the Oxford grading of muscle strength where normal muscle strength is a grade 3/5 and normal sensation is recorded as 2/2 (Maynard et al., 1997). The abovementioned standards were developed by the American Spinal Injury Association (ASIA) for assessing the neurological deficit in patients with SCI and for classifying the injury (Cohen and Bartko, 1994).

The ASIA Impairment Scale (AIS) reflects the completeness of the lesion (Maynard et al., 1997).

A = A complete lesion, no sensory or motor function is preserved below the level of the lesion.

B = Sensory incomplete lesion (including segments S4-S5), but no motor function below the level of lesion.

C = Sensory and motor incomplete but more than half of the 10 pairs of key muscles have strength of less than Grade 3 on a scale 0–5.

D = Sensory and motor incomplete, at least half of the key muscles have strength of greater or equal to Grade 3.

E = Sensory and motor function normal.

The standards are accompanied by a reference manual, which gives detailed explanation on how to perform motor and sensory neurological examination and how to classify the SCI based on the results of the examination (Cohen and Bartko,1994) (Appendix F) . Very good levels of agreement between two examiners in all components of the ASIA neurological examination have been found (Savic et al., 2007). This confirms that changes in total ASIA scores and in neurological levels of injury are reliable outcome measures in clinical research with one or more examiner (Savic et al., 2007).

The ASIA motor scoring system uses ten muscle groups in the body to represent the motor innervation by the cervical and lumbosacral segments of the spinal cord. It excludes certain muscles (e.g. the hamstring muscles) as the segmental levels that innervate these muscles are already represented by other muscle groups (Maynard et al., 1997). The ASIA motor scoring system does not include the abdominal muscles (i.e. T10-11) as the thoracic spinal levels are much easier to determine from sensory dermatome levels than motor levels (Maynard et al., 1997). Each of the ten muscle group's strength is tested using the Oxford Scale. The Oxford Scale is a 0-5 scale of 0-5 grades of different muscle strengths;

- 0- Total paralysis
- 1- Palpable or visible contraction
- 2- Active movement, full range of movement, gravity eliminated
- 3- Active movement, full range of movement, against gravity
- 4- Active movement, full range of movement, against gravity and provides some resistance

- 5- Active movement, full range of movement, against gravity and provides normal resistance

A score out of five is given for each of the ten muscle groups and then a total motor score out of 50 is calculated (Maynard et al., 1997).

2.6.2 SCIM III- Spinal Cord Independence Measure version III

The Spinal cord independence measure III is used to determine the level of functional ability. It is a comprehensive self-care and mobility ability rating scale for people with a SCI (Itzkovich et al., 2007). It was designed by Professor Amiram Catz and Professor M. Itzkovich at Lowenstein Rehabilitation hospital in Israel. It assesses the ability of persons with SCI performing basic everyday tasks and it also takes into account the economic burden of disability (Itzkovich et al., 2007). There are three versions of the SCIM scale. Versions I, developed in 1997, and II, developed in 2001, have had their validity, reliability and advantages proven in several publications (Itzkovich et al., 2007). The SCIM version III, refined in 2007, was used in this study; it is the latest version of the scale. The validity and reliability of this version has been proven in a multi-cultural setup and by rach-analysis.Inter-rater reliability: total agreement was found between 74.5% and 96.2%, in 13 of the 18 tasks the total agreement was above 80.0%. Kappa coefficients ranged between 0.63 and 0.82, and were statistically significant for all tasks ($p<0.001$) with intraclass correlation coefficient values above 0.94 for the total SCIM III score and for all SCIM III subscales.

Pearson correlation coefficients between SCIM III and FIM were 0.79 ($p<0.001$) for the first rater and 0.78 ($p<0.001$) for the second rater (Itzkovich et al., 2007). It was found that the responsiveness of SCIM III was better than that of the FIM in the following subscales: respiration, sphincter management, and mobility indoors and outdoors. The SCIM III is an efficient measure for the functional assessment of individuals with a SCI (Itzkovich et al., 2007). The criterion related concurrent validity of the scale is supported by the high correlation between the FIM and the SCIM. The SCIM has been found to be more responsive to change in function of persons with SCI when compared to the FIM (Itzkovich et al., 2007; Segal et al., 1993; Roth et al., 1990).

The SCIM III has three subscales:

1. Self-care, which includes six tasks and makes up 20 points.

2. Respiratory and sphincter management, which includes four tasks and makes up 40 points.
3. Mobility, which is further separated into room/toilet and indoors/outdoors. Mobility has nine tasks and makes up 40 points.

The total score may range from 0-100 where a higher score denotes a higher level of functional independence (Itzkovich et al., 2007) (Appendix E). Although higher scores represent higher functional ability, an individual with a total score below a minimal value (which is the sum of the minimal item scores in each section representing independent functioning, which is a score of 70 for SCIM III) is not functionally independent (Bluvshtein et al., 2012). Higher SCIM III scores indicate better execution of more difficult functional tasks. In contrast, lower scores indicate that a higher amount of assistance is required to complete a functional task (Bluvshtein et al., 2012). SCIM III grading can be safely used to identify the functional status of individuals with paraplegia (Bluvshtein et al., 2012).

The SCIM III is a user friendly scoring system that is in the form of a detailed check list, it can be safely used for clinical and research trials including international multi-centre and multi-cultural studies (Itzkovich et al., 2007). The scoring criteria are detailed in the evaluation form, which eliminates the need for a manual. The SCIM III is an efficient measure for functional assessment of patients with SCI and can be safely used for clinical and research trials including international multi-centre and multi-cultural studies (Itzkovich et al., 2007).

The SCIM defines individual capacity on the basis of the individual's comfort, medical condition, and economic burden, therefore an activity achieved with costlier or more challenging assistive devices or that is associated with medical short comings is considered to be of lower value and therefore scored lower than activities achieved without such devices and short comings (Itzkovich et al., 2007).

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2.7 Conclusion

This literature review was conducted to find information about the level of functional ability of individuals with paraplegia, as well the demographic and physical factors of the study population, and the physical and demographic factors that influence the functional ability of individuals with paraplegia at discharge from in-patient rehabilitation. The literature confirmed

that there are factors that influence the functional ability in individuals with paraplegia. From literature the five most common factors that may affect the functional outcome of persons with SCI at discharge from an inpatient rehabilitation unit were: age at onset of injury, neurological level of injury, early versus delayed admission to spinal cord injury rehabilitation units (time to admission), presence of a pressure sore and urinary tract infection. A review of the literature was conducted focussing on each of the outcome measure instruments used, in order to ensure that all were valid, reliable, and appropriate for the study.

CHAPTER 3

3. METHODOLOGY

3.1 Introduction

This chapter describes the study design, the subject sample, ethical considerations, and the pilot study. A description of the instruments and procedures that were used for data collection is also provided.

3.2 Type of study

This was a cross-sectional, observational study design.

3.3 Study population

3.3.1 Source of subjects

Patients for this study were recruited from Netcare rehabilitation hospital (private) and Natalspruit hospital spinal rehabilitation unit (government) in the South Gauteng region. Netcare rehabilitation hospital is a private healthcare facility which has spinal cord injury unit and Natalspruit hospital is a state run hospital which also has a spinal cord injury rehabilitation unit. Prior to data collection, the Gauteng department of health, managing director, Chairperson of Physicians Advisory Board of Netcare Rehabilitation Hospital and hospital manager were sent letters requesting permission to conduct research within their facility (Appendices H-K).

3.3.2 Sample size and selection

All consecutive patients who fitted the inclusion criteria for the study and that were nearing the date of discharge from in-patient rehabilitation during the period of data collection were approached to be included in the study. From literature the five most common factors that may affect the functional outcome of persons with SCI at discharge from an inpatient rehabilitation unit were: age at onset of injury, neurological level of injury, early versus delayed admission to spinal cord injury rehabilitation units (time to admission), presence of a pressure sore and urinary tract infection. For every factor that is considered to have a possibility of influencing the

results of the study, at least ten patients are required (Nunnaly, 1978). Therefore the minimum sample size for this study was 50 participants.

3.3.2.1 Inclusion criteria: Male and female individuals with traumatic and non-traumatic SCI resulting in paraplegia, ASIA classifications A and B, who were above 18 years for consent purposes, and at Netcare rehabilitation hospital or Natalspruit hospital's spinal cord rehabilitation unit .

3.3.2.2 Exclusion criteria: Individuals with additional central nervous system lesions, located outside of the spinal cord or who had additional peripheral nervous system pathology. Individuals with unstable vital signs and any patients with pre-existing physical disability (prior to SCI), as well as those with mobility and cognitive problems prior to SCI, which are likely to impair daily function.

3.4 Instrumentation and outcome measures

3.4.1 Self-designed questionnaire

A self-designed questionnaire was developed and used to establish the factors that influence the level of functional ability in individuals with SCI at discharge from an in-patient rehabilitation unit. The questionnaire had three sections:

Section A: The first section of this questionnaire was used to collect demographic details of the target population. This included name, phone numbers and postal addresses for feedback once the study was complete. This was filed separately and coded to ensure the participant's autonomy.

Section B: The second section was used to record possible demographic and physical factors which could influence the function of each participant. This included: date of injury, date of discharge from acute hospital, date of admission to rehabilitation facility (TTA), date of discharge from rehabilitation facility (LOS), neurological injury level, age at onset of injury, gender, race, and set bladder and bowel routine.

Section C: The third section was used to determine if participants experienced any secondary complications since their injury that could affect their rehabilitation or length of stay (including reasons for early or delayed discharge; medical aid, government, Workman's Compensation Act or private patient). Secondary complications experienced during hospital stay (e.g. pressure sore from acute hospital or a pressure sore from

rehabilitation hospital, urinary tract infection, pain, contractures or limited range of movement, and uncontrolled movements or spasticity of the lower limbs) were also captured in this section.

3.4.2 American Spinal Injury Association (ASIA) classification

The ASIA classification scale of neurological impairment was used to establish the level and completeness of the lesion. The completeness of the injury was determined as follows:

A: A complete lesion, no sensory or motor function is preserved below the level of the lesion

B: Sensory incomplete lesion (including segments S4-S5), but no motor function below the level of lesion

C: Sensory and motor incomplete but more than half of the 10 pairs of key muscles have strength of less than Grade 3 on a scale 0–5

D: Sensory and motor incomplete, at least half of the key muscles have strength of greater or equal to Grade 3

E: Sensory and motor function normal

3.4.3 SCIM III- Spinal Cord Independence Measure version III

The Spinal cord independence measure III was used to determine the level of functional ability post SCI. The SCIM III total score ranges from 0-100 where a higher score denotes a higher level of functional independence

3.5 Procedure

3.5.1 Content validity of the questionnaire

In order to ensure the content validity of the questionnaire, experts within a spinal rehabilitation setting and academics were consulted to develop and analyse the questionnaire to determine if the questions were appropriate for the set objectives of this study. At this meeting there were two occupational therapists, and six physiotherapists. An additional two physiotherapists who have a masters degree in neurological physiotherapy and were involved in academia were also consulted. During the meeting the following aspects were recommended:

- That there are three separate sections to the questionnaire instead of two, separating the factors which may influence function into their own section.

- That bladder and bowel management were separated into two different factors which could each individually influence function.
- That the use of a TLSO during rehabilitation may be a factor that influences function and should be included in section C.
- That respiratory tract infections and weight gain should be removed, as those are not factors that may influence function in individuals with paraplegia at discharge from rehabilitation.

All of the above recommendations were accepted by all team members and the necessary changes were made. A reviewed draft was given to team members and the final consensus and acceptance of the questionnaire was made.

3.5.2 Pilot study

A pilot study was done at Netcare rehabilitation hospital to:

- Determine the amount of time it took to complete the self-designed questionnaire, ASIA classification and SCIM III.
- To check the understanding of the questionnaire and SCIM III instructions by the researcher and participants.
- To check if the data could be entered on the designed data collection spread sheet.
- To check for any unforeseen problems during the data collection process.

3.5.2.1 Methodology of the pilot study

After permission was given by the hospital manager and head of the institutional research committee, five participants (10% of the main study) were recruited to participate in this pilot study. Participants were given an information sheet on the specific details of the pilot study and all individuals who were willing to participate in the pilot study were asked to sign an informed consent form (Appendix C).

