Factors influencing the early post-operative functional outcome in elderly patients with a hip fracture

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Declaration

I, Saadiya Adam, hereby declare the following:

- The entirety of the work contained therein is my own unaided work except where I have explicitly indicated otherwise

- I have followed the required conventions in referencing the thoughts and ideas of others

- This dissertation is being submitted for the degree of Master of Science in Physiotherapy at the University of the Witwatersrand, Johannesburg.

- This dissertation has not been submitted before for any degree or examination at this or any other University.

Date: 11 November 2013

Signature: Saadiya Adam

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Abstract

<u>Background:</u> Hip fractures are among the most common causes of disability and hospitalisation in the elderly. Currently there are no studies available in South Africa that determine the factors that influence the early post-operative functional outcome in elderly patients with a hip fracture.

<u>Aim:</u> To establish the factors influencing the early post-operative functional outcome in elderly patients with a hip fracture.

<u>Methodology:</u> A prospective pre-test post-test observational study design was used. Consecutive sampling was used to recruit participants (n=72). Assessments were conducted pre-operatively, at discharge and six weeks post discharge at two public health care hospitals in Johannesburg, South Africa. Pre-operatively the pre-fracture functional mobility of the participants was determined using the New Mobility Score (NMS), the presence of pre-existing co-morbidities was assessed using the Cumulative Illness Rating Scale for Geriatrics (CIRS-G) and the cognitive function was assessed using the Six-Item Cognitive Impairment Test (6CIT). At discharge and at six weeks post discharge the participants post-operative functional level was assessed using the Elderly Mobility Scale (EMS) and the Lower Extremity Functional Scale (LEFS). A multiple regression analysis was used to determine associations. The study was set at $p = 0.05$ level of significance and 95% confidence interval (CI).

<u>Results:</u> Participants were generally independent with pre-fracture mobility at baseline and presented with approximately three pre-existing co-morbidities. The presence of cognitive impairments in the participants decreased during the duration of the study, while the post-operative functional level in this population improved. Pre-fracture functional level was strongly related to and also the strongest predictor of post-operative functional outcome. The presence of co-morbidities and impaired cognitive function were also indirectly related.

<u>Conclusion</u>: Pre-fracture functional mobility was found to be the strongest determinant of post-operative functional outcome, followed by cognitive function and the presence of pre-existing co-morbidities. By ensuring that these factors are optimal prior to sustaining a hip fracture, elderly patients are more likely to have better outcomes. For those patients who do sustain a hip fracture, intensive rehabilitation is especially necessary for the patient who presents with poor pre-fracture mobility, impaired cognition and pre-existing medical co-morbidities.

Keywords: Hip fracture, pre-fracture functional mobility, early post-operative functional outcome

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List of Abbreviations

6CIT:	Six Item Cognitive Impairment Test
AHEAD:	Assets and Health Dynamics Among the Oldest Old
AMTS:	Abbreviated Mental Test Score
ANOVA:	Analysis of variance
ASA:	The American Society of Anesthesiologists
BIMC:	Blessed Information-Memory-Concentration Scale
CAS:	Cumulated Ambulation Score
CI:	Confidence Interval
CIRS-G:	Cumulative Illness Rating Scale for Geriatrics
CVA:	Cerebro-Vascular Accident
EMS:	Elderly Mobility Scale
GIT:	Gastro-intestinal Tract
HA:	Hemi-Arthroplasty
HRQoL:	Health Related Quality of Life
IBM:	The *International Business Machines* Corporation
ICC:	Intraclass Correlation Coefficient
ICF:	International Classification of Functioning, Disability and Health
IQR:	Interquartile Range
LEFS:	Lower Extremity Functional Scale
MMSE:	Mini-Mental State Examination
NMS:	New Mobiilty Score
PFNA:	Proximal Femoral Nailing Arthrosis
SD:	Standard Deviation
SPSS:	Statistical Package for the Social Sciences
THR:	Total Hip Replacement

Chapter 1 - Introduction

1.1. Introduction

The aim of this chapter is to provide an overview of the study. This chapter will begin with a concise background with regards to hip fractures and the effects thereof. The research question developed on the foundations of the problem statement will then ensue. This chapter will then conclude with the main aims of the study, objectives and significance of this study.

1.2. Background

Hip fracture is a common, serious injury that occurs predominantly in the elderly (Holt et al, 2008). Hip fractures are a major cause of morbidity and mortality and occur in 20 to 30 percent of older people who fall (Kalula, 2012).

A hip fracture can be defined as any fracture of the proximal femur extending down to a level of five centimeters below the lower border of the lesser trochanter (Parker, 2003). Classification of hip fractures can be divided into intracapsular and extracapsular. Intracapsular fractures involve the femoral neck while extracapsular fractures involve the intertrochanteric and subtrochanteric regions (Eby, 2009). Fractures occurring after a simple fall are more common in the elderly population, while severe trauma or underlying bone weakness are common causes of hip fractures in younger patients (Parker, 2003).

Hip fractures are among the most common causes of disability and hospitalisation in the elderly and result in significant morbidity and mortality (Williams et al, 2005). The prevalence and incidence of falls rise steadily after the age of 65 due to increasing age and frailty and occur in 30 to 60% of elderly persons annually (WHO, 2007). The morbidity and mortality occurring after sustaining a hip fracture is a reflection of the frail state of the patients who sustain this injury (Holt et al, 1994). The average age of a patient who sustains a hip fracture in developed countries is about 80 years and 80% of these patients are female. In developing countries, the average age is less than 80 years and a greater percentage of these patients are male (Parker, 2003). A few studies are available on the incidence of hip fracture in Africa. Osteoporosis and fragility fractures are believed to be uncommon in Africa due to reduced longevity (Dhanwal et al, 2011). Zebaze et al (2003) conducted a study in Cameroon and Maghraoui et al (2002) conducted a similar study in Morocco, both of the studies concluded that fragility fractures of the hip do occur in Africa, but less frequently when compared to other countries. In Cameroon, the incidence of hip fractures in men over the age of 65 is 35 per 100,000 persons per year, whereas in Singapore the incidence increases to 170 per 100,000 persons per year (Zebaze et al, 2003). In South Africa the prevalence rate for falls in the elderly population is 26% (Kalula, 2012) and the average acute care cost of a hip fracture amounts to approximately R50,000 per patient (Hough, 2005).

Hip fracture has negative effects on the social, mental and physical functions of elderly people. The risk of mortality and the medical resources they consume increase and their functions decline (Lin et al, 2004). Tosteson et al (2007) found that excess mortality is at its highest closest to the time of fracture and that there is no evidence of excess mortality beyond six months following a hip fracture. A study by Bentler et al (2009) revealed that in-hospital mortality was 2.7% and six month mortality rates were 19%. Nielson et al (2009) found that lower 30 day mortality rates in patients with a hip fracture are associated with higher quality of care during the hospital period.

Age is one of the essential factors to determine post operative outcome in hip fracture patients (Foss et al, 2006). Kristensen et al (2010) assessed several variables to determine the effect they had on in-hospital outcome after hip fracture surgery. Older age was found to be independently associated with not regaining independence in basic mobility. Age is a highly discriminating factor with a pronounced influence on rehabilitation pattern (Thorngren et al, 2005). Lin et al (2004) also concluded that age is an important influencing factor on recovery and patients aged over 85 tend be more dependent in social functioning and have a worse functional recovery. However, Atalay (2007) found that even the oldest-old patients with co-morbid health problems have the potential to become ambulatory.

The ability of a patient to walk prior to the fracture is a good indicator of the general medical and mental health of the patient (Holt et al, 1994). Pre-fracture functional level is known to be a predictive factor of rehabilitation outcome (Hershkovitz et al, 2007). The functional level before the fracture appears to be the most consistent predictor of short-term rehabilitation outcome and 30 day mortality in hip fractures in the elderly (Kristensen et al, 2010; Foss et al, 2006). Kristensen et al (2010) concluded that a patient with a low pre-fracture functional level is 18 times more likely not to regain independence in basic mobility during hospitalisation or regained independence in mobility on average three days later.

Co-morbid medical problems are one of the many factors that render an unfavourable overall prognosis for older adults with hip fracture (Atalay, 2007). Roche et al (2005) found that patients with a number of co-morbidities present on admission increases the mortality rate at 30 days and the risk of development of post-operative complications. Patients with three or more co-morbidities are more at risk compared to those with none (Roche et al, 2005). Foss et al (2006) concluded that in-hospital and 30 day mortality has been associated with pre-existing co-morbidities in patients with a hip fracture. Co-morbidities are probably one of the essential factors to determine post operative outcome in hip fracture patients. Ceder (2005) reported that the general medical condition of elderly patients with a hip fracture plays a crucial role in the rehabilitation of these patients.

Cognitive function has also been reported an important prognostic factor associated with rehabilitation success of older patients with a hip fracture. Impaired cognitive function may negatively affect functional gain in disabled elderly patients with a hip fracture (Hershkovitz et al, 2007). Poor post–operative outcome as well as higher in-hospital and 30 day mortality rates have been associated with impaired cognitive function (Foss et al, 2006). Lenze et al (2004) successfully hypothesized that cognitive impairment and depressive symptoms in elderly patients with a hip fracture have a poorer rehabilitation outcome, this is due to poor participation during therapy.

Foss et al (2006) hypothesised that early ambulation is one of the essential factors to facilitate post operative rehabilitation. A patient’s mobility in the first few days after surgery may be an indicator of short-term outcome and that an assessment of function in the early post-operative period should be taken into consideration when making a discharge plan (Ross et al, 2002).

Inpatient rehabilitation is a critical component for successful recovery, and rehabilitation for hip fracture is a typical example of inpatient rehabilitation for the elderly (Lenze et al, 2004). Hip fracture rehabilitation care includes physical therapy that would aim to improve transferring, walking the length of a room, climbing stairs, equilibrium, muscle strength and range of movement (ROM) (Hershkovitz et al, 2007).

1.3. <u>Problem Statement</u>

A new study that determines the early post-operative functional outcome as well as the factors that influence post-operative functional outcome in elderly patients with a hip fracture has not yet been carried out in a public health setting in South Africa.

1.4. Research Questions

What is the early post-operative functional outcome in elderly patients with a hip fracture?

What are the factors that influence the early post-operative functional outcome in elderly patients with a hip fracture?

1.5. Aims

To establish the early post-operative functional outcome in elderly patients with a hip fracture

To establish the factors that influence the early post-operative functional outcome in elderly patients with a hip fracture.

1.5.1. Objectives

The objectives of the study were to establish the:

1. Pre-fracture functional level in elderly patients with a hip fracture.
2. Pre-existing co-morbidities in elderly patients with a hip fracture.
3. Cognitive function in elderly patients with a hip fracture pre-operatively, at discharge and six weeks post discharge.
4. Post-operative functional level in elderly patients with a hip fracture at discharge and six weeks post discharge.
5. Factors influencing post-operative outcome in elderly patients with a hip fracture.

1.6. Significance of the study

Determining the post-operative functional outcome and the influencing factors in elderly patients with a hip fracture in a selected public health setting in South Africa will identify those patients who are especially at risk of not regaining independence in basic mobility. Exploration of this topic may lead to future research on improving functional outcome for these high risk patients and could have a potential impact on policy, formulation of protocol and further advances in the field locally and to a lesser extent internationally.

Chapter 2 - Literature Review

2.1. Introduction

This review examines and interprets current relevant literature on hip fracture outcomes in the elderly population. Firstly the review will define hip fractures and old age. Updated world-wide epidemiological trends and morbidity and mortality will then be discussed. Rehabilitation and functional outcomes following a hip fracture are closely associated with various factors. The factors that will be discussed in this review include age, cognitive function, presence of pre-existing co-morbidities and pre-fracture functional mobility. Standardised tools used in this study will be interrogated and assessed against those that are considered gold-standard in their fields. The review will then conclude with a summary of the literature reviewed.

Selected literature was examined to gain insight into international hip fracture trends and outcomes. The term 'hip fracture' was a constant entry in the search parameter. Other variables entered into the search parameter included; epidemiology, functional outcome, rehabilitation, prognosis, morbidity and mortality, age, cognitive impairment, co-morbidity and pre-fracture function. Search engines included PubMed, ScienceDirect, CINHAL and Google Scholar. Only English literature was reviewed and literature was limited to the year 2000 and over, unless the information contained in the older articles was ground breaking. The occasional older article was reviewed in special circumstances or in the case of the development of a scale. The theme focused on the prognosis after sustaining a hip fracture in the elderly and the factors that played a role.

2.2. Definition of old age

"The ageing process is of course a biological reality which has its own dynamic, largely beyond human control. However, it is also subject to the constructions by which each society makes sense of old age. In the developed world, chronological time plays a paramount role. The age of 60 or 65, roughly equivalent to retirement ages in most developed countries, is said to be the beginning of old age. In many parts of the developing world, chronological time has little or no importance in the meaning of old age. Other socially constructed meanings of age are more significant such as the roles assigned to older people; in some cases it is the loss of roles accompanying physical decline which is significant in defining old age. Thus, in contrast to the chronological milestones which mark life stages in the developed world, old age in many developing countries is seen to begin at the point when active contribution is no longer possible" (Gorman, 1999: 3-21).

The chronological age of 65 years has been accepted by most developed world counties as the definition of 'elderly' or old age, but like most first world concepts this definition does not suit the situation in Africa. In Africa it seems more appropriate to use a combination of chronological, functional and social definitions (WHO, 2012). In a project carried out by The World Health Organization in Africa, the age of 50 years was deemed appropriate to fully determine the health status of this population. The above classification is based on the fact that it is illogical to categorise elderly persons in Sub-Saharan Africa according to definitions of age followed in more developed countries purely because majority of elderly persons in sub-Saharan Africa live and work in rural areas and do not benefit from any formal retirement benefits. A first world definition is further illogical in a region where life expectancy is lower and there is a smaller ratio of elderly persons (WHO, 2012)

Shephard (1998) classified old age according to three different categories; young old as 65-75 years, middle-old as 75-85 years, very old as 85 years or older. The South African Department of Social Development offers 24 hour state funded care to those elderly people who are frail and require full time assistance. The department defines elderly people as females who are 60 years and older, and males who are 65 years or older (South African Government Services, 2012).

2.3. Anatomy of the hip joint and definition of a hip fracture

The hip joint is a synovial joint which consists of the acetabulum and the head of the femur. The head of the femur is connected to the proximal portion of the femoral shaft by the neck of femur. The term "hip fracture" is a fracture in any of these locations (Burroughs et al, 2012). Parker (2003) defined a hip fracture as any fracture of the proximal femur extending down to a level of about five centimeters below the lesser trochanter. Classification of hip fractures can be divided into intracapsular and extracapsular. Intracapsular fractures involve the femoral neck while extracapsular fractures involve the intertrochanteric and subtrochanteric regions (Eby, 2009). Parker (2003) further classified basicervical fractures which occur on the intertrochanteric line. These fractures may involve the capsular attachments and can be classified as both intracapsular and extracapsular. The prognosis, and treatment of basicervical fractures is quite similar to that of a trochanteric fracture, thus it is best considered as an extracapsular fracture.

The prognosis of hip fractures varies by the anatomic region of the fracture. Intertrochanteric fractures heal well with reduction and fixation due to the increased amount of cancellous bone and a good blood supply in the area. Displacement in this region can occur due to the actions of the iliopsoas muscle on the lesser trochanter, and the major external rotator and abductor muscles of the hip on the greater trochanter. In contrast, the femoral neck has a decreased amount of cancellous bone, a thin periosteum, and a relatively poor blood supply that is susceptible to disruption. Neck of femur fractures have a high incidence of complications, such as avascular necrosis and degenerative changes in the hip joint (Burroughs et al, 2012).

Diagnosis following a hip fracture is usually simple. The elderly patient complains of severe pain and the inability to walk, clinically the limb is shortened and externally rotated, standard anteroposterior or lateral radiographs further verify the hip fracture diagnosis (Parker, 2003). Conservative and surgical options are available for hip fracture management. Conservative treatment, primarily for undisplaced fractures, consists of a period of bed rest followed by protective weight bearing. Surgical options include open reduction and internal fixation (sliding hip screws, cannulated screws and compression screws), hemi-arthroplasty or total hip replacement (Parker 2003; Eby 2009). Rehabilitation will be discussed later.

2.4. Epidemiology of hip fractures

Hip fractures are a major cause of disability and hospitalisation, increasing morbidity and mortality as well as increasing social and economic repercussions among the elderly (Costa et al, 2009; Williams, et al 2005). The morbidity and mortality occurring after sustaining a hip fracture is a reflection of the frail state of the patients who sustain this injury (Holt et al, 1994). A hip fracture in the elderly is the most serious consequence of osteoporosis due to the painful and disabling complications that this disease is associated with (Dhanwal et al, 2011). Hip fractures are recognised as major public health threats in developed nations. Incidence rates for hip fracture in developing nations such as Asia, South America and Africa are reportedly lower. Demographic changes in these countries will lead to increased hip fractures in the elderly population (Cooper, 1992).

In the year 2000, there were an estimated 9 million osteoporotic fractures worldwide, of which 1.6 million were at the hip (Cooper et al, 2011). The prevalence and incidence of falls rise steadily after the age of 65 and occur in 30 to 60% of elderly persons annually (WHO, 2007). In developed countries the average age of a person sustaining a hip fracture is 80 years old and 80% of patients are female. In developing countries the average age is lower and predominantly males sustain this injury (Parker, 2003). The average age of a person sustaining a hip fracture in a developing country is 67 years old for males and 72 years old for females (Zebaze et al, 2003). A fall, often from a standing height, is the most common cause of falls in the elderly. The risk of sustaining a fall doubles with each decade after 50 years. Nine out of ten patients who sustain a hip fracture are 65 years and older (Eby, 2009).

The number of hip fractures occurring worldwide will increase from 1.66 million in 1990 to 6.26 million in 2050 (Cooper, 1992). However, a study in the United States used hospital discharge data (1990 to 2006) to determine the national trends in hip fracture incidence for people over the age of 65 years. Hip fracture incidence decreased substantially from 1990 to 2006. The rates decreased from 54.6 and 108.4 in 1990 to 48.8 and 91.7 per 10,000 in 2006 and in males and females respectively (Stevens et al, 2010). These results are consistent with those of Kannus et al (2006), who reported that the incidence of hip fracture declined by 20% in women and 6% in men from 1997 to 2004 in Finland. Factors that could possibly account for these declines and challenge Cooper's (1992) finding that the incidence of hip fractures will increase include, a healthier ageing population, improved functional abilities in the elderly, removal or withdrawal of the use of psychoactive drugs and an increase in average body weight (Stevens et al, 2010; Kannus et al, 2006).

In Geneva, Switzerland, hip fracture trends have been studied from 1991 to 2000. Hip fractures were sustained in 2981 females and 822 males aged 50 years and over in the 10 year period. The overall hip fracture incidence was 455 per 100,000 person in females and 153 per 100,000 persons in men. The study found that the number of hip fractures remained constant over the 10 year period despite an ageing population. A considerable decline of 1.4% per year for age-adjusted rates in females in particular age groups of 60 - 64 years of age and 90 years and over was also concluded. The rate remained unchanged in males (Chevalley et al, 2007). This result is consistent with that of Dhanwal et al's (2011) statement that hip fracture incidence has leveled off in most European countries. A similar study with differing results to Chevalley et al (2007) was also conducted in neighboring Austria between 1994 and 2006 (Mann et al, 2008).

After adjustment for age and sex, the incidence rate rose from 471 to 567 in males and from 637 to 759 per 100,000 in females per year. The total increase in incidence over the study period was calculated to 13%. The rise in incidence, when compared to the result of Chevalley et al (2007) is held accountable by the rise in patients seen over the age of 80 years. Despite the adjustment for age in the study by Mann et al (2008), hip fracture incidence still rose. Cooper (1992) stated that as people live longer, the number of hip fractures in the world is expected to rise.

The Asian Osteoporosis Study documented and compared the hip fracture incidence in four Asian countries. Hospital data for the year 1997 was collected for Hong Kong, Singapore, Malaysia and Thailand. The age-adjusted incidence rates for males and females, per 100,000, were; Hong Kong 180 and 459, Singapore 164 and 442, Malaysia 88 and 218 and Thailand 114 and 289. The female to male ratio in this study was 2.5. The rates in Hong Kong and Singapore were quite similar, the rate in Thailand was 60% of that in Hong Kong and in Malaysia the rate was 50% of that of Hong Kong. In 1989 in the US age-adjusted incidence rates for males and females, per 100,000, were 187 in males and 535 in females. In the US, Hong Kong and Singapore hip fracture incidence increased five to eight times after the age of 75. In Malaysia and Thailand the increase was only three to four times. The differences between Hong Kong, Singapore, Thailand and Malaysia could be attributed to the difference in levels of urbanization. Hong Kong and Singapore are much more urbanized in comparison to Malaysia and Thailand (Lau et al, 2001).

Shao et al (2009) conducted a nationwide descriptive epidemiological study over seven years (1996 to 2002) to establish the frequencies and incidences of hip fracture by gender, fracture type and age. The results showed an incidence rate of 57,54 per 10,000 per year. The overall incidence increased by 30% over the seven year study period. The average ratio for females to males was 1.76. The incidence of neck of femur fractures was higher than that of intertrochanteric fractures in females, in males this result was the direct opposite. Patients aged 85 years or older are 7.9 and 9.9 times more likely to sustain a hip fracture compared to those patients aged 65 to 69 years in males and females respectively. Each of the above studies were carried out in different time periods which explains the differences in incidence rates between the two studies. Due to the changing demographic profile in Asia, hip fracture incidence rates rose substantially in Asia (30% in the study by Shao et al, 2009) when compared to the rise in hip fracture incidence in Europe (13% in the study by Mann et al, 2008).

A few studies are available on the incidence of hip fracture in Africa. Osteoporosis and fragility fractures are believed to be uncommon in Africa (Dhanwal et al, 2011). Fragility fractures are believed to be uncommon in Africa due to reduced longevity (Maghraoui et al, 2002). Zebaze et al (2003) conducted a study in Cameroon and Maghraoui et al (2002) conducted a similar study in Morocco, both of the studies concluded that fragility fractures of the hip do occur in Africa, but less frequently when compared to other countries. In Cameroon, severe trauma was the most common cause of hip and wrist fractures in men and women younger than 50 years. After the age of 50, 90% and 83.3% of the fractures in women and men respectively were fragility fractures resulting from falls. In Cameroon, the incidence of hip fractures in men over the age of 65 is 35 per 100,000 persons per year (Zebaze et al, 2003). In Morocco, a rise in incidence rate was found for both men and women with increasing age, the age-adjusted incidence of hip fracture is 52.1 and 43.7 per 100,000 in women and men respectively (Maghraoui et al, 2002). The characteristics of hip fractures described in these two studies imply that fragility fractures occur in Africa, although significantly less frequently than in most North American, European and Asian countries. Fragility fractures occur more frequently in Northern Africa compared to sub-Saharan African countries. Low fragility fracture rates are most likely due to reduced longevity and underreporting in Africa.

In South Africa the prevalence and incidence rates for hip fractures in the elderly population has not been determined, however the prevalence rate for falls in the elderly is 26% and the incidence of falls is 236 and 407.5 per 1,000 persons per year for males and females respectively (Kalula, 2012). In South Africa the average acute care cost of a hip fracture amounts to approximately R50,000 per patient (Hough, 2005).

Guerri-Fernandez et al (2013) reported that HIV infection and antiretroviral therapies have damaging effects on bone metabolism, the authors therefore explored the association of HIV infection and risk of sustaining a hip or major osteoporotic fracture in Spain. After adjusting for age, gender, smoking, alcohol consumption and the presence of co-morbidities, a significant association between HIV infection and hip fracture risk was reported.

In summary, hip fracture incidence rates are rising worldwide, more so in developing countries in Asia, South America and Africa. The factors that account for cultural and social differences in hip fracture rates and incidences include differences in the demographic profile, level of physical activity, calcium intake, body weight, prevalence of cigarette smoking and alcohol consumption and the frequency of falls in the elderly population (Dhanwal et al, 2011). More recently, it has also been reported that HIV infection is significantly associated with hip fracture risk (Guerri-Fernandez et al, 2013).

2.5. Morbidity and mortality following a hip fracture

Hip fractures are a major cause of morbidity and mortality and occur in 20 to 30 percent of older people who fall (Kalula, 2012). Gathering information on the trends and incidence of hip fractures and mortality associated with hip fractures is important to aid in the future management of this high risk condition (Haleem et al, 2008).

Haleem et al (2008) reviewed 36 articles on the outcome after a hip fracture over a four decade period (1959 - 1998) to determine any changes that had occurred in the mortality rates and patient demographics. The authors presented results on the number of patients who sustained a hip fracture in that decade, the mean age of these patients, the percentage of female patients, the percentage of intracapsular fractures and the six month and one year mortality rates. The study concluded that the mean age of patients who sustain a hip fracture increases steadily over each decade. The mean age in the 1960's was 73 years and this increased to 79 years in the 1990's. This could reflect the longer life expectancy of a fitter elderly population. The six month and one year mortality remained relatively unchanged over the four decade period. Hip fracture mortality remains significant, being 11-23% at six months and 22-29% at one year. A large number of the articles reviewed in this study were published in the United Kindom, United states of America and Europe. Of the 36 articles reviewed, only three were published in the Far East and none in Africa, South America or other developing countries. More recent detailed international comparisons of hip fracture mortality are required to determine if variations in mortality are due to demographic changes or improvements in treatment techniques.

After reviewing baseline and biennial data collected from the Survey on Assets and Health Dynamics Among the Oldest Old (AHEAD) in the United States of America, Bentler et al (2009) found that 6 month mortality rates were 19% in elderly patients admitted to hospitals with a hip fracture. The mean age of the respondents was 85 years old and 73% of respondents were female. Available data ranged from the year 1993 to 2005. Penrod et al (2008) collected data in from three cohorts and used a multiple regression analysis to examine the relationship between gender, race and presence of co-morbidities with functional outcome and mortality at six months post hip fracture. Thirty seven percent of the respondents were 85 years of age and older and 73% of respondents were female. The overall mortality rate at six months was 12%. Men had a significantly higher mortality rate at 19.2% compared to that of women at 9.7%. In Lazio, Italy the mortality at six months was 18%. These were the results of a cohort study that used administrative health databases to determine the mortality in a population aged 65 years and older (Castronuovo et al, 2011). The mean age in Castronuovo et al's (2011) study was 83 years old and 73% of respondents were female. All of the above studies conducted using databases or cohorts over a similar time frame reveal comparable six month mortality rates. In each of the three studies the mean age and percentage of female participants were almost identical. These rates are also consistent with those reported above over a four decade period (11-23%) by Haleem et al (2008).