<u>The sequence of measurements that took place:</u>

Using each participant's medical hospital file and in conjunction with the participant, the researcher completed the questionnaire and established the ASIA classification. Each of the participants was observed doing the tasks detailed in the SCIM III within the facilities of the rehabilitation unit. All of the 50 SCIM III trials were conducted by the same researcher and in

the same sequence. The same researcher gave instructions to each participant before each trial and recorded all the data during each observation. Participants were observed on different days due to different discharge dates and were not allowed to watch one another completing the SCIM tasks to minimise participant learning which could affect the reliability of the tests. Data was then recorded.

3.5.2.2 Results of the pilot study

It took the following amount of time to administer the following: SCIM 30-40 minutes, ASIA 20-30 minutes, and Questionnaire 5-10 minutes. There was full understanding of the questionnaire and SCIM instructions by both the researcher and participants. Data capturing forms and spreadsheets worked well and there were no modifications or unforeseen problems that occurred.

3.5.2.3 Conclusion of the pilot study

In total it took between 55 and 80 minutes to complete all aspects of the assessment. It was an acceptable length of time and the shortest possible time that could be spent with each participant to ensure the correct data was collected and to ensure that all aspects of the assessment were thoroughly covered.

The entire pilot study was considered successful, as there was good understanding of all aspects by the researcher as well as the participants, and the data entry was smooth and manageable with no unexpected problems. The researcher felt that everything was in order and ready for the main study data collection to begin.

3.5.3 Main study

The researcher sought permission to recruit patients from the spinal rehabilitation units within the Gauteng province. Patients that fitted the inclusion criteria and were, at that time preparing for their discharge from in-patient rehabilitation, identified and asked to participate in the study. An information sheet was handed out and written consent forms were signed by those willing to participate (Appendix B). At this time a file was opened and section A of the self-designed questionnaire was recorded and stored for feedback purposes. A number code was allocated to each participant's personal detail record and to the corresponding section B and C of the self-designed questionnaire, SCIM III and ASIA data collection forms. This was to ensure that their

scores were anonymous. Participants were included in the study in a consecutive manner. At discharge from in-patient rehabilitation the self-designed questionnaire, ASIA assessment form and SCIM III score sheet was completed. This took place at the rehabilitation facility that the participant was admitted into.

The sequence of measurements that took place:

Using each participant's medical hospital file and in conjunction with the participant, the researcher completed the self-designed demographic questionnaire and assessed the participant according to the ASIA scale. Each of the participants was observed doing each of the tasks detailed in the SCIM III within the rehabilitation unit. All of the 50 SCIM III trials for every participant were conducted by the same researcher and in the same sequence. The researcher gave instructions to each participant before each trial and recorded all the data during each trial. Participants were not allowed to watch one another completing the SCIM III tasks, to minimise participant learning which could affect the reliability of the tests.

The following measurements were recorded using data collection forms: ASIA scale indicating each participant's neurological level, and the SCIM III score indicating the participant's level of functional ability. The ASIA and SCIM III data collection forms that were used were organised for the logical and sequential recording of data. All data was then recorded and analysed.

3.6 Ethical considerations

- Permission from respective hospital managers and the heads of the Institutional research committees was sought and granted (Appendices H-K).
- Participants were free to withdraw from the study at any time with no prejudice and for no reason.
- All the participants were required to sign a written consent form to participate in the study (Appendix C).
- An information sheet was availed to the participants at the start of the study explaining all the possible risks and benefits of the study (Appendix B).
- The confidentiality and anonymity of all participants was maintained by: not publicly divulging their names, personal details and also ensuring that their details and scores have been coded and will be destroyed after the study.

- Ethical approval for this study was granted by the University of the Witwatersrand Ethics Committee on Human Research (Appendix G).

3.7 Data analysis

Participants' data was collected and captured in Microsoft Excel 2010. Data were analysed using descriptive statistics for age, gender, race, classification of funder, time to admission to rehabilitation, length of stay, ASIA motor score, all complications post SCI, and SCIM score. The principle analysis was to determine the factors that influence the level of functional ability in patients with SCI at discharge from in-patient rehabilitation.

A univariate analysis was conducted in order to determine significant factors that affect function, using STATA 10 programme. This was followed by a multivariate analysis. In order to prevent the multivariate analysis from being limited, all the variables were included in the multivariate analysis. However, the data was not distributed normally; therefore, the data was transformed and then analysed using the STATA 10 programme.

CHAPTER 4

4. RESULTS

4.1 Introduction

The objectives of this study were to establish the level of functional ability in individuals with SCI resulting in paraplegia, at discharge from in-patient rehabilitation and to then establish demographic and physical factors that influence the level of functional ability in these individuals. Results of this study will be presented in this chapter in the following order:

4.2 Description of the demographic information of the study participants.
4.3 Description of the physical details of the sample population.
4.4 Functional ability of individuals post SCI resulting in paraplegia.
4.5 Factors that influence the functional ability of individuals post SCI resulting in paraplegia.

4.2 Demographic information of the study participants

4.2.1 Age, length of stay, time to admission and ASIA motor score

The average age, length of rehabilitation hospital stay, time to admission into rehabilitation, and ASIA motor score are shown in Table 4.1 below.

Table 4.1 The average age, LOS, TTA and ASIA motor score for the study sample

Factor	Mean	Standard deviation	Minimum	Maximum
Age (years)	40	15.35	18	80
Time to admission to rehabilitation (days)	168.03	10.00	7	1640
Length of rehabilitation stay (days)	89.56	25.84	12	216
ASIA motor score	42	7.76	20	50

The average age at time of injury was 40 (±15.35) years, the average time to admission was 168.03 (±10.00) days, the average rehabilitation length of stay was 89.56 (±25.84) days, and the average ASIA motor score was 42 (±7.76).

4.2.2 Gender Distribution

Figure 4.1 below shows the gender distribution of the study sample.

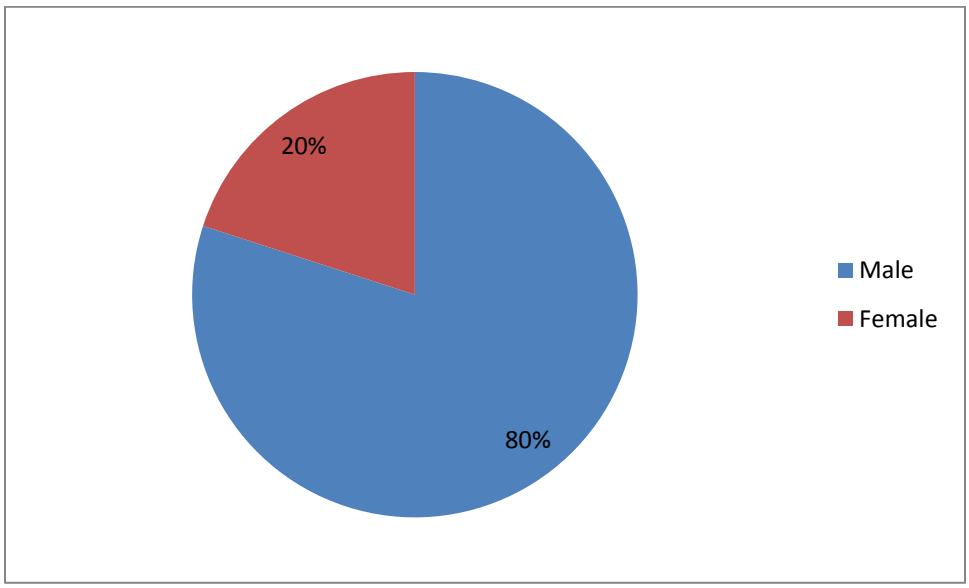

Figure 4.1 Gender distribution (n = 50)

There were more male participants (80%) than female participants (20%).

4.2.3 Race distribution

Figure 4.2 below shows the race distribution of the study sample

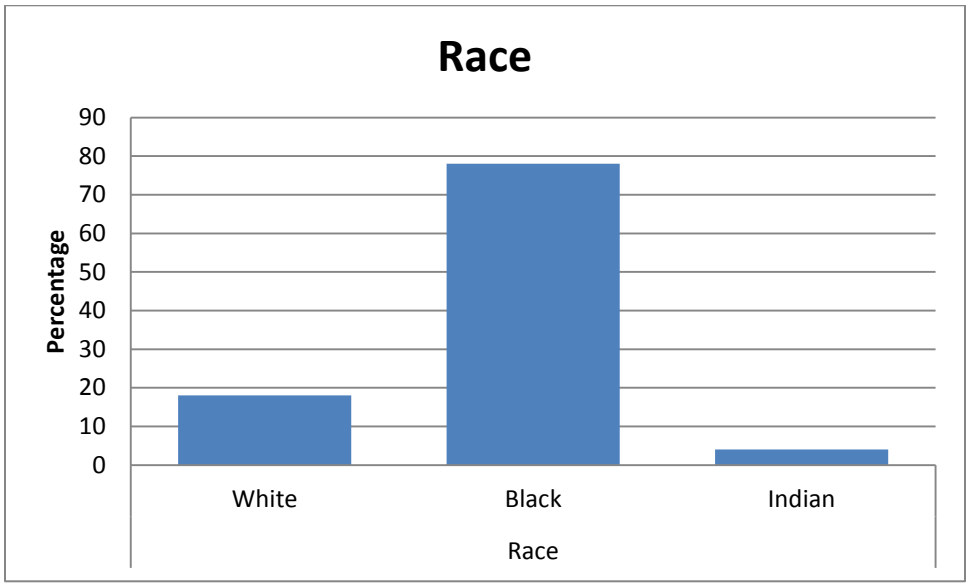

Figure 4.2 Race distribution (n=50)

Majority of the participants in this study were of the black race (78%), with the white race at (18%) and the Indian race at (4%).

4.2.4 Classification of funder

Figure 4.3 below shows the distribution of the classification of funders for the study sample

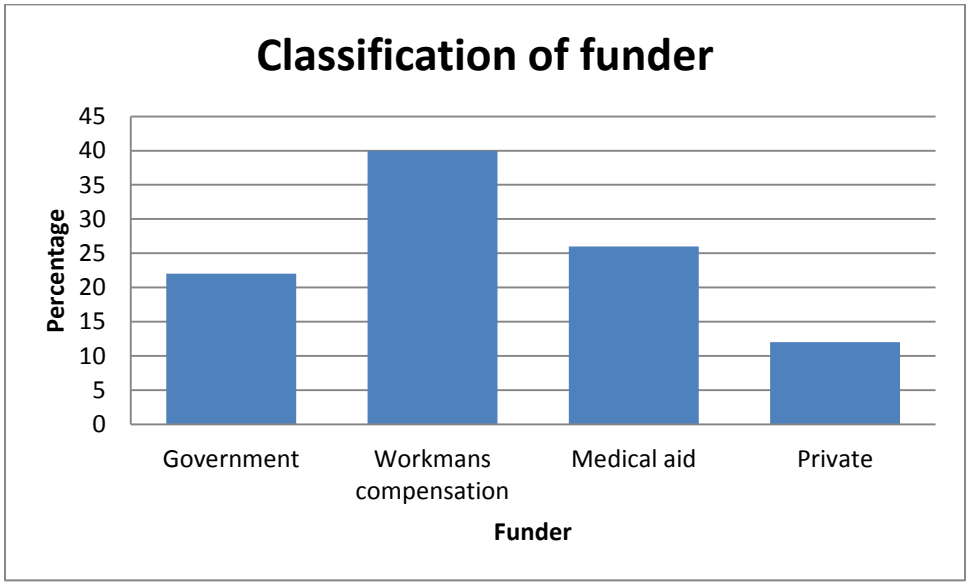

Figure 4.3 Distribution of the classification of funders (n=50)

The majority of the participants in this study sample were classified under workman's compensation classification (40%), with medical aid classifications at (26%), government classifications at (22%) and private classification at (12%).

4.3 Physical details of the sample population

General participants' physical characteristics are shown in Table 4.2 below.