Roche et al (2005) carried out a prospective observational cohort study in Nottingham England whereby they evaluated post operative complications and the mortality associated with these complications at 30 days and one year post operatively. The association between pre-existing co-morbidities and development of post operative complications and mortality were also examined in elderly patients admitted with an acute hip fracture. Roche et al (2005) concluded that the most common post operative complication was chest infections and then followed by heart failure. At 30 days, mortality was 9.6% and at one year mortality was 33%. In women and men there was a significant difference in 30 day mortality rates, this being 8.2% and 15% respectively. A large sample of patients were included in this study and a 100% follow up on mortality statistics was completed. In a large Danish nationwide population-based cohort study investigating the quality of care and 30 day mortality in elderly patients with a hip fracture, the overall 30 day mortality rate recorded was 10.3%. The authors concluded that high quality of treatment offered to patients resulted in significantly lowered 30 day mortality rates (Nielsen et al, 2009). Both of the above nationwide cohort studies in first world countries reveal consistent 30 day mortality rates for elderly patients with a hip fracture.

In New South Wales, Australia, relative survival of 65 to 74 year old men and women at one year after a hip fracture is 82 and 90% respectively. In the 85 year and older group, relative survival was 65% in men and 80% in women. Men were found to have a 2.2 times more likely chance of death compared to women (Hindmarsh et al, 2009). A strength of the population-based study by Hindmarsh et al (2009) is the inclusion criteria of the 16,836 cases that were analysed. Cases were not included according to the contributing cause of death but rather according to the initial diagnosis of a hip fracture associated with an external fall. Mortality rates would be significantly lower if the researchers were only to consider deaths contributed by hip fracture, as many patients deaths result from complications following a hip fracture. These results are somewhat consistent to the world-wide results published by Haleem et al (2008).

In Turkey, Ozturk et al (2010) investigated the risk factors for mortality over one year in elderly patients (mean age of 77.9 years) who sustained a hip fracture. At three months, patient survival was 94.6%, 81.1% at six months and 79.7% at 12 months. Ozturk et al (2010) concluded that there is a high rate of mortality risk in the first six months after admission. This result is consistent with a study conducted by Tosteson et al (2007) who examined the long term excess mortality following a hip fracture while taking into consideration the role of underlying health status and adjusting for pre-fracture function. Ozturk et al (2010) further concluded that increased co-morbidities and the female gender are independent risk factors for increased mortality. Thus far, Ozturk et al (2010) are the sole reporters of the female gender being an independent risk factor for increased mortality. The authors attributed this finding to the distinctive frailty of their female population.

Ozturk et al (2010) recorded 20.3% mortality rate at one year is fairly consistent with that of a similar study carried out in China. The mortality rate at one year after a hip fracture was 17.4% in a study that examined the functional recovery one year after a hip fracture among elderly people (Mean age of 78.3 years) (Lin et al, 2004). The mean age in the study by Ozturk et al (2010) and Lin et al (2004) was equal. However, Lin et al (2004) did not investigate the risk factors that are independent for increased mortality.

In a prospective study in a Portuguese population that examined mortality and functional impairment after a hip fracture, the overall one year mortality rate was 17.1% (Costa et al, 2009). This rate is comparable to those reported in the above studies. The authors justify this mortality rate on a high proportion (75%) of patients that became dependant after sustaining a hip fracture. In the study by Costa et al (2009), males were more likely to die before six months after sustaining a hip fracture. This result is comparable with other international studies (Hindmarsh et al 2009; Roche et al 2005) but contradictory to that of Ozturk et al (2010) who explained the discrepancy based on the distinctive frailty in their female population.

In Africa, Mnif et al (2009) assessed the mortality and morbidity following a trochanteric fracture in 100 elderly patients in Tunisia. At two years, the mortality rate was 28%. This 28% comprised of a 3% mortality rate during the first week postoperatively, 8% between two weeks and three months, 7% between four and 12 months and 10% between 12 and 24 months. Age was one of the most significant risk factors influencing the two year mortality rate. Patients belonging to the "old-old" age group (>90 years) had a 100% two year mortality rate, compared to 25% and 5% respectively for those in the "middle-old" (75-90) and "young-old" (60-74) age group. Associated co-morbidities and fracture instability was also found to be associated with increased mortality.

In South Africa the in-hospital mortality in elderly patients with an intertrochanteric fracture is 14% (Ngobeni, 2010). The mortality rate rises significantly to 32% during the first year and to 39% in the second year. No difference was found in mortality rates when associated with the place of residence prior to hospital admission and the time elapsed between admission and date of operation, as long as the operation was performed during the first week of admission (Ngobeni, 2010). The mortality rates between the two studies in Africa varied substantially, Mnif et al (2009) recorded a 3% in hospital mortality rate, 7% one year mortality and 28% two year mortality in comparison to Ngobenis' (2010) 14%, 32% and 39% respectively. In each of the studies by Ngobeni (2010) and Mnif et al (2009), 64% and 68% of the patients respectively who died throughout the course of the study had one or more pre-existing co-morbidity. Mnif et al (2009) and Ngobeni (2010) limited the inclusion criteria to trochanteric fractures and any femoral neck fractures were excluded. Literature has shown that patients who sustain a femoral neck fracture have significantly higher mortality rates when compared to those with trochanteric fractures (Costa et al 2009). The mean age in Ngobeni's (2010) study was 79 years and the mean age in Mnif et al's (2009) study was 76 years. Despite similar demographics in each of the studies, varying results were reported. These differences can be attributed to the social and cultural factors that varies across different geographical settings and influence the prognosis of hip fractures (Costa et al, 2009)

Patients admitted from nursing facilities and residential homes have significantly increased mortality rates compared to those patients admitted from their own home (Rosell et al, 2003). Ngobeni (2010) contradicted this finding by reporting that place of residence prior to sustaining a hip fracture is not an independent risk factor for increased mortality. These discrepancies between the two studies can be justified by the lack of consideration for each participants pre-fracture functional level and the exclusion of neck of femur fractures in Ngobeni's (2010) study.

Patients admitted to hospital with three or more pre-existing co-morbidities, male gender, respiratory disease, renal disease or increased age are more likely to have a significantly increased 30 day mortality rates (Roche et al, 2005). These findings are consistent with that concluded by Costa et al (2009) and Librero et al (2012) who reported that advanced age, male gender and poor general health status are the main predictors of mortality after a hip fracture. Librero et al (2012) and Ngobeni (2010) further concluded that time to surgery was not associated with a higher in-hospital mortality.

Many studies investigate in-hospital, 30 day, one year and occasionally two year mortality rates after a hip fracture. Only a few studies report long term outcome. A study conducted by Johansen et al (2012) in Cardiff, United Kingdom set out to determine the five year mortality rates after a hip fracture using a cohort of 1,050 people. Eight hundred and sixty nine patients data was presented and the patients age ranged from 31 to 103 with a mean age of 81.3 years and a median age of 83 years. The authors concluded that at five years only one third of patients will still be alive and for every 10 year increase in age, the risk of death increases by 41%.

Only one study was published whereby in-hospital mortality decreased after a hip fracture. Maravic et al (2011) extracted data from the French Hospital National Database and found that in-hospital mortality decreased from 4.7% to 3.5% from 2002 to 2008. These favourable results could be attributed to better care of frail patients as well as inclusion of a younger population in this sample. Data was collected for all patients over the age of 40 years, in most cases literature published on mortality after a hip fracture included patients over the age of 60 years.

2.6. Rehabilitation

The ultimate goal of rehabilitation is to return the patient to their pre-fracture status or condition, however many patients fail to regain their pre-fracture condition due to medical and social reasons. It is imperative to recognize the factors which are positive or negative for rehabilitation (Elliot et al, 2003). Administering the correct rehabilitation program to the appropriate patient will provide improved care to patients as well as aid in the reduction of global health expenses (Shabat et al, 2005). In-hospital rehabilitation in the elderly is a crucial component of successful recovery, and rehabilitation following a hip fracture is an example of geriatric rehabilitation (Lenze et al, 2004).

Rehabilitation in the elderly is performed at different levels. In the acute phase, admission to the appropriate trauma unit is necessary. In this phase, elderly patients require maximal nursing support and acute rehabilitation. The ultimate goal in this phase is return to full function in the shortest possible time. The sub-acute phase includes rehabilitation for high risk geriatric patients in a selected rehabilitation hospital. Medical supervision is required in this phase and the final goal is to assist these patients into returning to their community. The sub-acute phase also includes rehabilitation for low risk patients in a chronic care facility. Total medical supervision is not required. The rehabilitation chosen for each patient based on a structured clinical evaluation and use of validated scales impact on the patient, their family and the health care system (Shabat et al, 2005)

Ceder (2005) interpreted results of a series of studies and confirmed that social factors and the general health status of patients after sustaining a hip fracture play a vital role in the rehabilitation process. A standardised scale that determines these social factors and general health status was not utilised in this study. Ceder et al (2005) concluded that, early return home following admission for a hip fracture depends on the success of the operation, having no co-morbidities, an effective rehabilitation program and a good social network as well as family support. The dates of which these series of studies were carried out ranged from 1966 to 1978. This is a definite limiting factor to this study as this dates back to approximately five decades ago. Thorngren et al (2005) investigated the influence of gender, age, fracture type and pre-fracture living conditions on the rehabilitation pattern after a hip fracture in the elderly. Data from the Standardised Hip Fracture Audit of Europe was analysed. The data in Thorngren et als' (2005) study was more recent and hence more applicable than that of Ceder et al (2005). Thorngren et al (2005) concluded that the patients pre-fracture functional level, their place of living and age were the most influential factors for rehabilitation outcome.

In the older age group, rehabilitation should be approached in a multi-disciplinary manner. Rehabilitation starts pre-operatively with optimization of medical conditions, prevention of secondary complications and family education (Shabat et al, 2005). Physiotherapy immediately after hip fracture surgery is associated with improved locomotion at two and six months after discharge (Penrod et al, 2004). Typical in-hospital physiotherapy for elderly patients after undergoing surgery for a hip fracture consists of; chest physiotherapy techniques in order to maintain a clear chest and prevent complications, pain relieving modalities if necessary, strengthening and range of motion exercises, re-education of bed mobility techniques, transfer and gait training and progression of mobility (Horgan et al, 2003).

Lieberman et al (2006) investigated the factors associated with absolute efficacy in in-patient rehabilitation. A total of 946 patients were included in the study and 40 variables were assessed. Eight of these variables namely; pre-fracture functional level, serum albumin at discharge, cognitive function, presence of dyspnoea on mild exertion, visual impairment, age, previous stroke with resulting motor impairment and decreased serum folic acid were significantly associated with in-patient rehabilitation outcome. Four of the above variables can be corrected with clinical or nutritional adjustments.

Other factors associated with poor rehabilitation participation and outcomes include depression and cognitive impairments, the presence of pre-existing co-morbidities and pain intensity (Lenze et al, 2004; Press et al, 2007; Arinzon et al, 2007). The severity of pain is a good evaluator when considering the prognosis of patients with a hip fracture. Poor assessment and associated treatment affects a patients functional outcome and increases the rehabilitation time and therefore increases local health costs (Arinzon et al, 2007).

Lenze et al (2004) found that cognitive impairment is associated with poorer rehabilitation outcomes in elderly patients with a hip fracture. Cognitively impaired patients cannot participate effectively in therapy, hence leading to a poor functional outcome. Rehabilitation participation was assessed using a newly created Rehabilitation Participation Scale, which rates participation on four levels; 1 - Refused entire session, did not participate at all; 2 - Did not participate in at least half the session; 3 - Participated in most of the session but did not show maximal effort; 4 - Participated with maximum effort and finished most exercises. Lenze et al (2004) also found that depressed patients are more likely to be discharged to a nursing facility. The Rehabilitation Participation Scale developed by Lenze et al (2004) had a ceiling effect and was later modified to a six item scale.

2.7. Functional outcome following a hip fracture

Assessment of disability and functional outcome following a hip fracture can be conceptualised using the International Classification of Functioning, Disability, and Health (ICF). The ICF is a multi-purpose classification that provides a standard language and framework for describing and organizing information on functioning and disability (WHO, 2002). The ICF defines functioning and disability as concepts relating to: the body functions and structures of people, the activities performed and the life areas in which they participate; and the environmental factors that affect these experiences. (WHO, 2010). In the ICF framework the impairments, loss of ability to perform functional activities (activity limitations) and the inability to be actively involved in life situations (participation restrictions) can be identified. An illustration providing an example of how a hip fracture can be conceptualised according to the ICF will follow.

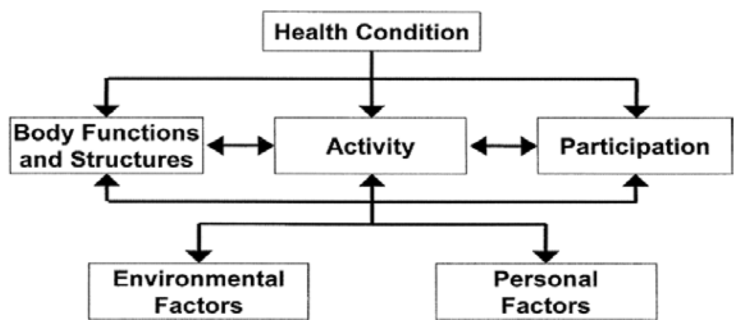


Figure 2.1. Model of the International Classification of Function (WHO, 2002).

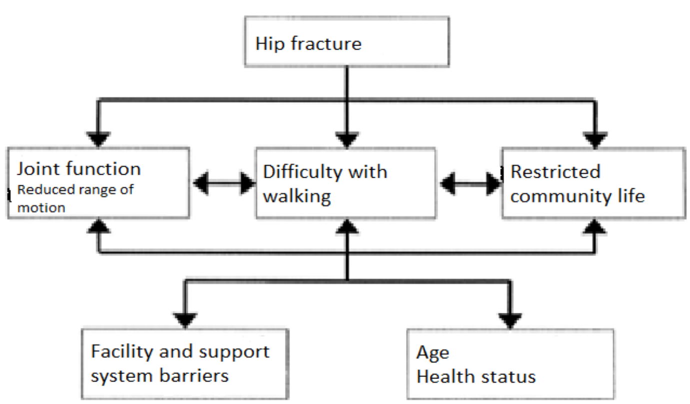


Figure 2.2. Illustration of functioning associated with a hip fracture.

Dawson (2000) defined *functional recovery* as the use of measures which reflect the ability of an individual to ambulate or perform activities of daily living. Dawson (2000) further defined *functional outcome* as being based on living arrangements and residential location following a hip fracture, these specifically referring to; home, assisted living or a skilled nursing facility. The chances for full functional recovery remains relatively low for a considerable number of older persons who sustain a hip fracture each year (Dawson, 2000).

Rosell et al (2003) estimated that in the year after a hip fracture functional abilities will decline by about 15-20% directly related to the hip fracture and about five percent unrelated to the hip fracture. There will also be an increase in the amount of survivors that require social support. This result is consistent with that of Dawson (2000) who reported that physical disability and the need for assistance in activities of daily living are common functional outcomes in the elderly after a hip fracture. Individuals may struggle to perform basic activities such as bathing, toileting and dressing (Dawson, 2000). Both of these studies performed in first world countries had relatively consistent parameters with regards to mean age of the study population and size of the population studied.

After sustaining a hip fracture most elderly patients are unable to recover their functional outcome to the level preceding the fracture in a one year period of follow up, most recovery takes place within the first three months after discharge. Prior to the fracture 93.2% of patients could walk, 73.8 % could walk outdoors, 74.8% could climb stairs and 90% could take care of themselves with respect to feeding, toileting and dressing. One year after the hip fracture only 70.9% of patients could walk, 58.2% could walk outdoors, 49.1% could climb stairs and about 75% could take care of themselves (Lin et al, 2004).

Haentjens et al (2007) compared the functional outcome and survival rates of elderly women after sustaining an intertrochanteric or femoral neck fracture. The functional outcome and survival rates were analyzed at discharge from hospital and one year post discharge. At hospital discharge, patients who sustained a femoral neck fracture were more likely to walk independently compared to those patients who sustained an intertrochanteric fracture. At one year post discharge, the remaining patients shared a similar functional outcome. This result of Haentjens et al (2007) is inconsistent with that of Costa et al (2009), who reported that patients with neck of femur fractures fair worse post-operatively and hence have increased mortality. The difference detected by the two studies can be explained by the differences in frailty between the participants as well as the recruitment process of each study. Haentjens et al (2007) failed to take into consideration the level of frailty and dynamics of the participants when analysing the results and included only female patients compared to Costa et al (2009) who included male and female patients.

After two years of follow up, Laflamme et al (2012) found a significant deterioration in the ambulatory status of patients who sustained a hip fracture. Pre-operatively 64% of participants were independently mobile. At one year and two years following the hip fracture, 54% and 46% were respectively independently mobile. Laflamme et al (2012) excluded patients presenting with cognitive impairments due to the nature of the questionnaires used in their study. This exclusion criteria skews the overall outcome as a large population of hip fracture patients present with cognitive impairments. Cognitive function has been reported as an important prognostic factor associated with rehabilitation success of older patients with a hip fracture (Hershkovitz et al, 2007).

Many studies investigate the functional outcome after a hip fracture in the elderly, however the overall health perception of these patients is seldom assessed. Costa et al (2009) evaluated the functional outcome and perception of health in a sample of Portuguese patients with a hip fracture. Costa et al (2009) found that post discharge 51.7% of males and 68.9% of females were bedridden. Forty four percent of males and 32.8% of females were unable to walk again on their own. A significant number of patients were admitted to a hospital in the year following the hip fracture and 75% of patients became dependant after sustaining the hip fracture. With regards to health-related quality of life 42.4% of female patients and 50% of male patients rated their health in general as somewhat worse or much worse compared to that of one year ago. The deterioration of independence in physical activities and health-related quality of life is apparent in this study. The study failed to take into consideration the functional level of the participants prior to the fracture.

2.8. Factors influencing functional outcome

The functional outcome of patients with a hip fracture is considered to be multi-factorial. Pre-fracture functional level and advanced age are considered to be key influencing factors on the outcome after a hip fracture (Kristensen, 2011; Semel et al, 2010). To a lesser extent, other factors may include, gender, cognitive and general health status, fracture type and related procedures, anaemia, pain at the fracture site, lower educational levels, muscle strength and postoperative mobility status (Kristensen, 2011; de la Torre-Garcia et al, 2011). Semel et al (2010) further concluded that not living alone prior to the fracture and being prescribed less medication that increase the risk of patients falling result in a better functional outcome. One of Semel et als' (2010) most interesting finding was that patients with diabetes mellitus had poorer rehabilitation outcomes, a longer length of hospital stay and were less likely to be discharged directly home. Neuropathies affecting balance and strength resulting from diabetes mellitus could possibly explain the poorer functional outcome.

Holt et al (2008) examined the outcome after surgical intervention for a hip fracture in the extremely elderly (>95 years) in Scotland. Mobility and mortality of an extremely elderly cohort was compared to a modal control group (75 - 89 years) taking into consideration case-mix variables such as pre-existing co-morbidities, age, sex, pre-fracture functional level and fracture type. The authors concluded that the extremely elderly have an increased number of pre-fracture co-morbidities and are thus less likely to be independent with mobility. Survival after sustaining a hip fracture in the extremely elderly often results in a permanent loss of mobility. These results are contradictory to that of Intiso et al (2009), who concluded that patients 90 years of age or older achieve good functional outcomes and are able to return home after rehabilitation. In the study by Intiso et al (2009) 80% of patients achieved their pre-fracture functional level and 41% regained gait without an aid and were able to maintain this level of independent ambulation. These differences in literature can be attributed to the varying sample sizes of each study. Holt et al (2008) analyzed collected data of 919 extremely elderly patients and 15,461 control patients from 22 acute care orthopaedic units using the Scottish Hip Fracture Audit. Intiso et al (2009) analyzed the data of 42 elderly patients in an intensive rehabilitation setting. Intiso et al (2009) lacked a control group. Arinzon et al (2005) also compared the functional outcome after rehabilitation between the old-old elderly (85 years and older) and young elderly (65 - 74 years) patients. On admission the old-old patients presented with cognitive impairments, malnutrition and increased pain. At discharge the old-old patient group had a longer length of stay and although functional ability improved, it was substantially lower than that of the young elderly group. Age is an important indicator of frailty and functional recovery after a hip fracture (Arinzon et al, 2005).

A patients level of mobility within the first few postoperative days is a good indicator of the short-term post-operative functional outcome following a hip fracture. Ross (2002) confirmed this hypothesis in a study investigating the factors predictive of independence in transfers and ambulation after hip fracture. Other variables significant to predicting independence in ambulation at two weeks post-operatively are age, cognitive function and pre-fracture functional mobility. Patients with intact cognitive function and those who are functionally independent achieve better functional outcomes at discharge and are thus discharged home instead of to a nursing facility and their hospital length of stay is shorter (Hershkovitz et al, 2007).

Hagino et al (2011) investigated which risk factors predict difficulties with discharge to own home. Three hundred and forty five patients were included and all were living at home prior to the injury. 58.6% of patients were discharged to their own home and 41.4% were unable to return to their own home due to in-hospital death or admission to a skilled rehabilitation facility. The risk factors that were identified included age at admission, pre-existing co-morbidities, presence of dementia and walking disability before the fracture.

2.9. Age

Of the numerous factors that could affect post operative functional outcome, the most important is age, followed by pre-fracture functional level of the patient (Holt et al, 1994). More recently, Thorngren et al (2005) also concluded that older age is a highly discriminating factor with a significant influence on the rehabilitation pattern following a hip fracture.

In a study by Kristensen et al (2010) older age proved to be independently associated with a loss of independence in basic mobility after sustaining a hip fracture. These older patients also experienced a greater number of post operative days to regain independence in basic mobility and were also more likely not to be discharged directly to their own home.

Holt et al (2008) examined a cohort of 919 extremely elderly individuals and concluded that extreme old age (>95 years) is associated with increased mortality after sustaining a hip fracture, irrespective of other variables. Lin et al (2004) sampled 103 elderly patients with a hip fracture and concluded that patients over the age of 85 tend to have a worse post-operative functional outcome. Intiso et al (2009) contradicted the above conclusions and found that patients 90 years of age or older achieve good functional outcomes and are able to return home after rehabilitation. These results of Intiso et al (2009) are unique and can be explained by the 42 participants that were used in the study. All of these participants were recruited from a highly specialised rehabilitation facility and hence are more likely to have better outcomes. Intiso et al (2009) further excluded patients who were demented and dependent with mobility prior to the injury. Holt et al (2008) included all patients, thus providing more realistic results with regards to functional outcome in this frail population.

2.10. Pre-fracture functional level

Holt et al (1994) believes that the morbidity and mortality caused by a hip fracture is due to the frail state of the patients who sustain this injury and that the patients pre-fracture functional level is a good indication of the general mental and health status of the patient. A discriminant analysis in this study revealed that pre-fracture functional level is inversely proportional to mortality. Patients with a higher pre-fracture functional mobility had a lower death rate. In a more recent study, Williams et al (2005) reinforced that a decreased pre-fracture functional level affects postoperative mortality in this high risk patient group. A positive correlation of p=0.005 was established.

The most reliable predictor of rehabilitation outcome in elderly patients with a hip fracture appears to the pre-fracture functional level (Parker and Palmer, 1993). More recently, Kristensen et al (2010) found that the pre-fracture functional level is a strong predictor of in-hospital outcome in elderly patients with a hip fracture. A patient with poor pre-fracture functional abilities is 18 times more likely not to regain independent basic mobility while in hospital, if these patients regained independence in basic mobility, it was on average three days later. Patients with a low pre-fracture functional level are also less likely to be discharged directly to their own home in comparison to a patient with a high pre-fracture functional level. Patients who are independent in mobility and activities of daily living before sustaining the fracture are 1.8 times more likely to survive at six months compared to those who were unable to walk independently or carry out activities of daily living (Penrod et al, 2008).

Dubljanin- Raspopovic et al (2012) hypothesised that pre-fracture functional mobility is an independent predictor of functional outcome at four months post discharge. Dubljanin-Raspopovic et al (2012) compared pre-fracture functional level in those patients presenting with a cognitive impairment and those with intact cognition. Patients with better cognitive scores using the Short Portable Mental Questionnaire presented with better pre-fracture functional levels.

2.11. Pre-existing co-morbidities

The American Society of Anesthesiologists' (ASA) physical status classification is a scale developed in 1941 by Sakland. Patients are graded on a scale of I to V: I, healthy patient; II, mild systemic disease - no functional limitation; III, severe systemic disease - definite functional limitation; IV, severe systemic disease that is a constant threat to life; V, moribund patient unlikely to survive 24 hours with or without operation. Kristensen et al (2011) concluded that the number of co-morbidities or ASA rating is valuable when predicting the prognosis after a hip fracture.

The factors associated with one year mortality following a hip fracture in the elderly includes a high ASA rating in addition to other factors (Ozturk et al, 2010). Roche et al (2005) also evaluated the effect of co-morbidities on one year mortality following a hip fracture. The authors further elaborated on this topic by concluding that the presence of three or more co-morbidities, respiratory disease or malignancy on admission is a strong post-operative risk factor and leads to increased mortality at one year. Ozturk et al (2010) graded each patients general health status according to the ASA classification status while, Roche et al (2005) assessed each patient by the number of co-morbidities present on admission and recorded their incidence. Therefore providing more elaborate and specific results with regards to co-morbidities. Shebubakar et al (2009) concluded that the presence of pre-existing co-morbidities is one of the independent risk factors for a poor post-operative functional outcome in elderly patients after receiving partial hip replacement surgery for a traumatic fracture.