Table 4.2 General physical characteristics of participants in the study sample (n = 50)

Physical detail		**n (%)**
Cause of injury	Traumatic	38 (76)
	Non traumatic	12 (24)
Level of injury	High level injury (T2-T9)	16 (32)
	Low level injury (T10-L3)	34 (68)
TLSO used in Rehabilitation	Yes	8 (16)
	No	42 (84)
Bladder management regime	Yes	41 (82)
	No	9 (18)
Bowel management regime	Yes	39 (78)
	No	11 (22)
Readmission to acute hospital during rehabilitation	Yes	2 (4)
	No	48 (96)

There were more traumatic injuries (76%). More participants sustained a low level of injury (68%), and 82% of participants were on a set bladder management program and 78% of individuals were on a bowel management program.

Complications post SCI in the study sample are shown in Table 4.3 below

Table 4.3 Complications post SCI in the study sample (n=50)

Complication		**n (%)**
Back pain	Yes	21 (42)
	No	29 (58)
Leg pain	Yes	5 (10)
	No	45 (90)
Shoulder pain	Yes	6 (12)
	No	44 (88)
Pressure sores acute hospital	Yes	17 (34)
	No	33 (66)
Pressure sore rehabilitation hospital	Yes	13 (26)
	No	37 (74)
Urinary tract infection	Yes	17 (34)
	No	33 (66)
Spasticity	Yes	12 (24)
	No	38 (76)
Decreased range of movement in lower limbs	Yes	3 (6)
	No	47 (94)

Forty two percent of the participants experienced back pain, and 12% experienced shoulder pain. Thirty four percent of the participants had a pressure sore while in the acute hospital and 26% had a pressure sore while at the rehabilitation hospital.

4.4 Functional ability of individual's post SCI resulting in paraplegia

Figure 4.4 below shows the distribution of the SCIM scores for this study sample.

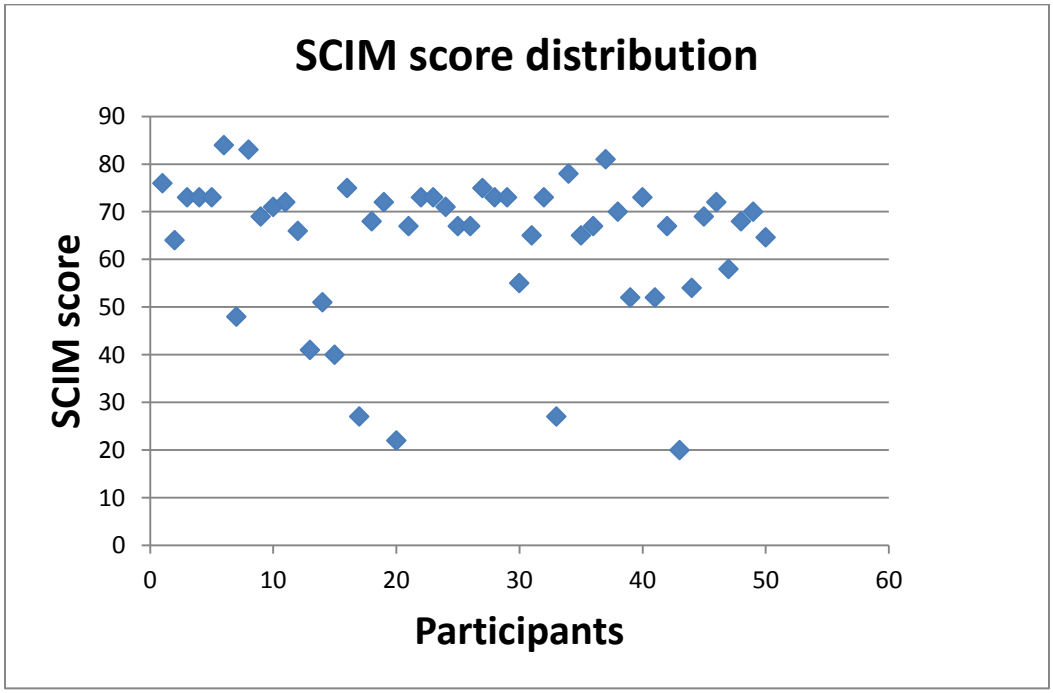

Figure 4.4 Distribution of SCIM scores (n=50)

The average SCIM score in this population was 64.6 (+-27.58) with the lowest score being 20 and the highest score being 84. One score n=1 (2%) fell on the mean, there were n=13 (26%) scores that fell below the mean and n=36 (72%) scores that fell above the mean. In this study the individuals with high level injuries had an average SCIM score of 55.9 and the low level injuries had a SCIM score of 67.5.

4.5 Factors that had a statistically significant influence on the functional ability of individuals post SCI resulting in paraplegia

After the univariate analysis was performed a stepwise regression was done. To check for possible co-linearity the VIF (Variance Inflation Factors) were checked. None of the VIF's were close to 10 and only factors with VIF's above 10 would warrant further investigation for co-linearity, therefore there was no effect of co-linearity in the results. The inclusion criteria for the factors that were included in into the multivariate model were as follows; the probability in each factors result must be significant at the most at 0.1 for the factors to be included.

Table 4.4 below presents the multivariate analysis results of the factors that had an influence on functional ability of individuals post SCI.

Table 4.4 Factors that had a statistically significant influence on function of individuals with SCI on multivariate analysis

SCIM	Coef.	Std. Err.	T	P>|t|	95% Conf. Interval
Age	-0.18	0.09	-2.07	0.05	-0.4 - (-0.003)
LOS	0.06	0.02	2.34	0.03	0.01 – 0.1
Pressure sore at acute hospital	-9.00	3.36	-2.68	0.01	-15.8 – (-2.18)
Spasticity	-8.34	3.00	-2.78	0.01	-14.4 – (-2.3)
Classification of funder					
Reference: Government					
Work comp	-4.82	3.35	-1.44	0.16	-11.63-1.99
Medical aid	-8.07	3.64	-2.21	0.03	-15.5 – (-0.7)
Private	-10.84	4.07	-2.67	0.01	-19.1 – (-2.6)
ASIA motor score	1.29	0.21	6.23	<0.001	0.87 – 1.7
Level of injury					
Reference: High(T2-T9)					
Low(T10-S5)	6.64	0.05	-2.12	0.01	0.76-0.96

For every one year increase in the age of the participant, there was about 0.18% decrease in the SCIM score. For every day increase in LOS, there was a corresponding increase of 0.06%

in the SCIM score. With respect to the presence of a pressure sore from the acute hospital, those who had pressure sores had 9% lower SCIM scores than those who did not have pressure sores. Participants with spasticity had 8.3% lower SCIM scores relative to those that did not have spasticity.

Relative to participants in government funding classification, workman's compensation participants had 4.82% lower SCIM score followed by the medical aid participants with 8.07% lower SCIM and the private participants with 10.84% lower SCIM scores. For every unit increase in the ASIA motor score, there was an increase of 1.29% in the SCIM score. Participants that have a low level of injury had 6.64% higher SCIM score relative to those with high level injury.

4.6 Conclusion

In conclusion, the average SCIM score in this population at discharge from rehabilitation was 64.4. The demographic factors of the population that were found to have an influence on their functional ability after multivariate analysis were; age, ASIA motor score, classification of funder and LOS in rehabilitation. Older participants were less functional younger ones. Participants who had longer length of stays and higher ASIA motor scores were found to be more functional. In relation to participants under the government classification, those under the workman's compensation were found to be the most functional. Participants with low level injuries and those whose injuries were traumatic were more functional.

The physical factors of the population that were found to have an influence on their functional ability after multivariate analysis were; level of injury, the presence of a pressure sore from acute hospital and the presence of spasticity. Participants who sustained a pressure sore in the acute hospital or had spasticity were less functional. These results will be discussed in more detail in the following chapter.

CHAPTER 5

5. DISCUSSION

5.1 Introduction

The aim of this study was to determine factors that influence the functional ability of individuals post SCI at discharge from in-patient rehabilitation. The objectives of this study were to establish the level of functional ability in individuals with SCI resulting in paraplegia, at discharge from in-patient rehabilitation and to establish demographic and physical factors that influence the level of functional ability in individuals with SCI at discharge from in-patient rehabilitation The results were presented in chapter four and will be discussed in this chapter in the following order:

5.2 Demographic information of the study sample.
5.3 Physical details of the study sample.
5.4 Functional ability of individuals with SCI resulting in paraplegia in this study sample.
5.5 Factors that influence functional ability of individuals with SCI injury resulting in paraplegia in this study sample.

5.2 Demographic information of the study sample

The average age of the sample in this study was 40 years, with the youngest patient being 18 years and the oldest 80 years. This is supported by literature which indicates that people of all ages are at risk of a spinal cord injury. McKinley (2007) has found the average age at time of injury to be 38 years. In one study it was reported that patients with non traumatic SCI had a median age of 69 years (New, 2005), and in another study in Australia nearly half (47%) of the patients were aged older than 65 years on admission, and only 11% were younger than 40 years at age of onset (New, 2007).

There were more male participants (80%) than female participants (20%) in this study. Previous studies have also found that males are more commonly affected by SCI than females, with males accounting for up to 77% of the total SCI population (McKinley, 2007; Eng and Miller 2008). The male to female ratio has been found to be in the range of 2,5:1 to 5,8:1 in a study by

Eng and Miller (2008). In an Australian study there was fairly even gender distribution where only 46% of participants were male (New, 2007).

There were more traumatic injuries (76%) than non-traumatic (24%) in this study. In South African literature it has been found that traumatic lesions were more frequent and mostly in younger persons (<50), and non-traumatic lesions were more frequent in older persons (>50) (Hart et al., 1994). Hart et al. (1994) had similar findings to this study as this studies average age was 40years (<50) and more of the injuries in this study sample were traumatic in nature.

The average TTA of the sample in this study was 356 days, with the shortest being 7 days, and the longest being 3650 days. Statistics available from a private rehabilitation facility in Johannesburg South Africa show that the time to admission to the rehabilitation hospital is one to two weeks post injury but can be as long as six weeks post injury (Henn, 2009). Celani et al. (2001) found that there was an average time to admission of 55 days after a traumatic SCI, and 167 days for non-traumatic SCI. Similar results were found by (Scivoletto et al., 2005) with a TTA of 57 days after traumatic SCI (Scivoletto et al., 2005). The mean TTA in this study was much longer than that in local and international studies. These results show that there was a large distribution of scores around the mean and that this sample's scores were widely displaced. The longest TTA score in this study was 3650 days which is much longer than the rest of the scores in this study. Individuals in this study with a longer outlier score may be due to different factors such as living in a remote rural part of the country and not having access to a rehabilitation facility despite sustaining a SCI up to 10 years before admission into a rehabilitation hospital. The overall delivery and availability of both public and private sector health care benefits in South Africa is pro-rich; poorer socio-economic groups benefit less from the use and availability of health services than richer socio-economic groups in South Africa (Ataguba and McIntyre, 2012).

The average LOS of this study sample was 96 days, with the shortest being 12 days and the longest being 337 days. Length of stay at one of the rehabilitation hospitals in Johannesburg, for rehabilitation of individuals with complete paraplegia was found to be 86 days to achieve all necessary functional goals (Henn, 2009). Average international LOS values were as follows; 20-74 days in the USA (McKinley et al., 2002), 56-61 days in Australia (New et al., 2007), 91-143 days in Italy (Celani et al., 2001), 150 days in Bangladesh (Sconherr et al., 1996) 154 days

in Netherlands (Hoque et al., 1999), 198-222 days in Spain (Bravo et al., 1993), and 149-285 days in Denmark (Biering-Sorensen et al., 1990). The mean LOS in this study was longer than other local studies but shorter than some international studies.

The majority of this sample was classified under workman's compensation classification (40%), with medical aid classifications at (26%), government classifications at (22%) and private classification at (12%). Due to an increasing need to cut expenses by funders, individuals receive a reduced length of stay in rehabilitation units (Ronen et al., 2004). In this study the workman's compensation patients had the longest length of stay followed by individuals under medical aid classification, followed by individuals under the government classification and individuals who paid privately for rehabilitation had the shortest length of stay. Government funded institutions have a high demand for access to healthcare and often have shortage of beds in the rehabilitation unit which case each individual admitted into the facility has a strict number of days to complete their rehabilitation in so that another individual may begin their rehabilitation. In the author's clinical experience, most private medical aids approve funding for rehabilitation on a week to week basis pending weekly reports and motivation letters from the rehabilitation therapists. Some individuals do not have medical aid policies and choose to pay for private rehabilitation in their own personal capacity, this however does become unaffordable for the average individual and therefore they do not receive an adequate in-patient LOS as they cannot afford the rehabilitation expense in their personal capacity.

The average ASIA motor score of the sample was 42, thus on average participants in this study had Oxford grade 3/5 and 4/5 muscle strength in their upper limbs. Grade 3/5 muscle strength is defined as the ability to perform the full active movement through the full range of movement against gravity (Maynard et al., 1997). The implications of a mean ASIA motor score of 42 out of 50 shows that not all participants reached the maximum Oxford grading scale of 5/5 strength in their upper limbs. The stronger the upper limbs of an individual with a paraplegic SCI, the easier it is for the individual to complete physical functional tasks such as transfers and wheelchair mobility skills (Chen et al., 2003).

5.3 Physical details of the study sample

In this sample there were more traumatic injuries (76%) than non-traumatic (24%). This was an expected finding as it has been shown in previous local studies that traumatic injuries account for 89% of all spinal cord injuries within South Africa (Hart et al., 1994). Most individuals (82%) were on a set bladder management program and (78%) of individuals were on a bowel management program. During in-patient rehabilitation at the rehabilitation hospitals used in this study, every individual is taught a bladder and bowel management program. Many individuals with a SCI do not become fully continent, it is important that they achieve optimal independence in their bladder and bowel care in order to prevent incontinence as much as possible (Schonherr et al., 1999).

Forty two percent of the study sample experienced back pain, 10% experienced leg pain and 12% experienced shoulder pain. Studies have described an incidence of pain from 48-94%, and estimates that disabling severe pain ranges between 11-34% of SCI (Cairns et al., 1996). In another more recent study it was found that pain after SCI can range from 35%-73% of individuals post injury and the most common site of pain is in the shoulders (Nash et al., 2008). The results for this study are similar to the reported percentage of individuals affected with pain post SCI in other studies in the literature (Nash et al., 2008). In this current study the percentage of individuals with shoulder pain was less than the percentage of individuals with back pain, this may be due to shoulder pain taking longer to develop as it is usually related to overuse injuries of the shoulders and upper limbs (Nash et al., 2008). The high percentage of individuals experiencing back pain could be due to musculoskeletal pain from the injury itself, incorrect seating posture and wheelchair use or from neurogenic pain at the level of the lesion (Sjolund, 2002).

Thirty four percent of the participants had a pressure sore while in the acute hospital and 26% had a pressure sore during their rehabilitation. This is similar to results of a study performed in Dutch rehabilitation units in the Netherlands where it was recorded that during acute care or rehabilitation, where 34% of the patients developed at least one pressure ulcer (Verschueren et al., 2011). In the same study the occurrence of pressure ulcers was 36.5% during the acute hospital phase and 39.4% during the functional rehabilitation hospital phase, which is different from this current study as in this study there were more individuals who sustained a pressure sore in the acute hospital compared to those who sustained a pressure sore in rehabilitation

hospital. In the authors opinion this difference may be due to a greater emphasis being placed on pressure care and the prevention of pressure sores by rehabilitation facilities as compared to acute hospitals. The occurrence and risk factors for pressure ulcers during initial in-patient rehabilitation of SCI patients is unclear (Verschueren et al., 2011). The average TTA in Verschueren et al. (2011) was 35 days (range 25–61 days) whereas in this study the average TTA of the sample was 356 days, with the shortest being seven days, and the longest being 3650 days. A shorter TTA in the Dutch study could indicate that the majority of individuals are admitted to rehabilitation units sooner than the individuals in this study. In the acute stage post injury an individual is dependent on others for all mobility and functional activities and therefore making them more prone to developing complications of immobility such as pressure sores.

Thirty four percent of participants in this study had a UTI while in a rehabilitation hospital. After a SCI it has been found that an individual will experience between 1.82 and 2.6 symptomatic UTI's per year (Opperman, 2010). In a study conducted in Spain it was reported that only 10-15% of individuals with SCI had a UTI which is much less than the results found in this study (Garcia Leoni and Esclarin De Ruz, 2003). In the authors opinion this difference may be due to a more stringent infection control program internationally or from a stricter approach to hand washing and catheter apparatus cleaning before and after each use, it may also be due to different approaches in the teaching process of individual's with SCI to manage their bladder program.

Twenty four percent of participants in this study experienced spasticity in their lower limbs. In another study by Noreau et al. (2000) it was found that up to 70% of individuals with SCI develop spasticity that may cause considerable disability (Noreau et al., 2000). That value is a lot higher than the result found in this study and this may be because spasticity may take months or years to develop after the acute SCI (Noreau et al., 2000).

Six percent of the participants in this study experienced decreased range of movement in their lower limbs. These individuals were among the participants who experienced spasticity in their lower limbs. Severe spasticity may contribute to contractures and decreased ROM (Yelnik et al., 2010). Another reason for the lower limb decreased range of movement in this study is that SCI results in varying degrees of paresis, this paresis can lead to adaptive shortening of muscles that change the afferent input that is going to the spinal cord (Gracies 2005). This in turn

exacerbates the spasticity and causes the development of contractures, limited range of movement, and abnormal positioning (Gracies 2005).

5.4 Functional ability of individuals with SCI injury resulting in paraplegia in this study group

The average SCIM score in this population was 64.6 with the lowest score being 20 and the highest score being 84. Higher SCIM III scores indicate better execution of more difficult functional tasks. In contrast, lower scores indicate that a higher amount of assistance is required to complete a functional task (Bluvshtein et al., 2012). Although higher scores represent higher functionality, an individual with a total score below a minimal value (which is the sum of the minimal scores that represent independent functioning which is a score of 70 for SCIM III) is not functionally independent (Bluvshtein et al., 2012). From this it is seen that the majority of the participants in this study were discharged from rehabilitation without reaching functional independence. Similar results were found in a study by Aidinoff et al. (2011) where the average discharge SCIM score in paraplegic individuals was 67.8, which is not much higher than the average SCIM score in this study, and it shows that the majority of those individuals also did not reach functional independence by the time they were discharged from rehabilitation.

In another study performed in Switzerland by Wirth et al. (2008) 64 patients with motor complete paraplegia had their functional ability assessed on admission to, and discharge from a rehabilitation hospital, as well as one year post injury. The average rehabilitation LOS in the study was 157 days (-+55days) and varied between three and six months (Wirth et al., 2008). At discharge from rehabilitation the mean SCIM score increased from 60 at the earliest discharge of three months to a score of 71 at the latest discharge time of six months (Wirth et al., 2008). From these results it can be seen that individuals discharged at three months were not functionally independent as they did not reach scores of 70 and above (Bluvshtein et al., 2012). The individuals that were discharged at six months did reach functional independence (Wirth et al., 2008). In this present study the average LOS was 96 days or approximately three months, and the average SCIM score was 64.6. Compared to the study by Wirth et al. (2008) this current study had a shorter average LOS, but had higher SCIM scores when compared to the individuals that were discharged from rehabilitation at three months.

The functional independence of individuals with compete SCI at discharge from rehabilitation was found to be consistently higher when the neurological level of injury was more caudal (Aidinoff et al., 2011). In the abovementioned study the average of two maximum SCIM scores was calculated for each level of complete paraplegic injury, this was to develop the target SCIM score values for each level of injury (Aidinoff et al., 2011). The maximum average target score for all paraplegic injuries is 73.6 (Aidinoff et al., 2011). The maximum target score for high level injuries (T2-T9) is 70.3, and for low level injuries (T10-L2) is 76.9 (Aidinoff et al., 2011). Both these scores show that the target SCIM score for all levels of paraplegic injuries is above 70, and therefore the goal for these individuals at discharge from rehabilitation is a level of functional independence (Aidinoff et al., 2011). In this current study the high level injuries had an average SCIM score of 55.9 and the low level injuries had a 67.5. When compared to the study by Aidinoff et al. (2011), both of the groups in this study did not achieve functional independence and did not achieve scores near to the maximum target scores for these levels of injuries. These differences may be due to differences in the methodologies and demographics of the studies. The average age of participants in this current study was older, the average LOS shorter, TTA longer, and less traumatic SCI's compared to the study by Aidinoff et al. (2011). The difference in these factors may influence the difference in SCIM scores between the populations.

Independent levels of functioning have frequently not been achieved in individuals with paraplegia at the time of discharge from rehabilitation. This finding might even be more noticeable by the trend toward shorter length of in-patient rehabilitation, therefore emphasizing the importance of outpatient rehabilitation after discharge in order to reach full levels of functional independence.

5.5 Factors that influence functional ability of individuals with SCI injury resulting in paraplegia in this study sample

5.5.1 Age

For every one year increase in the age of the participant, there was about 0.18% decrease in the SCIM score. This was an expected result as it has been previously reported that in individuals with paraplegia, age appears to adversely affect functional outcome (Cifu et al., 1999; New, 2007; McKinley et al., 2003). New (2007) also found a statistically significant

negative correlation between the participant's age and the FIM mean motor subscale score at discharge. This may be because when compared with younger patients, older patients with SCI have reduced functional reserves with greater comorbidities and are more likely to have been physically disabled or weaker prior to their SCI (McKinley et al., 2003).

5.5.2 Length of hospital stay

For every day increase in LOS, there was a corresponding increase of 0.06% in the SCIM score. This was an expected result as in other literature it has been found that a longer LOS is associated with a higher functional gain (McKinley et al., 2002; Ronen et al., 2004). The longer the length of stay in rehabilitation, the greater the opportunity for an individual with a SCI to achieve all of their functional goals before discharge except in individuals with a more severe clinical and medical condition who have slower functional gains (Ronen et al., 2004).

5.5.3 Pressure sores

With respect to the presence of a pressure sore from the acute hospital, those individuals who had pressure sores had 9% lower SCIM scores than those who did not have pressure sores. In this study 36% of participants had a pressure sore whilst in the acute hospital and 26% had a pressure sore whilst in the rehabilitation hospital.

During rehabilitation the maintenance of an already existing pressure sore or the management of a new pressure sore includes the individual avoiding any pressure to that area until the wound is fully healed (example: if an individual has a sacral pressure sore they will not be allowed to sit or lie supine until the wound is fully healed). This may delay the individual's functional ability as it leads to avoidance of functional positions, prolonged periods of immobility, increased LOS, funders refusing to pay for further rehabilitation, delay the overall accomplishment of achieving rehabilitation goals, as well as a delay in the correct seating of the individual and their acquisition of wheelchair skills (Chen et al., 2005).

5.5.4 Spasticity

Participants with spasticity had 8.3% lower SCIM scores relative to those that did not have spasticity. The individuals who experienced spasticity in their lower limbs were significantly less

functional than those who did not have spasticity. Yelnik et al. (2010) also reported that spasticity may contribute to decreased functional ability post spinal cord injury.
Light to moderate spasticity has been shown to have a positive effect on the functional ability in individuals post SCI (Adams and Hicks, 2005). Moderate spasticity may make it possible for individuals with lower limb paresis to perform all mobility transfers with more ease and independence, therefore allowing higher overall SCIM scores to be reached (Adams and Hicks, 2005). Severe spasticity may contribute to decreased functional ability, contractures (decreased ROM), incorrect posture, pressure sores and pain, all of which may negatively impact an individual's ability to independently perform mobility and activities of daily living tasks (Yelnik et al., 2010). Spasticity can prevent functional independence; by preventing transfers, and negatively affecting seating (Yelnik et al., 2010).

Treatment techniques such as rhythmic passive movements, neural facilitation techniques, prolonged standing and passive cycling movements were used in both facilities. This is in line with treatment techniques discussed in the literature studies by Kakebeeke et al. (2005) and Kirchblum (1999), although the individuals' spasticity in this study still had a negative impact on the individuals functioning. If moderate to severe spasticity is adequately managed and controlled with medical/ pharmaceutical and non-medical/pharmaceutical interventions it could allow for the possibility of full functional independence in individuals with paraplegia, this shows that the spasticity of participants in this study was not adequately controlled and managed as the participants with spasticity had lower functional abilities than those without spasticity.