Semel et al (2010) investigated the effects of diabetes mellitus on the outcome following a hip fracture in the elderly. It was concluded that the presence of diabetes mellitus predicts a poorer rehabilitation outcome. However, a limitation of the study by Semel et al (2010) was the lack of a measure to grade the level of diabetes mellitus and its control. Ekstrom et al (2012) also evaluated the effect of diabetes mellitus on Health Related Quality of Life (HRQoL) after sustaining a hip fracture. The authors concluded that preoperatively, patients with diabetes mellitus had more pain and more co-morbidities. A final follow up at 24 months revealed that patients with diabetes mellitus frequently presented with cardiac and renal complications, but the level of function and reported Health Related Quality of Life was comparable to that of patients without diabetes.

The presence of incontinence, pressure ulcers and atrial fibrillation are the factors that most negatively affect functional outcome after a hip fracture (Atalay et al, 2007). Other co-morbidities such as Parkinson's disease , stroke and arrhythmia decreased the odds of walking independently or performing activities of daily living at six months after a hip fracture (Penrod et al, 2008; Lin et al, 2004).

Hagino et al (2011) investigated the risk factors that predict difficulties with achieving the goal of discharge directly home in 345 elderly patients with a hip fracture. The presence of systemic chronic diseases positively correlated to not being discharged directly home. Hagino et al (2011) acknowledged the fact that the presence of systemic chronic diseases are already present at the time of admission and alleviating these diseases is probably unlikely by a medical team. Hence, effective hospital discharge planning to appropriate facilities is important.

2.12. Cognitive function

Cognitive impairments have profound implications on the ability to live independently (Parker and Philp, 2004). Dementia and other cognitive impairments that are present prior to a hip fracture in the elderly are important predictors of outcomes. Incident cognitive impairment presenting at anytime during hospitalization appears to be a predictor of poor functional outcomes in this elderly population group. Forty percent of incident cognitive impairment detected while in hospital persisted at two to 12 months after hospitalization and this yields poorer independence in basic activities of daily living. Patients who are older, present with decreased pre-fracture functional mobility, male, less educated, more depressed, present with intertrochanteric fractures (vs. femoral neck) and have more co-morbidities are more likely to develop incident cognitive impairment (Gruber-Baldini et al, 2003). A strength of this study was the use of pre-fracture ratings of dementia and cognitive functioning through the use of proxy responders. This study included only community dwelling participants, the prevalence of cognitive impairment would have been higher if participants from nursing homes were included.

Lenze et al (2004) examined the adverse effect of depression (Hamilton Rating Scale for Depression)and cognitive impairment (Mini-Mental State Examination) in elderly hip fracture patients receiving inpatient rehabilitation. The authors concluded that depression and cognitive impairment predicted poorer functional outcomes because these patients are unable to participate as well in their therapy sessions. Söderqvist et al (2006) used the Short Portable Mental Status Questionnaire on admission in patients with a hip fracture to identify those with severe cognitive impairment. A score of less than three and the male gender was associated with poorer functional outcomes and increased mortality at one year.

Moderate to severe cognitive impairment, assessed by the Abbreviated Mental Test Score, is associated with poor functional outcome at discharge and an increased likelihood to be discharge to a nursing home after a hip fracture (Horgan et al, 2003). At six months, dementia hampered mobility, survival and the ability to perform activities of basic living (Penrod et al, 2008). A study by Williams et al (2005) positively correlated the effect of increased cognitive dysfunction on postoperative mortality following a hip fracture in the elderly.

In summary, Sections 2.9 to 2.12 provide evidence that pre-fracture functional level and advanced age are considered to be key influencing factors on the outcome after a hip fracture. To a lesser extent, other factors may include, gender, cognitive function and general health status, fracture type and related procedures, anaemia, pain at the fracture site, lower educational levels, muscle strength and postoperative mobility status.

2.13. Outcome measures

An outcome measure is defined as “a measurement tool (instrument, questionnaire, rating form, scale, standardised test.) *used* to document change in one or more client characteristic over time” (Cole et al, 1995: 5-6). An outcome measure is used to identify patient’s abilities at baseline, to document progress and measure change. To enhance clinical decision-making about the patient and rehabilitation programme and to inform policy reforms (Cole et al, 1995: 5)

Standard validated scales are used to assess medical, surgical, rehabilitative and functional outcomes as objectively as possible in elderly patients. These scales should be used in conjunction with a physical examination. Validated tools are more accurate than clinical impression alone, however the appropriate combination of clinical experience and a validated scale may well contribute to improved care of elderly patients with hip fractures (Shabat, 2005). The subsections to follow include the development, use and reliability of standardised scales. These scales are interrogated against and compared to those considered gold-standard in their field.

2.13.1 Elderly Mobility Scale (EMS)

The Elderly Mobility Scale (EMS) is an ordinal scale devised to provide a physiotherapy-orientated measure for frail elderly people which is complementary to other scales (Smith, 1994). The scale assesses seven items of functional performance. These include; locomotion, balance and key position changes, all of which are skills required for the performance of activities of daily living. The maximum score is 20, with higher scores indicating better performance.

Spilg et al (2001) investigated the responsiveness of the EMS to change. In a falls rehabilitation program 83% of patients who were expected to improve in mobility improved on the EMS compared to 42% and 35% on the Barthel Index and Functional Ambulation Classification scores respectively.

Nolan et al (2008) evaluated inter-rater, intra-rater and concurrent validity properties of the EMS in an acute hospital setting in patients over the age of 55 years. Latent class analysis of the EMS showed that neither the therapist testing (inter-rater reliability $R^2 = 0.0037$ $p = 1.00$), occasion of testing (intra-rater reliability $R^2= 0.0035$ $p = 0.72$), years of experience ($R^2 = 0.0051$ $p = 1.00$) nor the amount of EMS assessments previously completed ($R^2 = 0.0048$ $p = 1.00$) had any statistically significant change on EMS scores. Thus indicating strong reliability of the EMS. Concurrent validity was evaluated by a comparison to the Modified Rivermead Mobility Index. A high correlation between the two scales was revealed (Spearman's rho (ρ) = 0.887, $p<0.05$, 95% CI: 779-0.994), thus demonstrating concurrent validity.

2.13.2. The Cumulated Ambulation Score (CAS)

The Cumulated Ambulation Score (CAS) is a recently developed tool that measures day - to - day improvements in basic mobility. The CAS assesses a patients independence in three functional activities, getting in and out of bed, sit to stand from a chair and walking. Each item is rated on a three point scale (two, able to perform activity safely without verbal queuing or human assistance; one, able to perform activity safely with verbal queuing or human assistance; zero, not able to perform activity) providing a daily score of zero to six. The score is cumulated over three first post-operative days resulting in a total score of zero to 18 (Foss et al, 2006). The CAS is a reliable (weighted kappa ≥ 0.92) post-operative predictor of short-term mortality, functional outcome, discharge status in patients sustaining a hip fracture (Kristensen et al, 2009). The CAS being only a predictor of short-term functional outcome and its accumulation of scores over three first post-operative days is a limitation of the instrument.

2.13.3. Lower Extremity Functional Scale (LEFS)

Binkley et al (1999) aimed to develop a functional measure that can be administered and scored easily as well being applicable to patients with a wide variety of lower extremity orthopaedic conditions. The LEFS was developed for clinicians to measure patients' initial function, ongoing progress and final outcome, in addition to assist in setting functional goals. The functional measure was required to be a self report, condition specific tool that would be reliable and valid in a clinical and research setting

The LEFS consists of 20 items, each item describes a functional lower limb activity. Each item is scored from zero to four, (zero = extremely difficult and unable to perform activity ; four = no difficulty). A total possible score of 80 is indicative of a high functioning patient. The scale can be filled out by the patient independently in approximately two minutes (Binkley et al, 1999).

After developing the Lower Extremity Functional Scale (LEFS) as well as determining its measurement properties and clinical application, Binkley et al (1999) concluded that the LEFS is easily administered and scored and can be used on a wide variety of acute and chronic patients with orthopaedic conditions. Construct validity was determined by comparing the LEFS to the physical function subscale [r = .80 (95% lower limit CI = .73)] and the physical component score [r = .64 (95% lower limit CI = .54)] of the SF-36. Intra-rater reliability of the entire sample tested at 24 and 48 hours post initial assessment was r = .86 (95% lower limit CI = .80). The potential error associated with a given measure is 5.3 scale points. The minimal detectable change and the minimal clinically important difference is nine points.

The LEFS is a reliable and validated self reported measure that can be used as an outcome measure on acute and chronic musculoskeletal conditions of the lower extremity (Binklet et al, 1999). The LEFS would be beneficial to use as an adjunct to a physical performance measure. An elderly individuals perceived ability to perform a task is beneficial when thoroughly determining the post operative functional outcome following a hip fracture.

2.13.4 New Mobility Score (NMS)

The New Mobility Score (NMS) developed by Parker and Palmer (1993) assesses pre-fracture functional mobility. This tool was developed by assessing 882 patients with a proximal femoral fracture. The patients were assessed using the NMS and a mental test score, the results of these two tests were evaluated against the mortality after one year. The NMS proved to have a superior predictive value and was more sensitive in determining mortality. Hence proving to be a more functional assessment.

The score for the NMS is calculated on the patient's ability to walk indoors, outdoors and the ability to go shopping before sustaining the hip fracture. The patient is scored between zero and three (zero = not at all, one = with help from another person, two = with an aid, and three = no difficulty) for each function, resulting in a final score that can range from zero (no walking ability) to nine (fully independent) (Parker and Palmer, 1993).

The NMS is proven both reliable and valid by Kristensen et al (2008) and Parker and Palmer (1993) respectively. In a study by Kristensen et al (2008) a high inter-tester reliability score (0.98) was recorded, this was evaluated using the intraclass correlation coefficient. The intra-rater reliability was not investigated by the authors as it was likely for each physiotherapist to recall the answers of the first NMS score (recall bias) as well it being a common finding that when compared the intra-rater reliability is higher than the inter-rater reliability (Pervez et al, 2002). A cut off score of five on the NMS is the best valid predictor of functional outcome at one year (Parker and Palmer, 1993).

A study by Kristensen et al (2010) found that the pre-fracture functional level, determined by the NMS, is a strong and independent predictor of in-hospital and short-term outcome in patients with a hip fracture. Pre-fracture functional level assessed using the Barthel Index predicts the ability to walk independently at discharge. This score significantly fails to predict functional outcome following discharge (Bellelli et al, 2012) unlike the NMS. Kristensen et al (2010) further established that a patient with a low pre-fracture functional level (NMS</= 6) was 18 times more likely to have poor independence with basic mobility while in hospital, on average regained independence in basic mobility three days later, and the likelihood of not being discharged to their own home was 13 times higher than that of a patient with a high pre-fracture functional level (NMS > 6).

2.13.5 Cumulative Illness Rating Scale for Geriatrics (CIRS-G)

The Cumulative Illness Rating Scale (CIRS) measuring the chronic medical illness burden using 13 main systems was initially developed by Linn et al (1968). This version was later revised by Miller et al in 1992 and the 14 -system Cumulative Illness Rating Scale for Geriatrics (CIRS-G) was created in order to highlight common problems of the elderly, with an emphasis on morbidity. The CIRS -G included a separate category for "haemotopoietic". A "breast" category was added on to the "endocrine/metabolic" category. Common risk factors such as obesity and smoking history which were not formerly included into the scale were now incorporated into the scale and could be rated. The inter-rater reliability was determined in both geriatric inpatients and outpatients. The ICC on the inpatient sample was 0.88, whereas the ICC on the outpatient sample was 0.78.

The systems that are used in the CIRS-G are (1) cardiac; (2) vascular; (3) hematological; (4) respiratory; (5) otorhinolaryngological, opthalmological; (6) upper gastrointestinal; (7) lower gastrointestinal; (8) hepatic and pancreatic; (9) renal; (10) genitourinary; (11) musculoskeletal, tegumental; (12) neurological; (13) endocrine, metabolic, breast and; (14) psychiatric. The total score of the CIRS-G ranges from 0 to 56. Each system is rated on a scale from zero to four as follows: zero, no problem affecting that system; one, minor current problem or past significant history; two, moderate disability requiring primary care treatment; three, severe problem, constant significant disability, chronic problem difficult to control; four, extremely severe problem, immediate treatment required, organ failure or severe functional impairment.

In 2005, Hudon et al carried out a study that would determine the reliability and validity of the (CIRS-G). Hudon et al (2005) concluded that the CIRS-G scored via a chart review by nurses has an acceptable inter-rater reliability (ICC 0.78) that is similar to that of the CIRS-G scored via an interview (ICC 0.81). The intra-rater reliability measured two months later by two nurses revealed intraclass correlation coefficients 0.80 and 0.89. The authors of the study felt that better training could have improved the results. Due to the absence of a gold standard instrument that measures pre-existing co-morbidities, a gold standard measure for this study would be determined by the results obtained by the attending physician. Concomitant validity among the CIRS-G scores obtained via a chart review and interview as well the gold standard measure of the attending physician was deemed as acceptable in this study, ranging from 0.73 to 0.84. Scoring the CIRS-G via a chart review has its advantages as the patient's presence is not required, also the chart review scores are more closely related to the attending physicians score (gold standard). Scores of the CIRS-G administered via an interview are slightly overestimated due to patients reporting additional symptoms, especially in somatization problems. The CIRS - G is used in other studies to evaluate the level of co-morbidity in elderly patients with a primary diagnosis of hip fracture (Lenze et al, 2004; Holt et al, 2008).