5.5.5 Level of injury and ASIA motor score

Participants that have a low level of injury had 6.6% higher SCIM score relative to those with high level injury. Similar results were found by Bluvshtein et al. (2012) where it was found that an individual's functional ability may be determined by the level of spinal cord injury (Bluvshtein et al., 2012). In another study the same result was found where the functional independence measure gain during rehabilitation was consistently higher when the neurological level was lower in individuals with complete SCI (Aidinoff et al. 2011). The lower the level of injury, the more muscles that are fully innervated and the better strength and balance that an individual will therefore making it easier for the individual to accomplish physical mobility tasks and functional goals than an individual with a high level of injury.

For every unit increase in the ASIA motor score, there was an increase of 1.3% in the SCIM score. The average ASIA motor score of the sample was 42, thus on average participants in this study had Oxford grade 3/5 and 4/5 muscle strength in their upper limbs. The implications of a mean ASIA score of 42 out of 50 shows that not all participants reached the maximum Oxford grading scale of 5/5 strength in their upper limbs. A similar result was found by Chen et al. (2003), that the stronger the upper limbs of an individual with a paraplegic SCI, the easier it is for the individual to complete physical functional tasks such as transfers and wheelchair mobility skills and therefore they will score higher SCIM III scores and have an overall higher functional ability (Chen et al., 2003).

5.5.6 Source of funding for medical care

Relative to participants in government funding classification, workman's compensation participants had 4.8% lower SCIM score followed by the medical aid participants with 8.1% lower SCIM and the private participants with 10.8% lower SCIM scores. This indicates that in comparison to government classification the private participants were least functional when compared to the government participants. From the authors clinical experience individuals who are funded by workman's compensation have the longest length of stay in a rehabilitation hospital, followed by those under government medical aids and privately funded individuals. Should a funder not supply adequate funds for full rehabilitation in a private rehabilitation facility, an individual may be discharged prematurely. From the literature it can inferred that LOS restrictions put in place by funders may negatively impact on the functional ability of an individual with SCI (Ronen et al., 2004).

The demographic information and physical details of the study sample was discussed.

The functional ability of individuals with paraplegia as well as the factors that were found to influence the functional ability of this study sample was also discussed. In the discussion of the abovementioned results it was concluded that the findings in this study regarding the functional ability of individuals with paraplegia was lower than that in international literature. The discussion also confirmed that the factors which were found to influence the functional ability of the individuals in this study population were congruent with the trends found in International literature.

CHAPTER 6

6. Conclusion, Limitations, Clinical implications and recommendations

6.1 Conclusion

This study set out to establish the level of functional ability in individuals with paraplegia and it was found that the majority of the participants in this study were discharged from rehabilitation without reaching functional independence. The physical and demographic factors of the study population were described. In this study the following factors were found to have a negative influence on the functional ability of an individual at discharge from in-patient rehabilitation after sustaining a SCI resulting in paraplegia: being of older age, having a short rehabilitation length of stay, being funded privately, having a low ASIA motor score, having a pressure sore or spasticity, and having a higher level of injury to the spinal cord.

6.2 Limitations

Although this study identified the factors that influence the functional ability of individuals at discharge from rehabilitation, it did not focus on the functional ability of the participants on admission into rehabilitation. Further research comparing the admission and discharge functional ability scores is recommended. It would also be interesting to evaluate the differences in the amount of daily rehabilitation therapy sessions in place to improve the physical abilities of this population, and the effectiveness of the actual rehabilitation therapy on the functional ability of individuals. Further research could also be done locally to compare and describe the differences among the sub-sections of the SCIM III within this population, and not only the average SCIM III score, and also to compare other factors such as psychosocial and co-morbidities to the functional ability of individuals with paraplegia. This study did not measure the level or intensity of the spasticity which participants had; it is recommended that future studies done of this nature should include the spasticity. This study did not include the amount or type of rehabilitation that participants received in their daily rehabilitation inpatient stay, this was a limitation and further research could be done to include this.

6.3 Clinical implications and recommendations

This study revealed that certain factors have a negative influence on an individual's functional outcome post SCI. Therapists in the Gauteng region would be able to enhance their treatment efficacy and rehabilitation goal setting by paying special attention to the following:

- To look at each patient with a SCI as an individual taking into account the age of the individual.
- To try and fully educate all individuals and their families about the possible secondary complications of SCI and the prevention of these, especially pressure sores and spasticity.
- To try to maintain or restore full functional grade 5/5 strength in all fully innervated muscles especially those in the upper limbs in order for each individual with a SCI to achieve the highest possible ASIA motor score.
- When working towards functional recovery of an individual with SCI, therapists should do regular ASIA testing to monitor changes in an individual's neurological level of injury and take into account the functional implications of a high or lower level lesion.

This study set out to establish the level of functional ability in individuals with paraplegia, this was achieved and it was found that the majority of the participants in this study were discharged from rehabilitation without reaching functional independence. The physical and demographic factors of the study population were also described and the study concludes that there are several factors that do influence the functional ability of individuals with paraplegia.

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Appendices

Appendix A

Definitions of terms used in the study

Spinal cord injury: An insult to the spinal cord resulting in a change, either temporary or permanent, in the normal motor, sensory or autonomic function.

Functional independence: optimal physical, sensory, intellectual, psychological and social functional levels..

Outcome measure: A measurement tool used to document the change in one or more than one characteristic over a certain period of time (Cole et al., 1994).

Paraplegia: An individual with a spinal cord injury at the thoracic, lumbar, or sacral level that affects the lower limbs (Harvey, 2008).

Functional independence: Is the independence in activities of daily living, transfers, bed mobility and wheelchair dexterity (Eng & Miller 2008).

Rehabilitation: Is described as a goal orientated and time limited process which is aimed at enabling an impaired individual to reach an optimum mental, physical and social functional level, thus providing one with tools to change ones life when and where necessary. The WHO defines rehabilitation as a combined and coordinated use of medical, social, educational and vocational measures to enable the individual to reach the highest level of functional activity.

Independence: defined as the ability to perform an activity without the help of another person (with or without an assistive device or orthosis).

Complication: A complication has chronological relation to an injury or event, e.g. a SCI needs to precede the complication.

Appendix B

Information sheet

INFORMATION SHEET

Factors that influence the functional ability in individuals with a spinal cord injury.

Good Day

Hello, my name is Bronwyn Hastings; I am busy doing my masters degree through the Physiotherapy Department at the University of the Witwatersrand. You are invited to participate in my research. I am conducting research looking at the level of functional ability in individuals with spinal cord injuries I would be most grateful if you would consider participating in this observational research project.

Why am I conducting this study?
The most important goal in the rehabilitation process of individuals with a spinal cord injury is to maximise their chance of living a fully independent life after their injury and therefore every rehabilitation and therapeutic intervention should be directed towards achieving this good outcome.
Current research showing the functional ability of individuals after spinal cord injury is very limited, even more so in South Africa. I am interested in observing and recording such functional outcomes in order to gain a better understanding of the factors that influence the functional ability of individuals with a spinal cord injury in Gauteng. This is beneficial in that this research may assist health professionals in understanding, and possibly predicting the physical prognosis of individuals with spinal cord injuries.

What may participants be expected to do in this study?
I wish to observe you perform several functional tasks and also determine what factors have affected your performance of these tasks at the time of your discharge from a rehabilitation facility. You will therefore be required to attempt activities such as sitting, rolling, moving from one point to another, balancing, climbing stairs, and using a wheelchair. The participants' abilities in such activities will be observed and recorded according to the Spinal Cord Independence Measure (SCIM III), which is a completely observational assessment. Participants will also be required to complete a questionnaire in conjunction with the researcher. These observations will be recorded at your discharge from the Rehabilitation Hospital. Each session will require approximately one hour- (will be confirmed in the pilot study) of the participant's time. Each participant will be observed in the ward and rehabilitation facility they are about to be discharged from. In case of emergencies there will be an emergency trolley in each gym and ward, and I am trained in first aid and CPR.

What are the benefits of this study?
The Knowledge of factors that influence the level of functional ability in individuals with spinal cord injury are not well researched in Gauteng. If factors are identified that affect the functional ability levels by discharge from rehabilitation this may help to determine whether specific intervention protocols may be introduced to strengthen prevention measures of the negative factors. This study may bring light

into the amount of care and dependency that individuals with spinal cord injury will face as they are discharged. This study has the potential to expand on the existing knowledge of spinal cord injury in Gauteng. This study may also help in developing standardised rehabilitation length of stay guidelines for facilities within Gauteng.

Are there any risks if I participate?
As there is no intervention being done, there are no risks involved in this study. Participants may feel some physical discomfort and become tired or feel stiff after completing the physical functional activities.

May I withdraw from the study?
Any person may withdraw from the study at any time, without having to give a reason. This study is completely voluntary and not taking part in it, or withdrawing from it, is completely up to you. There will be no consequences involved.

Will participants' personal information be confidential?
Absolutely. All personal information will be kept confidential at all times. No names will be used, instead, information will be coded and each individual given a coded number. This coded number will be linked to each participant, and only known by the researcher (myself) so that anonymity and confidentiality are kept. In addition, information will be kept safely out of unofficial reach and locked in my office. Only the abovementioned researcher will have access to this information.

How long will the research take?
This research will involve around one hour in total per participant. The completion of this research project will be roughly December 2011 at which time a feedback letter will be sent out to inform all participants of the results of the study.

If you have any queries, please feel free to contact me:

084 825 5330 or 011 489 1212 – Bronwyn Hastings

If you would like to participate in this research, I would greatly appreciate it and would ask you to please sign the attached consent form.

Thank you,

Bronwyn Hastings
Physiotherapist Netcare Rehabilitation Hospital

Appendix C

Patient consent form

I, _____ , have read the attached information sheet and agree to participate in the respective study: “Factors that influence the functional ability of individuals with a spinal cord injury ”. I also understand that I am free to withdraw from the study at any time and without having to give a reason. I understand the risks and benefits of participating in this study.

I consent to the use of my information obtained in the above mentioned tasks, during research for academic purposes at the University of the Witwatersrand only.

Participant signature: _____

Date: _____

Appendix D

Questionnaire

QUESTIONNAIRE

Title of Study: Factors that influence functional ability in individuals with spinal cord injury.

Names of Researcher: Bronwyn Meloney Hastings

Section A: Demographic Details code: _____

- Name and surname:_____
- Rehabilitation Hospital:_____
- Home phone number:_____
- Cell phone number:_____
- Home address:_____
- Postal address:_____

Section B: Factors that may influence function code: _____

1. Age: _____

2. What caused your spinal cord injury?

_____

3. Date of injury: _____

4. Date admitted to the acute hospital: _____

5. Date discharged from the acute hospital:_____

6. Date admitted to the rehabilitation hospital: _____

7. Date discharged from the rehabilitation hospital: _____

8. Were you readmitted into an acute hospital during your rehabilitation? _____

9. Race:

White		Black		Coloured		Indian		Asian	

10. Gender:

Male		Female	

11. Do you have a set bowel regime?

Yes	No

12. Do you have a set bladder regime?

Yes	No

Section C: Complications since SCI

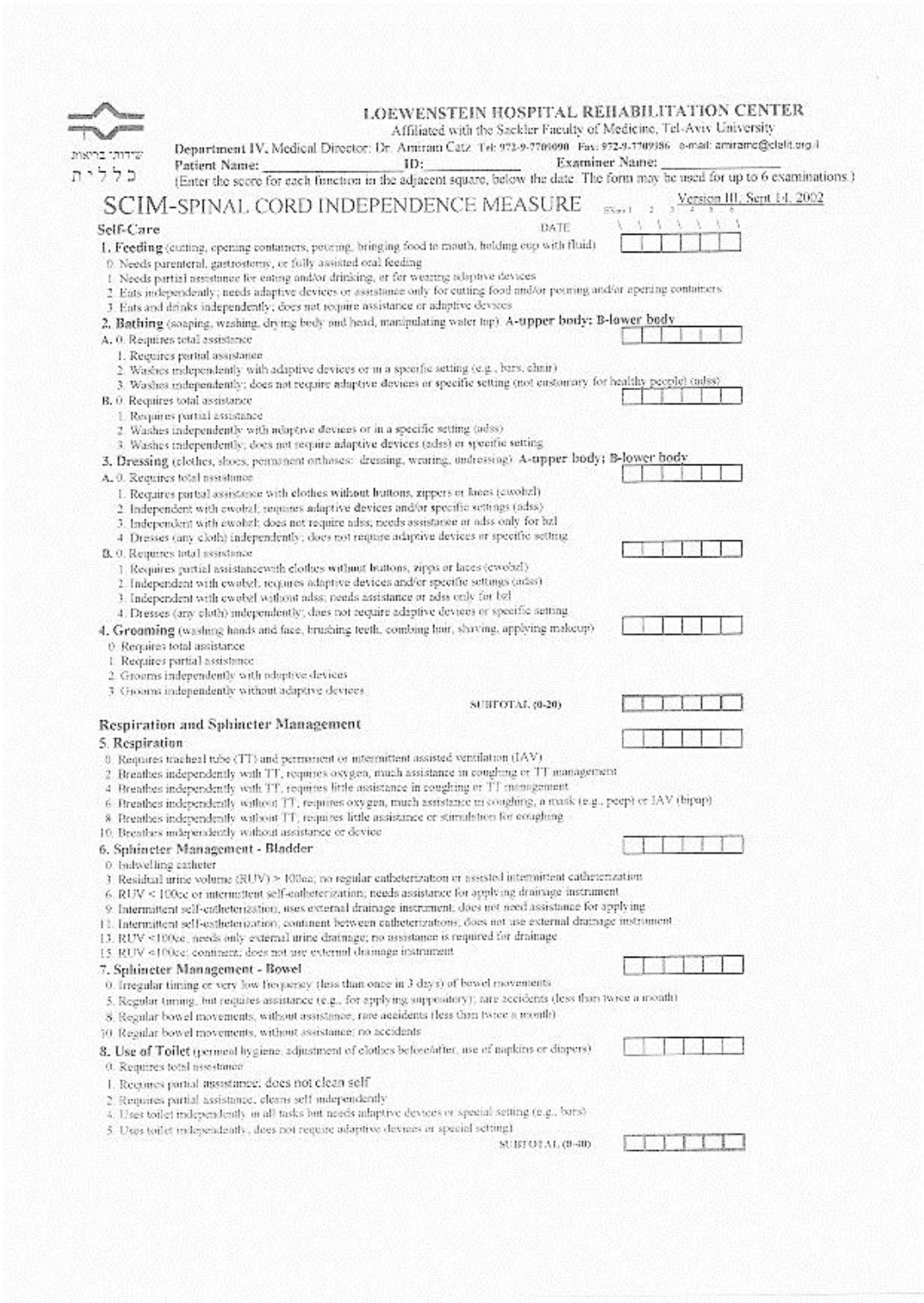
13

	Yes	No
Pain in back		
Pain in legs		
Pain in shoulders		
Decreased movement at joints(from acute hospital)		
Uncontrolled movements of arms and legs-spasms		

Pressure sore (acute hospital)		
Pressure sore (rehabilitation hospital)		
Urinary tract infection		
Did you wear a back brace after SCI (TLSO)?		
Tick which funding option applies to you below:		
Government classification		
Workmans compensation (WCA)		
Medical aid fund		
Privately funded		

Appendix E

The Spinal Cord Independence Measure



LOEWENSTEIN HOSPITAL REHABILITATION CENTER
Affiliated with the Sackler Faculty of Medicine, Tel-Aviv University
שיקומית בריאות
מ ל ר ת
Department IV. Medical Director: Dr. Amiram Catz. Tel: 972-9-7709090 Fax: 972-9-7709186 e-mail: amiramc@clalit.org.il
Patient Name: _____ ID: _____ Examiner Name: _____
(Enter the score for each function in the adjacent square, below the date. The form may be used for up to 6 examinations.)

SCIM-SPINAL CORD INDEPENDENCE MEASURE Version III, Sept 14, 2002

DATE

Self-Care

1. Feeding (cutting, opening containers, pouring, bringing food to mouth, holding cup with fluid)
0. Needs parenteral, gastrostomy, or fully assisted oral feeding
1. Needs partial assistance for eating and/or drinking, or for wearing adaptive devices
2. Eats independently; needs adaptive devices or assistance only for cutting food and/or pouring and/or opening containers
3. Eats and drinks independently; does not require assistance or adaptive devices

2. Bathing (soaping, washing, drying body and head, manipulating water tap) **A-upper body; B-lower body**
A. 0. Requires total assistance
1. Requires partial assistance
2. Washes independently with adaptive devices or in a specific setting (e.g., bars, chair)
3. Washes independently; does not require adaptive devices or specific setting (not customary for healthy people) (adss)
B. 0. Requires total assistance
1. Requires partial assistance
2. Washes independently with adaptive devices or in a specific setting (adss)
3. Washes independently; does not require adaptive devices (adss) or specific setting

3. Dressing (clothes, shoes, permanent orthoses: dressing, wearing, undressing) **A-upper body; B-lower body**
A. 0. Requires total assistance
1. Requires partial assistance with clothes without buttons, zippers or laces (ewobzl)
2. Independent with ewobzl; requires adaptive devices and/or specific settings (adss)
3. Independent with ewobzl; does not require adss; needs assistance or adss only for bzl
4. Dresses (any cloth) independently; does not require adaptive devices or specific setting
B. 0. Requires total assistance
1. Requires partial assistancewith clothes without buttons, zipps or laces (ewobzl)
2. Independent with ewobzl; requires adaptive devices and/or specific settings (adss)
3. Independent with ewobzl without adss; needs assistance or adss only for bzl
4. Dresses (any cloth) independently; does not require adaptive devices or specific setting

4. Grooming (washing hands and face, brushing teeth, combing hair, shaving, applying makeup)
0. Requires total assistance
1. Requires partial assistance
2. Grooms independently with adaptive devices
3. Grooms independently without adaptive devices

SUBTOTAL (0-20)

Respiration and Sphincter Management

5. Respiration
0. Requires tracheal tube (TT) and permanent or intermittent assisted ventilation (IAV)
2. Breathes independently with TT, requires oxygen, much assistance in coughing or TT management
4. Breathes independently with TT, requires little assistance in coughing or TT management
6. Breathes independently without TT, requires oxygen, much assistance in coughing, a mask (e.g., peep) or IAV (bipap)
8. Breathes independently without TT, requires little assistance or stimulation for coughing
10. Breathes independently without assistance or device

6. Sphincter Management - Bladder
0. Indwelling catheter
3. Residual urine volume (RUV) > 100cc; no regular catheterization or assisted intermittent catheterization
6. RUV < 100cc or intermittent self-catheterization, needs assistance for applying drainage instrument
9. Intermittent self-catheterization, uses external drainage instrument, does not need assistance for applying
11. Intermittent self-catheterization; continent between catheterizations; does not use external drainage instrument
13. RUV <100cc, needs only external urine drainage; no assistance is required for drainage
15. RUV <100cc; continent; does not use external drainage instrument

7. Sphincter Management - Bowel
0. Irregular timing or very low frequency (less than once in 3 days) of bowel movements
5. Regular timing, but requires assistance (e.g., for applying suppository); rare accidents (less than twice a month)
8. Regular bowel movements, without assistance; rare accidents (less than twice a month)
10. Regular bowel movements, without assistance; no accidents

8. Use of Toilet (perineal hygiene, adjustment of clothes before/after, use of napkins or diapers)
0. Requires total assistance
1. Requires partial assistance; does not clean self
2. Requires partial assistance; cleans self independently
4. Uses toilet independently in all tasks but needs adaptive devices or special setting (e.g., bars)
5. Uses toilet independently; does not require adaptive devices or special setting

SUBTOTAL (0-40)

Mobility (room and toilet) DATE \ \ \ \ \ \ \

9. Mobility in Bed and Action to Prevent Pressure Sores

0. Needs assistance in all activities: turning upper body in bed, turning lower body in bed, sitting up in bed, doing push-ups in wheelchair, with or without adaptive devices, but not with electric aids
2. Performs one of the activities without assistance
4. Performs two or three of the activities without assistance
6. Performs all the bed mobility and pressure release activities independently

10. Transfers: bed-wheelchair (locking wheelchair, lifting footrests, removing and adjusting arm rests, transferring, lifting feet).

0. Requires total assistance
1. Needs partial assistance and/or supervision, and/or adaptive devices (e.g., sliding board)
2. Independent (or does not require wheelchair)

11. Transfers: wheelchair-toilet-tub (if uses toilet wheelchair: transfers to and from; if uses regular wheelchair: locking wheelchair, lifting footrests, removing and adjusting armrests, transferring, lifting feet)

0. Requires total assistance
1. Needs partial assistance and/or supervision, and/or adaptive devices (e.g., grab-bars)
2. Independent (or does not require wheelchair)

Mobility (indoors and outdoors, on even surface)

12. Mobility Indoors

0. Requires total assistance
1. Needs electric wheelchair or partial assistance to operate manual wheelchair
2. Moves independently in manual wheelchair
3. Requires supervision while walking (with or without devices)
4. Walks with a walking frame or crutches (swing)
5. Walks with crutches or two canes (reciprocal walking)
6. Walks with one cane
7. Needs leg orthosis only
8. Walks without walking aids

13. Mobility for Moderate Distances (10-100 meters)

0. Requires total assistance
1. Needs electric wheelchair or partial assistance to operate manual wheelchair
2. Moves independently in manual wheelchair
3. Requires supervision while walking (with or without devices)
4. Walks with a walking frame or crutches (swing)
5. Walks with crutches or two canes (reciprocal walking)
6. Walks with one cane
7. Needs leg orthosis only
8. Walks without walking aids

14. Mobility Outdoors (more than 100 meters)

0. Requires total assistance
1. Needs electric wheelchair or partial assistance to operate manual wheelchair
2. Moves independently in manual wheelchair
3. Requires supervision while walking (with or without devices)
4. Walks with a walking frame or crutches (swing)
5. Walks with crutches or two canes (reciprocal waking)
6. Walks with one cane
7. Needs leg orthosis only
8. Walks without walking aids

15. Stair Management

0. Unable to ascend or descend stairs
1. Ascends and descends at least 3 steps with support or supervision of another person
2. Ascends and descends at least 3 steps with support of handrail and/or crutch or cane
3. Ascends and descends at least 3 steps without any support or supervision

16. Transfers: wheelchair-car (approaching car, locking wheelchair, removing arm- and footrests, transferring to and from car, bringing wheelchair into and out of car)

0. Requires total assistance
1. Needs partial assistance and/or supervision and/or adaptive devices
2. Transfers independent, does not require adaptive devices (or does not require wheelchair)