The American Society of Anesthetists Inc developed a scale that would attempt to define and standardize what could be considered "physical state" (Saklad, 1941). This scale is known as the American Society of Anesthesiologists' (ASA) physical status classification. Patients are graded on a scale of I to V: I, healthy patient; II, mild systemic disease - no functional limitation; III, severe systemic disease - definite functional limitation; IV, severe systemic disease that is a constant threat to life; V, moribund patient unlikely to survive 24 hours with or without operation (Wolters et al, 1996). When compared to the CIRS-G, the ASA physical status classification does not separate bodily systems or allow for grading of the severity of co-morbidities, thus complicating the use of this scale.

2.13.6 Six Item Cognitive Impairment Test (6CIT)

Cognitive screening tests do not fully reflect the abilities of elderly patients in black and minority ethnic groups, factors that contribute to this are literacy, language, educational level and cultural specific references. The ideal screening test for cognitive impairment in the primary care setting should be brief and easy to score, require no information from a proxy/family member and no specialized equipment or intensive training for the assessor should be necessary. It should be reliable and its performance should not be affected by the culture, language or educational level of the elderly patient. It should also have a high specificity in order to eradicate incorrect diagnoses and a high sensitivity to ensure that milder or earlier cases of dementia are not missed. There are promising results on 'culture free' tests, but more evidence is needed (Parker & Philp, 2004).

One of the most commonly used tool for screening for cognitive impairment, as well as being regarded as the "gold standard" is the Mini Mental State Examination (MMSE) (Folstein et al, 1975). The MMSE tests the patients attention, orientation, recall, language, calculation and motor skills. A limitation of the MMSE is that the presence of purely physical inabilities can misinterpret the score of the MMSE in addition to the administration of the tool being time consuming.

The Six Item Cognitive Impairment Test (6CIT) (Katzman et al, 1983) developed via a regression analysis is an abbreviated version on the 26-item Blessed Information-Memory-Concentration scale (BIMC) (Blessed et al, 1968). Brooke and Bullock (1999) validated the Six Item Cognitive Impairment Test (6CIT) against the MMSE as well as establishing its suitability as a screening tool for dementia. The 6CIT was concluded to be a short and simple test of cognition. The 6CIT correlates well with the MMSE ($r^2 = -0.911$ $p<0.01$) but fairs better when screening for milder dementia, the MMSE when used as a screening test for dementia is of little value.

The 6CIT is newer than the MMSE and Abbreviated Mental Test Score (AMTS) and is easily translatable for different cultural and linguistic purposes. The 6CIT comprises of six questions that take three to four minutes to complete. The scoring system uses weighting techniques and is thus slightly more complicated than previous tests. The total score is 28 and scores of zero to seven are considered normal while scores of above eight are significant. At the seven / eight cutoff the 6CIT gives a specificity of 100% and a sensitivity of 78.57% while the MMSE at a cut off of 25/26 scores 100% and 51.43% respectively for mild dementia, thus confirming that the MMSE is a poor screening tool for milder dementia in the primary care setting (Brooke and Bullock, 1999).

Other abbreviated tests that screen for cognitive impairment do exist, one being the Abbreviated Mental Test Score (AMTS) (Hodkinson, 1972). The AMTS is an abbreviated mental test of ten questions of memory and orientation derived from the longer Roth - Hopkins test. The abbreviated test (AMTS) closely correlates with the original longer test and produces results that are acceptable. The AMTS is also more convenient to administer compared to the MMSE and Roth - Hopkins test and is suitable for the elderly population (Qureshi and Hodkinson, 1974).The AMTS was modified (Hong Kong version) and validated in 1995. The AMT (Hong Kong version) produced a sensitivity of 96% and a specificity of 94% at a cutoff point of 6 (Chu et al, 1995).

Based on the above literature on relevant outcome measures, the outcome measures that are most applicable to this study include the New Mobility Score (NMS) to assess pre-fracture functional level, the Six - Item Cognitive Impairment Test (6CIT) to assess cognitive impairment and the Cumulative Illness Rating Scale for Geriatrics (CIRS-G) to assess the presence of pre-existing co-morbidities. For the assessment of functional outcome, the Elderly Mobility Scale

(EMS) will be used to evaluate each participants functional outcome and the Lower Extremity Functional Scale (LEFS) will be used in conjunction with the EMS.

2.14. Conclusion

Many studies have shown that hip fractures may be the most critical event of life leading to functional decline, disability, or ultimately death in the elderly (Costa et al, 2009; Dawson, 2000; Lin et al, 2004). The functional outcome of patients with a hip fracture has been determined in many developed countries and various factors that influence these functional outcomes have been established (Holt et al, 2008; Intiso et al, 2009; Semel et al, 2010).

Research has shown that the average age of patients who sustain a hip fracture in developing counties, like South Africa, is lower than that of developed counties (Zebaze et al, 2003). In-hospital and one year mortality rates established by Ngobeni (2010) for the South African population was found to be higher than that of other counties in Africa as well as abroad. By determining the early post-operative functional outcome and the influencing factors in elderly patients with a hip fracture in South Africa, it will assist in understanding the reason why South Africans have higher mortality rates despite research indicating that a developing country such as South Africa should have a lower average age of patients who sustain hip fractures.

The post-operative functional outcome and the influencing factors in elderly patients with a hip fracture in a selected public health setting in South Africa has not yet been determined. Establishing the post-operative functional outcome after a hip fracture, as well as the influencing factors will identify those patients who are especially at risk of not regaining independence in basic mobility. Exploration of the post-operative functional outcome after a hip fracture may lead to future research on improving functional outcome for these high risk patients and could have a potential impact on policy, formulation of protocol and further advances in the field locally and to a lesser extent internationally.

Chapter 3 - Methodology

3.1. Introduction

This chapter describes in detail the study design, participant sample and the method in which the study was carried out. The method has been presented in chronological order and the details of all materials and variables have been included. Procedures for data collection have also been presented.

3.2. Study design

The study was a prospective pre-test post-test observational study.

3.3. Participants

Participants were elderly patients with a hip fracture from the orthopaedic wards of Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital in Johannesburg, South Africa.

3.3.1. Sample selection

Participants were consecutively sampled

3.3.2. Sample size

The sample size for this study was determined using a power calculation on STATA. The power was set at 90% and alpha at 5%. Standard deviations and the minimally clinical important difference for the Elderly Mobility Scale (EMS) and Lower Extremity Functional Scale (LEFS) were used. A sample size of 76 participants was required for the Elderly Mobility Scale (EMS) and 74 participants for the Lower Extremity Functional Scale (LEFS). A final result of n=75 was then decided on based on the above two results. A loss to follow up ratio was taken into consideration and was set at 20%, thus resulting in a final number of 90 subjects.

3.3.2.1. Inclusion criteria

- Patients admitted to Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital with a first time unilateral hip fracture who required surgical management.
- Patients above the age of 60 years

3.3.2.2. Exclusion criteria

- Bilateral hip fractures
- Polytrauma
- Patients re-admitted with complications of a previous surgery
- Patients managed conservatively
- Patients with co-morbidities affecting mobility (CVA, Parkinsons disease or a spinal cord injury).

3.4. Instrumentation

Each of the variables below and the respective instrumentation have been discussed in length in Chapter 2. A brief description will be discussed in this chapter.

The variables that were measured in this study, the outcome measures used and the point at which data was collected for each variable is presented in Table 3.1 below.

Table 3.1: Variables, outcome measures and point at which data was collected

Variable	Outcome measure	Point of data collection
Pre-fracture functional level	New Mobility Score (NMS)	• Pre-operatively • Method: Interview with verification from a caregiver
Pre-existing co-morbidities	Cumulative Illness Rating Scale for Geriatrics	• Pre-operatively • Method: Chart review and interview
Cognitive function	Six Item Cognitive Impairment Test (6CIT)	• Pre-operatively, discharge and six weeks post discharge • Method: Interview
Post-operative mobility	Elderly Mobility Scale (EMS)	• Discharge and six weeks post discharge • Method: Physical evaluation
	Lower Extremity Functional Scale (LEFS)	• Discharge and six weeks post discharge • Method: Interview

3.4.1. New Mobility Score (NMS) (Appendix A)

The New Mobility Score (NMS) was used to assess pre-fracture functional level. It is a composite score of the ability of a patient to perform indoor walking, outdoor walking and shopping prior to fracturing the hip. A score between zero and three is provided for each function (item) (zero = not at all, one = with the help from another person, two = with an aid, three = no difficulty, no aid). The total score ranges from zero to nine. A score of zero indicates that the patient has no walking ability at all and a score of nine indicates full independence (Kristensen et al, 2010). The NMS was administered using an interview, whereby participants are expected to recall pre-fracture function.

3.4.2. Cumulative Illness Rating Scale for Geriatrics (CIRS –G) (Appendix B)

Health status or the presence of pre-existing co-morbidities was evaluated using the Cumulative Illness Rating Scale for Geriatrics (CIRS – G) (Miller et al, 1992). The 14 – system version CIRS – G measures the pre-existing co-morbidities while taking into consideration the severity of chronic disease. Fourteen organs or bodily systems are considered and the total theoretical score ranges from zero to 56, based on the scoring of zero to four for each organ or bodily system as follows: zero, no problem; one, minor current problem or significant history; two, morbidity or moderate discomfort, requiring primary care treatment; three, severe problem: constant significant discomfort, chronic problem difficult to control; four, extremely severe problem, requiring immediate treatment: organ failure or severe functional impairment (Hudon et al, 2005). Lower scores reflect mild problems while higher scores reflect a more serious complication. A maximum score of 56 is impossible as it would indicate failure of several bodily systems not compatible with life (Hudon et al, 2007). The CIRS – G was completed by reviewing the participants medical records as well as a clinical interview.

3.4.3. Six Item Cognitive Impairment Test (6CIT) (Appendix C)

The Six Item Cognitive Impairment Test (6CIT) is a useful screening tool for cognitive impairment in primary care, the 6CIT is especially useful in the identification of milder dementia (Brooke and Bullock, 1999). The 6CIT consists of six questions that include orientation, memory and months and digits backwards that are weighted to produce a total out of 28. Scores of zero to seven are considered normal. Higher scores reflect cognitive impairment. The 6CIT was administrated using an interview.

3.4.4. Elderly Mobility Scale (EMS) (Appendix D)

The Elderly Mobility Scale (EMS) is a physical assessment of function and was demonstrated by each of the participants to determine a score out of 20. The EMS is an ordinal scale devised to provide a physiotherapy-orientated measure for frail elderly people which is complimentary to other scales (Smith, 1994). The scale assesses seven dimensions of functional performance. These include; locomotion, balance and key position changes, all of which are skills required for the performance of activities of daily living. The maximum score is 20, with higher scores indicating better performance.

3.4.5. Chair

The chair that was used as part of the Elderly Mobility Scale to assess sit to stand was 47cm (19 inches) in height and included arm rests as described by Smith (1994).

3.4.6. Lower Extremity Functional Scale (LEFS) (Appendix E)

The Lower Extremity Functional Scale (LEFS) was used to evaluate the functional activity level of a patient with a disorder of one or both lower extremities (Binkley et al, 1999). The LEFS is a questionnaire containing 20 questions about a person's ability to perform everyday tasks. The questionnaire starts off by asking the patient: "Today would you have any difficulty with:" followed by a list of functional activities. These activities are scored from zero (extreme difficulty) to four (no difficulty). The scale has columns which are summed to get a score. The maximum score is 80. The lower the score the greater the disability. For the purpose of this study, the LEFS was modified for cultural appropriateness. The LEFS was used in conjunction with the EMS in an attempt to thoroughly understand each participants perceived level of function as well as their actual physical level of function (measured using the EMS).

3.4.7. Demographic details form (Appendix F)

The self designed demographic details form for each participant included: The participants age, gender, date of fracture, type of fracture, date of admission, date of surgery, type of surgery performed, medications prescribed, date of discharge, number of physiotherapy sessions, and a list of complications that may have developed during the participants hospital stay. The above details were documented as they all could potentially have an impact on the early post-operative functional outcome in elderly patients with a hip fracture. A brief overview of these results will be discussed in Chapter 4.

3.5. Variables

3.5.1. Independent variables

- Pre-fracture functional level
- Pre-existing co-morbidities
- Mental status

3.5.2. Dependant variables

The dependant variable was the post-operative functional outcome in elderly patients with a hip fracture determined by the EMS and LEFS.

3.6. Ethical Considerations

Ethical clearance (M110403) (Appendix L) was granted by the Human Research Ethics Committee of the University of the Witwatersrand. Permission was also obtained from Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital

The participants were provided with an information sheet (see Appendix H) outlining the nature of the study and were provided with the opportunity to ask questions. Informed consent (see Appendix I and J) was obtained before participation in the study commenced. All participants were explained to that they are allowed to withdraw from the research study at any point without any prejudice against them. The study did not interfere with any treatment that the participant would normally receive. Participant's names were be substituted with participant codes so as to maintain confidentiality. Data and results obtained during the course of the study were kept confidential and access was limited to the researcher and the supervisors.

3.7. Procedure

3.7.1. Pilot study

3.7.1.1. Pilot study aim

To test the researcher's ability to use the instruments correctly so that relevant data was collected in the main study.