17. Transfers: ground-wheelchair

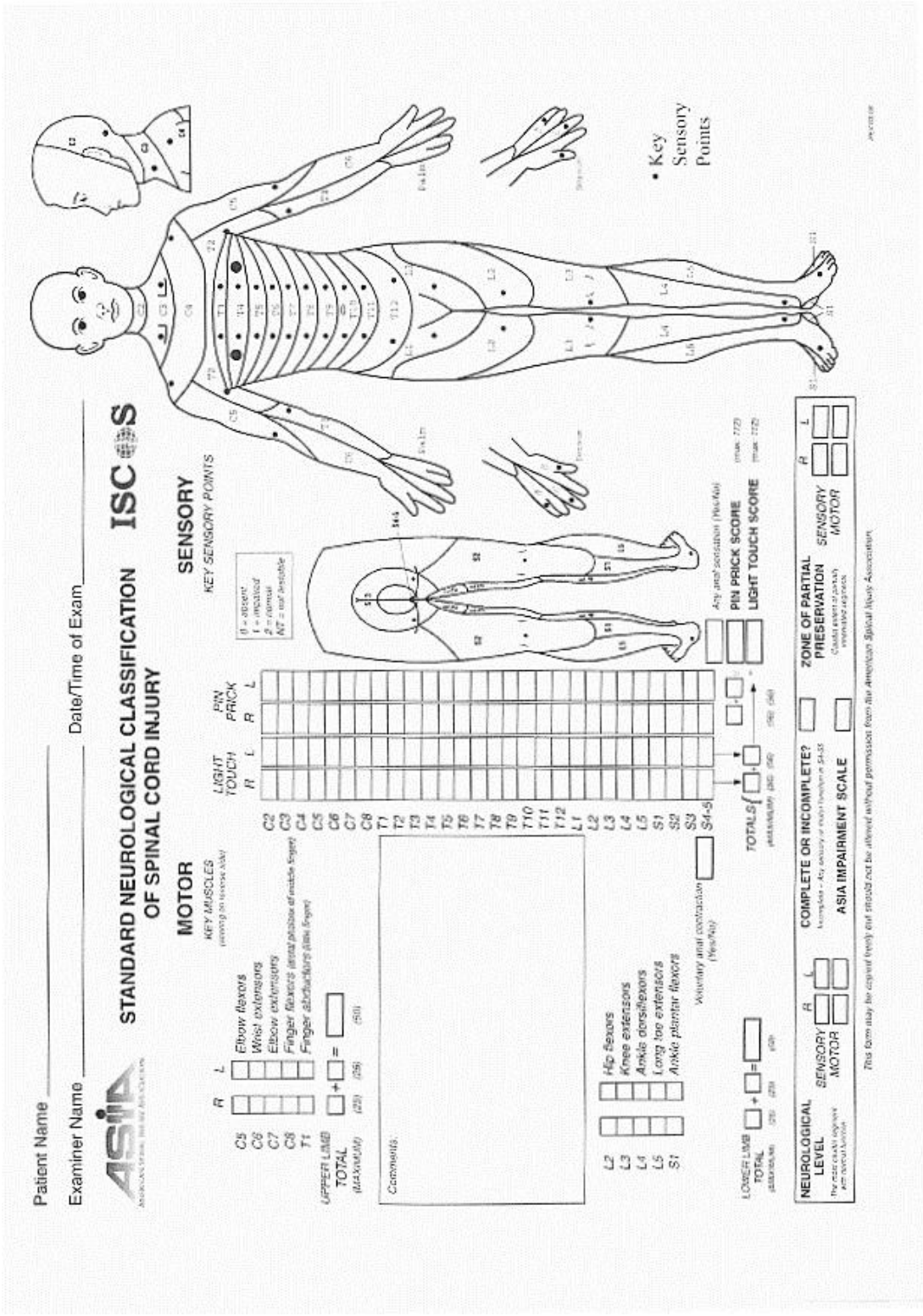
0. Requires assistance
1. Transfers independent with or without adaptive devices (or does not require wheelchair)

SUBTOTAL (0-40)

TOTAL SCIM SCORE (0-100)

Appendix F

The ASIS scale



Appendix G

Ethical clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Miss Bronwyn Hastings

CLEARANCE CERTIFICATE	**M10810**
PROJECT	factors that Influence the Functional Ability in Individuals with Spinal Cord Injury
INVESTIGATORS	Miss Bronwyn Hastings.
DEPARTMENT	Department of Physiotherapy
DATE CONSIDERED	27/08/2010
DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 01/09/2010 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Mrs V Ntsiea

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 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 H

Faculty of Health Sciences letter of approval

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011)717-2075/6

Reference: Ms Tania van Leeve
E-mail: tania.vanleeve@.wits.ac.za
01 November 2010
Person No: 0501871X
PAG

Miss BM Hastings
P O Box 44387
Linden
2104
South Africa

Dear Miss Hasting

Master of Science in Physiotherapy: Approval of Title

We have pleasure in advising that your proposal entitled "*Factors that influence functional ability in individuals with spinal cord injury*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix I

Letter of approval from the Chairperson of Physicians Advisory Board of

Netcare Rehabilitation Hospital

17/01/2011

Dear Dr Wilson

I, Bronwyn Hastings, am studying towards a Masters degree (MSc) through the Physiotherapy Department at the University of the Witwatersrand. Research is a requirement towards attaining this degree. I am conducting research looking at the level of functional ability in individuals with spinal cord injuries and I would be most grateful if you would allow me to seek consent, participation and information from spinal in-patients within this Rehabilitation Hospital in this observational research project.

The title of my research project is: Factors that influence the functional ability in individuals with spinal cord injury. The Objectives of the study are to establish the level of functional ability in patients with spinal cord injury resulting in paraplegia, and to establish demographic and physical factors that influence the level of functional ability in patients with spinal cord injury at discharge from in-patient rehabilitation. Prior to inclusion each participant will be given an information sheet on the specific details of the pilot study and all individuals who are willing to participate in the research study will be asked to sign an informed consent form. Anonymity and confidentiality of all participants' personal and medical information will be maintained throughout the research process.

The following outcome measures will be used: A self-designed questionnaire will be developed and used to establish the factors that influence the level of functional ability in patients with spinal cord injury by discharge from an in-patient rehabilitation unit. The American Spinal Injury Association (ASIA) classification scale of neurological impairment is used in spinal cord injury rehabilitation to describe the level and completeness of the lesion. The Spinal cord independence measure III (SCIM III) will be used to determine the level of functional ability. It is a comprehensive observational self-care and mobility ability rating scale for people with a spinal cord injury.

The sequence of events to take place for each participant: Using each participant's medical hospital file and in conjunction with the participant, the researcher will complete the self-designed questionnaire and establish the ASIA classification. Each of the participants will be observed doing each of the tasks detailed in the SCIM III within the facilities of the Rehabilitation Unit. This research will involve around one hour in total per participant. The completion of this research project will be December 2011 at which time a feedback letter will be sent out to inform all participants of the results of the study.

I would greatly appreciate your permission to conduct research within your facility.

If you have any queries, please feel free to contact me:
084 825 5330 or 011 489 1107

Yours Sincerely,

Bronwyn Hastings
Physiotherapist, Rita Henn and Partners Rehabilitation Therapists

Consent Form

I, Dr Virginia Wilson, Chairperson of the Physicians Advisory Board of Netcare Rehabilitation Hospital, give permission to Bronwyn Hastings, Master of Physiotherapy student from the University of the Witwatersrand, to conduct research within the Netcare Rehabilitation Hospital.
I consent to the use of medical information obtained, in the above mentioned research, for academic purposes at the University of the Witwatersrand only.

Signed: VBWilson
Date: 17-01-2011

Dr Virginia Wilson
PR 1497499
P.O. Box 150
2006 Auckland Park
011 482 4833

Appendix J

Letter of approval from Managing director of Rita Henn and Partners Physical Rehabilitation Therapists Inc.

Rita Henn & Partners Inc.
Rehabilitation Therapists

Pr: 050 000 026622
Reg No: 2003/024748/21 Vat reg no: 4040209369

Netcare Rehabilitation Hospital
2 Bunting Road
Auckland Park
Johannesburg
2006

Tel (011) 489 1226
Fax 086 510 7740
Email: info@physicalrehab.co.za
Website: www.physicalrehab.co.za

PostNet Suite 224
Private bag X 9
Melville
Johannesburg
2109

15/09/2010

Dear Miss Henn

I am busy completing my masters degree through the Physiotherapy Department at the University of the Witwatersrand. I am conducting research looking at the level of functional ability in individuals with spinal cord injuries and I would be most grateful if you would allow me to seek consent, participation and information from spinal in-patients within Netcare Rehabilitation Hospital in this observational research project.

The title of my research project is: Factors that influence the functional ability in individuals with spinal cord injury. The Objectives of the study are to establish the level of functional ability in patients with spinal cord injury resulting in paraplegia, and to establish demographic, physical, and environmental factors that influence the level of functional ability in patients with spinal cord injury at discharge from in-patient rehabilitation.

Prior to inclusion each participant will be given an information sheet on the specific details of the pilot study and all individuals who are willing to participate in the research study will be asked to sign an informed consent form. Anonymity and confidentiality of all participants' personal and medical information will be maintained throughout the research process. The following outcome measures will be used in my research: A self-designed questionnaire will be developed and used to establish the factors that influence the level of functional ability in patients with spinal cord injury by discharge from in-patient rehabilitation. The American Spinal Injury Association (ASIA) classification scale of neurological impairment will be used to describe the level and completeness of the lesion. The Spinal cord independence measure III (SCIM III) will be used to determine the level of functional ability of each participant. It is a comprehensive observational self-care and mobility ability rating scale for people with a spinal cord injury.

The sequence of events to take place for each participant: Using each participant's medical hospital file and in conjunction with the participant, the researcher will complete the self-designed questionnaire and establish the ASIA classification. Each of the

Directors: R Henn, M Ballington, D Bührs, M Marx, H Tierney

Rita Henn & Partners Inc.
Rehabilitation Therapists
Fn 050 000 0206822
Reg No. 2005/024744/21 Vat reg no: 4040209365

Netcare Rehabilitation Hospital
2 Bunting Road
Auckland Park
Johannesburg
2006

Tel (011) 489 1226
Fax 086 510 7740
Email: info@physicalrehab.co.za
Website: www.physicalrehab.co.za

PostNet Suite 224
Private bag X 9
Melville
Johannesburg
2109

participants will be observed doing each of the tasks detailed in the SCIM III within the facilities of the Rehabilitation Unit. This research will involve around one hour in total per participant. The completion of this research project will be roughly December 2011 at which time a feedback letter will be sent out to inform all participants of the results of the study.

I would greatly appreciate your permission to conduct research within this facility and ask you to please sign the attached consent form.

If you have any queries, please feel free to contact me:
084 825 5330 or 011 489 1107

Yours Sincerely,

Bronwyn Hastings
Physiotherapist, Rita Henn and Partners, Netcare Rehabilitation Hospital

Consent Form

I, Rita Henn, give permission to Bronwyn Hastings, masters physiotherapy student from the University of the Witwatersrand, to conduct research within Netcare Rehabilitation Hospital.
I consent to the use of medical information obtained, in the above mentioned research, for academic purposes at the University of the Witwatersrand only.

Signed: _____
Position Held: Managing Director
Date: 20/09/2010

Appendix K

Letter of permission from Netcare Rehabilitation Hospital manager

Netcare Rehabilitation Hospital

Tel: +27 (0) 11 489 1111
Fax: +27 (0) 11 489 1190
2 Bunting Road, Auckland Park, Johannesburg, South Africa
PO Box 150, Auckland Park, 2006, South Africa
www.netcare.co.za

3 March 2011

LETTER OF PERMISSION TO CONDUCT RESEARCH IN A NETCARE FACILITY

Rehabilitation Hospital

Cc: Hospital Manager

Dear Bronwyn Hastihgs

Research on Factors that influence functional ability

It is with pleasure that we inform you that your application to conduct research on Factors that influence functional ability at Rehabilitation Hospital site has been successful, subject to the following:

i) All information with regards to Netcare will be treated as confidential.

ii) Netcare's name will not be mentioned without written consent from the Academic Board of Netcare.

iii) Where Netcare's name is mentioned. the research will not be published without written consent from the Academic Board of Netcare.

iv) A copy of the research will be provided to Netcare once it is finally approved by the tertiary institution, or once complete.

v) All legal requirements with regards to patient rights and confidentiality will be complied with.

vi) All Parties participating must read and sign consent form with a copy supplied to academic board of Netcare.

We wish you success in your research.