3.7.1.2. Pilot study objectives

1. To familiarise the researcher in using the five outcome measures.
2. To establish the time taken to work with one patient.

3.7.1.3. Pilot study methodology

The pilot study began once approval was granted from the relevant committees. Twenty seven patients presenting with a hip fracture participated in the pilot study. The patients were divided into three groups consisting of nine patients in each group. The outcome measures intra-rater reliability was determined as this was the first time these tools were used by the researcher and it was necessary that the researcher could reproduce similar results before commencing the main study. An eight hour interval was deemed sufficient between intra-rater reliability assessments as piloting of three outcome measures in one sitting accumulated a total of over 20 questions and seven physical demonstrations. Due to the length of the questionnaires and age of the target group it can be assumed that elderly participants would have difficulty recalling any of the answers.

1. Group one consisted of nine patients who were recently admitted to the orthopaedic ward and are still awaiting surgery. The NMS and 6CIT was piloted by the researcher on two occasions with an eight hour interval in between. This was to determine the intra-rater reliability of the instrument. The CIRS –G was used to determine the chronic medical illness burden of the patients in group one to familiarise the researcher with the tool.

2. Group two consisted of nine patients who were being discharged from the hospital. The EMS was performed by the patients so as to enable the researcher to determine the suitability of the instrument for the study. The 6CIT and LEFS was also piloted to the patients in group two on two occasions with an eight hour interval in between to determine the intra-rater reliability of the instrument.

3. Group three also consisted of nine patients who have returned to Helen Joseph Hospital six weeks post-discharge for a routine doctor's appointment. The data was collected from these patients on their arrival at the hospital. Thereafter these patients attended their monthly hospital appointments, which included collecting their file, a consultation with the doctor, going for X-Rays, attending wound clinic for dressing changes, collecting medication at the pharmacy and attending their physiotherapy appointment. For many of these patients fulfilling the above appointments occupied their entire day. Patients whose data was collected for the pilot study were in communication with the researcher so as to complete the second assessment. The data of the patients who left the hospital early and could not complete the second assessment was discarded. Data of only those patients who had spent enough hours at the hospital between each assessment was used. The same tools that were piloted on group two were piloted on group three.

3.8. <u>Main study</u>

The staff of the physiotherapy and orthopaedic departments at Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital were informed about the study using a letter (Appendix G).

Potential participants were approached by the researcher within the first three days of admission once their condition had been stabilised and adequate pain control was administered according the each participants medication chart. The details of the study were then explained (Appendix H). Written informed consent was also obtained (Appendix I and J). Willing participants were then assessed by the researcher.

Due to the participant's pre-operative condition after sustaining a fracture of the hip, the baseline assessment was conducted in the orthopaedic ward with the participant positioned comfortably enough to communicate and participate while still remaining in bed. The order of the assessment was as follows:

<u>Pre-operative/Baseline assessment:</u>

Patients were interviewed using the New Mobility Score (NMS) (Appendix A) and the 6-Item Cognitive Impairment Test (6CIT) (Appendix B). A chart review was conducted to abstract data using the Cumulative Illness Rating Scale for Geriatrics (CIRS – G) (Appendix C). The results obtained from the participant for the NMS was verified by a caregiver of the participant. Standard physiotherapy treatment comprised of improving transferring, walking ability, balance, muscle strength and range of movement as well as chest physiotherapy if necessary. Treatment was provided at both Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital by physiotherapists working at the respective hospitals. The number of post-operative physiotherapy sessions received by each participant during their stay in hospital was documented on the demographic details form.

<u>Post-operative assessment period one follow up/Re-assessment one:</u>

On the day of discharge, the participant was reassessed using the Elderly Mobility Scale (EMS) (Appendix D), the Lower Extremity Functional Scale (LEFS) (Appendix E) and the 6-Item Cognitive Impairment Test (6CIT) (Appendix B).

1. The EMS was carried out in the physiotherapy gym as follows:

a. Lying to sitting and sitting to lying: these two tests were performed on a standard plinth in the physiotherapy gym.
b. Sitting to standing: the participant was assessed on their ability to rise from a 47cm (19in) chair in less than three seconds allowing the use of upper limbs.
c. Standing: the ability to maintain an upright standing position with or without the use of upper limbs to steady self was assessed.
d. Gait: the scoring for gait was based on the type of assistance required to walk, not the distance walked.
e. Timed walk: the participant was timed walking over a distance of six meters, at their normal speed, using their usual walking aid. Maximum score was given for a time of under 15 seconds.
f. Functional reach: the participant was required to reach forward beyond an arm's length while maintaining a fixed base of support. A maximum score was attained for a functional reach of 20 cm.

2. Participants were interviewed using the LEFS to determine each participants perceived level of function as well as to assist them in preparing for functional activities that they may encounter once discharged from the hospital setting.
3. Participants cognitive function was assessed then again using 6CIT.

<u>Post-operative assessment period two follow up/Re-assessment two:</u>

Six weeks after discharge the participant returned to the hospital for a routine appointment with the doctor. During this hospital visit the participants visited the physiotherapy gym for their final assessment according to the same procedure as Post-operative assessment period one follow up/Re-assessment one.

This arrangement was made telephonically prior to the assessment. Those participants who came to the hospital solely for their final assessment of the study were re-imbursed for travel costs for the period two follow-up only, this was on arrival for their final assessment. Documentation proving that travel costs were re-imbursed was signed by those participants that received it.

3.9. Data analysis

Data was analysed using IBM SPSS Version 19. Descriptive statistics were used to analyse the participants' demographic data. Data has been presented using frequency tables, means and standard deviation or medians and interquartile ranges depending on the distribution of the data. Cronbach’s coefficient alphas were used to measure internal consistency. Wilcoxon signed rank tests were used to test whether there was a median difference in paired data. The Kruskal-Wallis test is a non-parametric statistical test that was used to compare two or more independent groups. Spearman's Rho Correlation Coefficients were used to test if a linear relationship exists between two variables. A multiple regression analysis was used to determine associations. The study was set at p = 0.05 level of significance and 95% confidence interval (CI).

Chapter 4 - Results

4.1 Introduction

The purpose of this chapter is to present and interpret the data collected in this study. Section 4.2 interprets and describes the results of the pilot study. These results were used to determine the intra-rater reliability of the researcher, to familiarise the researcher with the tools that were used in the main study and to establish the time taken to implement these tools. The demographic data of the participants studied is described in section 4.3. Section 4.4 to 4.7 describes the pre-fracture functional mobility, pre-existing co-morbidities, cognitive function and post-operative functional level at different assessment periods during the study. The factors influencing the post-operative functional level are then analysed and discussed in section 4.8.

4.2. Pilot study results

The pilot study was conducted on three different groups of participants. These participants who had sustained a hip fracture were selected from the orthopaedic department at Helen Joseph Hospital . The demographics of the participants in the pilot study were similar to those participants who were in the main study. The data collected for the pilot study was not used in the main study as these participants were not followed through until six weeks post discharge, as the aim was to familiarise the researcher with using each outcome measure. Each group consisted of ten percent of the total number of participants used in the study ie. nine participants. Therefore, a total of 27 subjects were used to test the intra-rater reliability of the researcher. Due to the small sample size used in the pilot study, Spearman's Correlation Coefficient was used to determine the intra-rater reliability. Tables 4.1 to 4.3. demonstrates the results from each group assessed in the pilot study.

Table 4.1: Results of Group 1 (New Mobility Score (NMS), Six-Item Cognitive Impairment Test (6CIT), Cumulative Illness Rating Scale for Geriatrics (CIRS-G) (n=9)

Subject	NMS		6CIT		CIRS-G	
	Assessment 1	Assessment 2	Assessment 1	Assessment 2	Assessment 1	Assessment 2
1	9	9	0	0	3	3
2	9	9	0	0	6	6
3	8	8	2	4	9	10
4	9	9	0	2	4	4
5	6	6	21	24	11	13
6	9	9	2	0	3	3
7	9	9	2	2	1	0
8	9	9	2	2	2	2
9	8	8	6	6	5	4
Cronbach's Alpha	**α = 0.81**	**α = 0.81**	**α = 0.79**	**α = 0.85**	**α = 0.73**	**α = 0.78**
Correlation	**r = 1**		**r = 0.99**		**r = 0.99**	

*The time interval between assessments 1 and 2 was eight hours.

Cronbach's alpha (α) is the commonly accepted measure of internal consistency (Hair et al, 1998). The α for the NMS was good, while the 6CIT and CIRS-G were acceptable. The correlation results were excellent for each tool assessed on the subjects in group one.

Table 4.2: Results of Group 2 (Elderly Mobility Scale (EMS), Lower Extremity Functional Scale (LEFS), Six-Item Cognitive Impairment Test (6CIT) (n=9)

Subject	EMS		LEFS		6CIT	
	Assessment 1	Assessment 2	Assessment 1	Assessment 2	Assessment 1	Assessment 2
1	20	20	44	44	0	0
2	18	18	36	37	3	4
3	18	18	29	28	0	0
4	11	12	14	15	19	21
5	20	20	51	51	0	0
6	20	18	46	49	0	0
7	14	14	28	32	6	6
8	9	9	16	21	4	6
9	16	16	30	30	2	2
Cronbach's Alpha	**α = 0.81**	**α = 0.80**	**α = 0.96**	**α = 0.95**	**α = 0.77**	**α = 0.75**
Correlation	**r = 0.98**		**r = 0.99**		**r = 0.996**	

*The time interval between assessments 1 and 2 was eight hours

The Cronbach's alpha (α) value for the LEFS was excellent. The EMS and 6CIT Cronbach's alpha values were good and acceptable respectively. The correlation results in group two were excellent.

Table 4.3: Results of Group 3 (Elderly Mobility Scale (EMS), Lower Extremity Functional Scale (LEFS), Six-Item Cognitive Impairment Test (6CIT) (n=9)

Subject	EMS		LEFS		6CIT	
	Assessment 1	Assessment 2	Assessment 1	Assessment 2	Assessment 1	Assessment 2
1	20	20	45	46	3	2
2	19	19	38	35	2	2
3	18	19	41	42	0	0
4	16	16	29	29	6	4
5	18	20	35	39	4	2
6	14	14	30	31	0	0
7	12	13	26	28	6	10
8	17	17	34	34	0	0
9	20	20	46	45	0	0
Cronbach's Alpha	**α = 0.66**	**α = 0.62**	**α = 0.87**	**α = 0.85**	**α = 0.36**	**α = 0.59**
Correlation	**r = 0.99**		**r = 0.96**		**r = 0.84**	

*The time interval between assessments 1 and 2 was eight hours.

Cronbach's alpha values for the EMS and 6CIT in group three were questionable and poor. The LEFS however scored well with the α. Correlation values in groups three were excellent. The only correlation result lower than r = 0.95 was the 6CIT assessed in group 3 (r = 0.84).

- Assessment tools and outcome measures.

After administering the Cumulative Illness Rating Scale for Geriatrics (CIRS - G) for the first time, it was noted that the researcher required further reading to understand the scoring system of the tool. Implementation of the CIRS - G thereafter was uncomplicated.

A chart review to abstract data for the Cumulative Rating scale for Geriatrics (CIRS - G) was not always sufficient as notes in the patient file lacked a thorough history. To complete the CIRS - G, a chart review as well as an interview pertaining to the participants past medical history needed to be administered.

Questions from the interview based assessment tools needed to voiced slowly and in a loud manner to certain elderly participants, as most of the participants were hard of hearing.

Participants performing the timed walk aspect of the Elderly Mobility Scale (EMS) felt pressured to perform at their best once they understood that they were being timed, despite instructions to walk at their normal pace. This additional pressure affected the participants gait and balance and hence the participants fared worse. Keeping the stopwatch out of the participants sight during the timed walk rendered a more realistic result of the timed walk.

- Time

The time taken to administer the NMS, 6CIT, CIRS - G and LEFS to the participants varied according to the mental status of the participants. On average administration of the above four outcome measures ranged from 20 to 40 minutes.
The time taken for the participants to complete the EMS depended on the level of function the participant had regained during their hospital stay. Administration of the EMS took a maximum time of 20 minutes.

4.2.1. Pilot study conclusion

The pilot study was useful in familiarising and training the researcher with the five outcome measures and their use. The established time taken to assess a participant at baseline, discharge or 6 weeks post discharge should be between 30 to 40 minutes. No major changes were needed to be made to the main study after completing the pilot study. The correlation results to test the intra-rater reliability of the researcher was excellent in all three groups.

4.3. Demographic details of main study

4.3.1. Age and gender

Of the 90 participants studied, n=50 (69.4%) participants were female and n=22 (30.6%) were male. The mean age of the participants was 75.7 years (SD ± 9.54). The minimum age was 60 years and the maximum was 95 years. Table 4.4 depicts the differences in median scores for each outcome measure between males and females, as well as the different age groups.

Table 4.4: Median scores of each outcome measure between males, females and different age groups (n=90).