Interim permission granted, pending research committee approval

Marietha van Vuuren **Date** 03-03-11

Netcare Hospitals (Pty) Ltd T/A Netcare Rehabilitation Hospital
Directors:
J Du Plessis, V E Firman, R H Friedland, M I Sacks
Company Secretary: L Kok Reg. No. 1996/006591/07

Netcare Limited

Tel: + 27 (0)11 301 0000
Fax: Corporate +27 (0)11 301 0499
76 Maude Street, Corner West Street, Sandton, South Africa
Private Bag X34, Benmore, 2010, South Africa

RESEARCH COMMITTEE FINAL APPROVAL OF RESEARCH

8 April 2011

Miss Bronwyn Hastings
PO Box 44387
LINDEN
2104

E mail: dhastings@fnb.co.za

Dear Miss Hastings

Re: FACTORS THAT INFLUENCE THE FUNCTIONAL ABILITY IN INDIVIDUALS WITH SPINAL CORD INJURY

The above-mentioned research was reviewed by the Research Committee's delegated members and it is with pleasure that we inform you that your application to conduct this research at Netcare Rehabilitation Hospital, has been approved, subject to the following:

i) Research may now commence with this FINAL APPROVAL from the Academic Board of Netcare (Research Committee).

ii) All information with regards to Netcare will be treated as confidential.

iii) Netcare's name will not be mentioned without written consent from the Academic Board of Netcare (Research Committee).

iv) All legal requirements with regards to patient rights and confidentiality will be complied with.

v) Insurance will be provided and maintained for the duration of the research. This cover provided to the researcher must also protect both the staff and the hospital facility from potential liability

vi) In accordance with MCC approval, that medicine will be administered by or under direction of the authorised Trialist

vii) The research will be conducted in compliance with the GUIDELINES FOR GOOD PRACTICE IN THE CONDUCT OF CLINICAL TRIALS IN HUMAN PARTICIPANTS IN SOUTH AFRICA (2000)

ANNEXURE CG.10.7.1

DECLARATION IN RESPECT OF RESEARCH TO BE CARRIED OUT IN A NETCARE FACILITY

I, Boonwya Hastings, hereby confirm that I have applied to conduct research in the field of Spinal cord Injuries at Netcare Rehabilitation Hospital Netcare facility~~ies~~.

Should permission be granted, I confirm that:

i) All information will be treated as confidential.

ii) Netcare's name will not be mentioned in the research without written consent from the Academic Board of Netcare.

iii) Where Netcare's name is mentioned, the results will not be published without written permission from the Academic Board of Netcare.

iv) Netcare will receive a copy of the completed research, when it is finally approved by the tertiary institution, where applicable.

v) I will comply with all legal requirements regarding patient rights and confidentiality (if patients will form part of the research).

SIGNED [signature] **DATE** 09/03/2011

WITNESS [signature] **DATE** 9/03/2011

Appendix L

Letter of approval from Gauteng provincial hospital

GAUTENG DEPARTMENT OF HEALTH
AND SOCIAL DEVELOPMENT
BANK OF LISBON BUILDING
37 SAUER STREET JHB
PRIVATE BAG X085
MARSHALLTOWN
Tel: (011) 355 3477 / 3500 /
Fax: 086 538 2978

RESEARCH PROPOSAL EVALUATION FORM

Researcher's Name	Brownwyn Hastings
Researcher's contact details:	Tel: 011 489 1107 Cell: 0848255330
Research Topic	Factors that influence functional ability in individuals with spinal cord injury
Research institution's Name	University of the Witwatersrand
Date submitted:	25 May 2011
Date Reviewed	07 June 2011
Reviewer's name	Dr Bridget Ikalafeng
Research Site(s):	Rehabilitation centers
Type of research	Non trial

SECTION A

	YES	NO	Comments
1. Is this research project within the scope of the Department of Health key policy priorities/directives?	x		
2. Content of Research: Original work	x		
• New facts, ideas	x		
• Confirmation of uncertain data	x		
• Repetition of known data and consequently of limited importance		x	
• Unreliable and/or inadequate		x	
• Confusion of topics/questions		x	
• Intervention study	x		
Is the title of the research project suitable?	x		
4. Are the objectives of the research project adequate?	x		
5. Could the objectives be limited to better focus on the project's main objective?		x	
6. Writing style • The text of the proposal is clear	x		

1

• The nomenclature used is correct • The references used are relevant, comprehensive and accurate (corrected) • The spelling and grammar are correct • The language needs improvement • The research proposal needs restyling and rewriting	x x x x x		
7. Are the research methods appropriate to the study	x		
8. Does the study have ethical approval? If yes, name the ethics committee University of the Witwatersrand	x		
9. Is the definition and measurement of variables consistent with the scope of the proposal	x		
10. Is data collection method in line with study design?	x		
11. Is time frame of the proposal adequate to meet the objectives?	x		
12. Is it stated in the proposal the method of dissemination of the results of the research project?	x		
13. Is the possible conflict of interests clarified? Are financial implications and financial support transparent?	x		

Section B: Proposal summary project

Spinal cord injury (SCI) injury results in devastating disability which can produce severe functional impairment of an individual's physical and psychosocial functioning (Scivoletto *et al.*, 2003). The extent and location of damage in the spinal cord caused by a traumatic or non-traumatic injury, influences the severity of the impairments and functional limitations that will be present (Itzkovich *et al.*, 2007). An improvement of thsese skills is likely to have a considerable impact on the patients' level of disability, independent functioning and consequently their quality of life (van der Putten et al., 2001). There are many factors that influence the functional ability of patients with SCI resulting in paraplegia, such as age at onset of SCI, length of hospital stay including complications such as pressure sores from acute hospitals or rehabilitation hospitals, urinary tract infections, neurological level, gender and race, early versus delayed admission to spinal cord injury rehabilitation units, traumatic versus non-traumatic injuries and re-hospitalisation (Osterhun *et. al.*, 2009).

An increase in age is associated with a lower functional outcome (Scivoletto *et al.*, 2003). Age at onset of SCI, the length of time before admission to rehabilitation and the degree of one's disability whilst in rehabilitation have been identified as strong prognostic factors influencing the level of functional ability of these individuals (Scivoletto

et al., 2003). It is common practice that patients with SCI are admitted to a rehabilitation facility after discharge from the acute hospital. Beginning rehabilitation as soon as possible after an acute SCI has been linked with higher functional efficiency and more favourable level of functional ability (Scivoletto *et al.*, 2005, Sumida et al., 2001) and it is also advisable to begin rehabilitation as soon as possible before complications develop leading to secondary disability (van der Putten *et al.*, 2001).

There is a dearth of published literature that documents the levels of functional ability post SCI resulting in paraplegia, at discharge from in-patient rehabilitation facilities within Gauteng. In addition, the factors that influence functional ability are poorly defined in individuals with SCI resulting in paraplegia, at their discharge from in-patient rehabilitation facilities in Gauteng. This necessitates further investigation since it is vital for the level of functional ability and re-intergration of individuals with SCI resulting in paraplegia. The aim of this study is therefore to determine the factors that affect the level of functional ability in individuals with a SCI, resulting in paraplegia, at discharge from an in-patient rehabilitation facility.

OBJECTIVES

- To establish the level of functional ability in patients with SCI resulting in paraplegia at discharge from in-patient rehabilitation.
- To establish demographic and physical factors that influence the level of functional ability in patients with SCI at discharge from in-patient rehabilitation.

Methodology

Study design

Cross sectional, observational study design.

Target population

The study participants will be patients from the spinal rehabilitation centers in the South Gauteng region.

Sampling

All consecutive patients who fit the inclusion criteria for the study and that are nearing the date of discharge from in-patient rehabilitation units during the period of data collection will be included in the study.

Data collection

Patients will be recruited from the spinal rehabilitation units within the Gauteng province. Patients that are discharged from in-patient rehabilitation, and fit in the inclusion criteria, will be identified and asked to participate in the study. An information sheet will be handed out and written consent will be signed. A file will be opened and a section A of the self – designed questionnaire will be recorded and stored for feedback purposes. A number code will allocated to each participant's personal detail record and to the corresponding section B and C of the self - designed questionnaire and SCIM 111 and ASIA data collection forms. This is to ensure that scores are anonymous. At discharge from in-patient rehabilitation the self-designed questionnaire, ASIA assessment form and SCIM 111 will be completed. Using each participant's medical hosp[ital file and in conjuction with the participant, the researcher will complete the self-designed demographic questionnaire and

assess the patient according to the ASIA scale. Each of the participant will be observed doing each of the tasks detailed in the SCIM 111 within the rehabilitation unit. The researcher will give instructions to each participant before each trial and record all the data during each trial. Participants will not be allowed to watch one another completing the SCIM 111 tasks, to minimize participant learning which could affect the reliability of the tests. ASIA scale indicating each participant's neurological level and the SCIM 111 score indicating the participant's level of functional ability will be recorded using data collection forms.

Data analysis

STATA version (10.0) will be used for data handling, cleaning and statistical analysis. Patients' data will be collected and captured in Microsoft Excel 2007. Descriptive and Inferential data analysis will be done.

Section C: REVIEWER 'S FINAL CONCLUSION

Accept

The Reviewer

Dr B Ikalafeng
Research and Epidemiology
Date 2011/06/07

Recommended/Not Recommended

Ms C Nkosi
Acting Director: Policy, Planning and Research
Date 2011/06/07

Recommended/Not Recommended

health and
social development
Department: Health and Social Development
GAUTENG PROVINCE

Vision of the Department

"To be the best provider of quality health and social services to the people in Gauteng"

POLICY, PLANNING AND RESEARCH (PPR)
Enquiries: Dr Bridget Ikalafeng
Tel: +2711 355 3134
Fax: +2711 355 3675
Email: Bridget.Ikalafeng@gauteng.gov.za

CONTACT DETAILS OF THE RESEARCHER	
Date	07 June 2011
Contact number	084 825 5330
Email	dhastings@mweb.co.za
Researcher /Principal Investigator (PI)	Bronwyn Hastings
Supervisor	Mokgobadibe Mamabolo
Institution	University of Witwatersrand
Research title	**Factors that influence functional ability in individuals with spinal cord injury.**

This approval is granted only for a research proposal submitted to GDHSD by Bronwyn Hastings entitled
"Factors that influence functional ability in individuals with spinal cord injury."

Approval is hereby granted by the Gauteng Department of Health and Social Development for the above mentioned research study proposal for a study to be conducted within GDHSD domain. Approval is limited to compliance with the following terms and conditions:

1. All principles and South African regulations pertaining to ethics of research are observed and adhered to by all involved in the research project. Ethics approval is only acceptable if it has been provided by a South African research ethics committee which is accredited by the National Health Research Ethics Council (NHREC) of South Africa; this is regardless of whether ethics approval has been granted elsewhere.

   Of key importance for all researchers is that they abide by of all research ethics principles and practice relating to human subjects as contained in the Declaration of Helsinki (1964, amended in 1983) and the constitution of the Republic of South Africa in its entirety. Declaration of Helsinki upholds the following principles when conducting research, respect for:
   - Human dignity;
   - Autonomy;
   - Informed consent;
   - Vulnerable persons;
   - Confidentiality;
   - Lack of harm;
   - Maximum benefit;
   - and justice

2. The GDHSD is indemnified from any form of liability arising from or as a consequence of the process or outcomes of any research approved by HOD and conducted within the GDHSD domain;
3. Researchers commit to providing the GDHSD with periodic progress and a final report; short term projects are expected to submit progress reports on a more frequent basis and all reports must be submitted to the Director: Policy, Planning and Research of the GDHSD;
4. The Principal Investigator shall promptly inform the above mentioned office of changes of contact details or physical address of the researching individual, organisation or team;
5. The Principal Investigator shall inform the above office and make arrangements to discuss their findings with GDHSD prior to dissemination;
6. The Principal Investigator shall promptly inform the above mentioned office of any adverse situation which may be a health hazard to any of the participants;
7. The Principal Investigator shall request in writing authorization by the HOD via PPR for any intended changes of any form to the original and approved research proposal;
8. If for any reason the research is discontinued, the Principal Investigator must inform the above mentioned office of the reasons for such discontinuation;
9. A formal research report upon completion should be submitted to the Director: Policy, Planning and Research of the GDHSD with recommendations and implications for GDHSD, the Directorate will make this report available for the HOD.

This approval is granted only for a research proposal submitted to GDHSD by Bronwyn Hastings entitled **"Factors that influence functional ability in individuals with spinal cord injury."**

AGREEMENT BETWEEN THE GAUTENG DEPARTMENT OF HEALTH AND SOCIAL DEVELOPMENT (GDHSD) AND THE RESEARCHER

Mrs. C Nkosi
Acting Director, Policy Planning and Research

Date: 2011/06/07

Signature:

Bronwyn Melaney Hastings

Name and surname of Principal Researcher

Research/Academic Institution

Date: 07 June 2011

Signature:

This approval is granted only for a research proposal submitted to GDHSD by Bronwyn Hastings entitled **"Factors that influence functional ability in individuals with spinal cord injury."**