		Pre-operative			Discharge			6 Weeks post discharge		
		NMS	**6CIT**	**CIRS-G**	**EMS**	**LEFS**	**6CIT**	**EMS**	**LEFS**	**6CIT**
Median score		**7.8**	**12.4**	**9.3**	**11.5**	**21.0**	**10.4**	**14.2**	**28.8**	**8.9**
Age	**60-69**	8.8	10.1	7.0	14.2	27.6	8.7	17.1	36.7	6.6
	70-79	8.5	7.5	9.7	13.2	23.6	5.4	16.1	31.9	4.8
	80+	6.4	19.0	11.0	7.6	13.1	16.4	10.0	19.2	14.7
	Kruskal Wallis H-Statistic	23.3	19.5	14.1	19.6	22.3	16.6	20.9	21.9	14.8
	p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gender	**Female**	7.6	12.7	9.9	10.6	18.6	11.0	13.3	26.4	9.8
	Male	8.3	12.0	7.9	13.5	26.6	9.1	16.2	34.2	7.0
	Kruskal Wallis H-Statistic	3.9	0.03	3.4	3.75	8.1	0.4	3.9	4.7	1.3
	p-value	0.05	0.85	0.06	0.05	0.00	0.55	0.05	0.03	0.26

From the above Table 4.4 it is evident that the participants aged 80 years and older fared worse with each outcome measure when compared to their younger counter parts. The Kruskal Wallis H-Statistic is a non-parametric test to determine any significant changes between two or more groups with ordinal data, with one group being the stand out group ie: participants aged 80+ in the age groups. These differences are statistically significant ($p<0.000$). When comparing gender differences, it was found that male participants outperformed female participants in post-operative assessments of cognition and function. Pre-operatively, there was no significant statistical difference between male and female participants cognitive function ($p=0.85$). Female participants presented with poorer pre-fracture function ($p=0.05$) and more pre-existing co-morbidities ($p=0.06$) compared to males.

4.3.2 Type of fracture

Of the 90 participants included, whom baseline data was collected for, intertrochanteric (n=45) and neck of femur (n=45) fracture types were equally distributed between the sample of participants. Descriptive statistics with the mean and median values of the EMS and LEFS at discharge and six weeks post discharge for those participants who sustained an intertrochanteric fracture and a neck of femur fracture is presented in Table 4.5 below.

Table 4.5 :Descriptive statistics for type of fracture sustained (n=90).

	EMS (Discharge)		LEFS (Discharge)		EMS (6 weeks post discharge)		LEFS (6 weeks post discharge)	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Intertrochanteric fracture (n=45)	10.4 (±6.4)	10 (11)	19.3 (±12.3)	19 (18.5)	12.9 (±6.7)	15 (12.5)	26.9 (±16)	31 (21)
Neck of femur fracture (n=45)	11.6 (± 4.8)	12 (5.5)	20.6 (±9.9)	20 (11)	15.5 (±4.9)	16 (6)	30.6 (±12.5)	32 (11)

From the above table it is evident that those participants presenting with a neck of femur fracture performed slightly better at discharge and six weeks post discharge using the EMS and LEFS. However, a regression analysis to determine if the type of fracture sustained has a significant impact on early post-operative outcome will be presented and discussed in section 4.7.

4.3.3 Number of days between admission and surgery

Participants were grouped according to the number of days lapsed between admission and surgery. Surgery was either performed in less than seven days after admission or more than seven days. Table 4.6 presents the mean and median values of the EMS and LEFS at discharge and six weeks post discharge for those participants who were operated on in less than seven days (n=61) or more than seven days (n=29).

Table 4.6: Descriptive statistics for the number of days lapsed between day of admission and surgery (n=90).

	EMS (Discharge)		**LEFS (Discharge)**		**EMS (6 weeks post discharge)**		**LEFS (6 weeks post discharge)**	
	Mean (SD)	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**
Less than 7 days (n=61)	10.8 (±5.9)	11 (10)	19.6 (±11.3)	20 (16)	13.8 (±6.3)	16 (11)	27.6 (±15.1)	28 (19)
7 or more days (n=29)	11.3 (± 5.2)	12 (7)	20.6 (±11.1)	20 (15)	15.1 (±5.2)	16 (7.5)	31.3 (±12.4)	33 (12)

Approximately two thirds (n=61) of participants were taken to theatre in less than seven days. Participants who were taken to theater on the seventh day or later have slightly higher functional scores using the EMS and LEFS at discharge and six weeks post discharge. To determine if the number of days lapsed between admission and surgery has an statistical significance on early post-operative outcome following a hip fracture, a regression analysis will be presented and discussed in section 4.7.

4.3.4 Type of surgical management

Of the data collected for the 90 participants, four types of surgical procedures were performed consistently. These included, Proximal Femoral Nailing Arthrosis (PFNA), Total Hip Replacement (THR), Cannulated screws and a Hemi-Arthroplasty (HA). Table 4.7 presents the mean and median values of the EMS and LEFS at discharge and six weeks post discharge for those participants who received the above surgical procedures.

Table 4.7: Descriptive statistics for the type of surgical procedure performed (n=90).

	EMS (Discharge)		LEFS (Discharge)		EMS (6 weeks post discharge)		LEFS (6 weeks post discharge)	
	Mean (SD)	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**
PFNA (n=37)	11.5 (±6.3)	13.5 (10.3)	21.7 (±12.8)	24.5 (20.3)	15.2 (±5.6)	18 (9.5)	32.4 (±15.8)	34.5 (19.3)
Total Hip Replacement (n=20)	12.4 (± 4.5)	12 (4)	22.9 (±10.4)	22 (10)	16.5 (±4.7)	18 (4.7)	32.5 (±11.8)	33 (13)
Cannulated screws (n=9)	8.8 (± 5.9)	7 (7.8)	15.6 (±8.6)	15 (13)	10 (±7.5)	6.5 (7.5)	20.5 (±13.6)	16.5 (18)
Hemi-Arthroplasty (n=24)	9.8 (± 5.1)	9 (7)	16.1 (±8.2)	18 (9)	12.2 (±6.1)	14 (6.1)	22.9 (±11.6)	25.5 (16.5)

The most common type of surgical procedure performed on participants was a PFNA, followed by a THR, HA and lastly cannulated screws. Participants who underwent a THR yielded the highest scores in assessments of function at discharge and six weeks post discharge. The minority of participants who had cannulated screws inserted fared the worst when compared to the other surgical procedure groups in assessments of function at discharge and six weeks post discharge. A regression analysis to determine if the type of surgical procedure performed has a significant impact on early post-operative outcome will be presented and discussed in section 4.7.

4.3.5 Number of physiotherapy sessions

The number of post-operative physiotherapy sessions received by each participant was documented. The number of physiotherapy sessions received was grouped into less than seven sessions (n=59) and seven or more sessions (n=31). Table 4.8 presents the mean and median values of the EMS and LEFS at discharge and six weeks post discharge for the number of post-operative physiotherapy sessions received by each participant.

Table 4.8: Descriptive statistics for the number of post-operative physiotherapy sessions received by participants (n=90).

	EMS (Discharge)		LEFS (Discharge)		EMS (6 weeks post discharge)		LEFS (6 weeks post discharge)	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Less than 7 sessions (n=59)	11.5 (±6)	13 (10.5)	21.3 (±12.1)	21 (18.5)	14.8 (±6.3)	18 (7.3)	30.5 (±15.4)	33 (15.3)
7 or more sessions (n=31)	9.8 (± 4.7)	9 (6)	17.1 (±8.4)	16 (12)	13 (±5.2)	14.5 (7)	25.3 (±11.3)	28 (17.5)

Participants who received less than seven post-operative physiotherapy sessions during their hospital admission performed better in post-operative functional assessments at discharge and six weeks post discharge compared to those participants who received seven or more sessions. A regression analysis to determine if the type of surgical procedure performed has a significant impact on early post-operative outcome will be presented and discussed in section 4.7.

4.3.5 Complications developed during the course of the study

Complications developed during the course of the study by participants were vascular, cognitive, gastro-intestinal, pulmonary and neurological in nature. Four participants had surgical error complications. The mean (SD) and median (IQR) results for each type of complication developed during the course of the study is presented below.

Table 4.9: Descriptive statistics for the number of complications developed during the course of the study (n=90).

		EMS (Discharge)		LEFS (Discharge)		EMS (6 weeks post discharge)		LEFS (6 weeks post discharge)	
		Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Vascular	**Developed (n=15)**	8.2 (±5.3)	8 (4)	14.1 (±10.2)	15 (13.5)	10.8 (±6.4)	11 (5.6)	22.3 (±13.8)	23 (19.5)
	Not developed (n=75)	11.4 (±5.6)	12 (9)	20.8 (±11.1)	21 (15)	14.6 (±5.8)	16 (8.5)	29.6 (±14.3)	32 (16)
Cognitive	**Developed (n=23)**	7.5 (± 5.1)	7 (8)	13.1 (±9)	12 (14)	11.3 (±5.2)	12 (6.8)	21.9 (±11.8)	22 (19)
	Not developed (n=67)	12.2 (±5.4)	13 (8)	22.3 (±10.9)	22 (15)	15.2 (±5.9)	18 (6)	31.1 (±14.5)	33 (16.3)
Surgical error	**Developed (n=4)**	15.3 (± 4.5)	15 (4.5)	30.3 (±4.9)	28 (4.5)	18 (±2.8)	18 (2)	42.5 (±12)	42.5 (8.5)
	Not developed (n=86)	10.8 (±5.8)	12 (8.5)	22.3 (±10.9)	19 (15.5)	14.1 (±6)	16 (10.6)	28.4 (±14.3)	32 (18.5)
Gastro-Intestinal	**Developed (n=8)**	12 (± 4.1)	10.5 (5.5)	21.2 (±5.5)	21 (9)	13.6 (±2.6)	14 (4)	29 (±6.2)	28 (4)
	Not developed (n=82)	10.9 (±5.8)	12 (8.5)	19.8 (±11.5)	20 (17)	14.2 (±6.2)	16 (11)	28.8 (±14.8)	32 (19)
Pulmonary	**Developed (n=10)**	4.7 (±2.8)	6 (4)	8.4 (±5.3)	10 (9.5)	7.4 (±2.5)	8 (1)	13.2 (±5.4)	15 (5)
	Not developed (n=80)	11.6 (±5.5)	12 (8)	21 (±11)	21 (13.5)	14.7 (±5.9)	16 (8)	29.9 (±14.1)	32 (14.5)
Neurological	**Developed (n=1)**	11 (NA)	11 (0)	27 (NA)	27 (0)	16 (NA)	16 (0)	34 (NA)	34 (0)
	Not developed (n=89)	10.9 (±5.7)	12 (9)	19.8 (±11.2)	20 (16)	14.2 (±6)	16 (10.5)	28.7 (±14.4)	32 (18.5)

The most common complication developed was cognitive in nature (n=23), a cognitive impairment complication can be described as confusion, hallucinations and depression in the context of this section. A neurological complication was only developed by one participant. Due to the large differences in sample size for each complication developed or not developed, the differences in mean and median scores cannot be effectively analysed. A regression analysis to determine the effects of these complications developed on early post-operative functional outcome following a hip fracture in the elderly will be presented and discussed in section 4.7.

4.3.6 Medications

Medications prescribed to the participants varied from analgesia to anticoagulants. Table 4.10 below presents a summarised version of the percentage of participants that received various types of medication. The side effects for each medication is also presented as these effects can also impact outcome.

Table 4.10: Medications prescribed to participants (n=90).

Medication	Percentage of participants receiving medication	Side effects
Analgesia	100%	Drowsiness, dizziness, constipation, urinary retention
Anti-coagulants	94.4%	Hemorrhaging
Anti hypertensive drugs	78.7%	Dizziness, fatigue
Multivitamins	35.6%	Unusual taste in mouth
Prebiotics	31.1%	Gas, diarrhea and pain
Anti psychotics	22.2%	Weight gain, myocarditis
Antibiotics	21.1%	Diarrhea, nausea and vomiting
Diabetic medication	12.2%	Gastrointestinal effects
Anti asthmatic drugs	11.1%	Dryness of the mouth and irritation of the throat
Hypothyroidism drugs	10%	Heart palpitations, nervousness, tremors and insomnia
Antiemetic drugs	6.7%	Drowsiness and headaches
Anticonvulsants	6.7%	Dizziness, drowsiness, fatigue, tremor and confusion
Cholesterol medication	6.7%	Headaches, muscle cramps, drowsiness
Sedatives	4.4%	Depression, thoughts of suicide, anxiety
Proton pump inhibitors	1.1%	Headaches and diarrhea

The most common side effects of the prescribed medication to participants included drowsiness, dizziness and gastro-intestinal complications. Prescription of medications for each participant was collected at once and not divided into pre-operative and post-operative medications. Due to the manner in which data on medication prescription was collected, statistical analysis on the effect of adverse effects of these medications on early post-operative outcome was complex and therefore not carried out.

At baseline 90 participants results were analysed. During the hospital stay, seven participants deceased and one participant dropped out. A total of 82 participants underwent a discharge assessment. Between discharge and the six week follow up, four patients deceased and six participants could not be reached telephonically or physically. At the final six week post discharge assessment, 72 participants remained. The data of 72 participants was then analysed. Baseline data of those participants who deceased (n=11) during the course of the study was compared to those participants who completed the final assessment at six weeks post discharge. These results can be found in Table 4.11.

Figure 4.1 is a diagram depicting the number of participants assessed from baseline to six weeks post-discharge.

Figure 4.1: Breakdown of participants included from baseline through to six weeks post discharge.

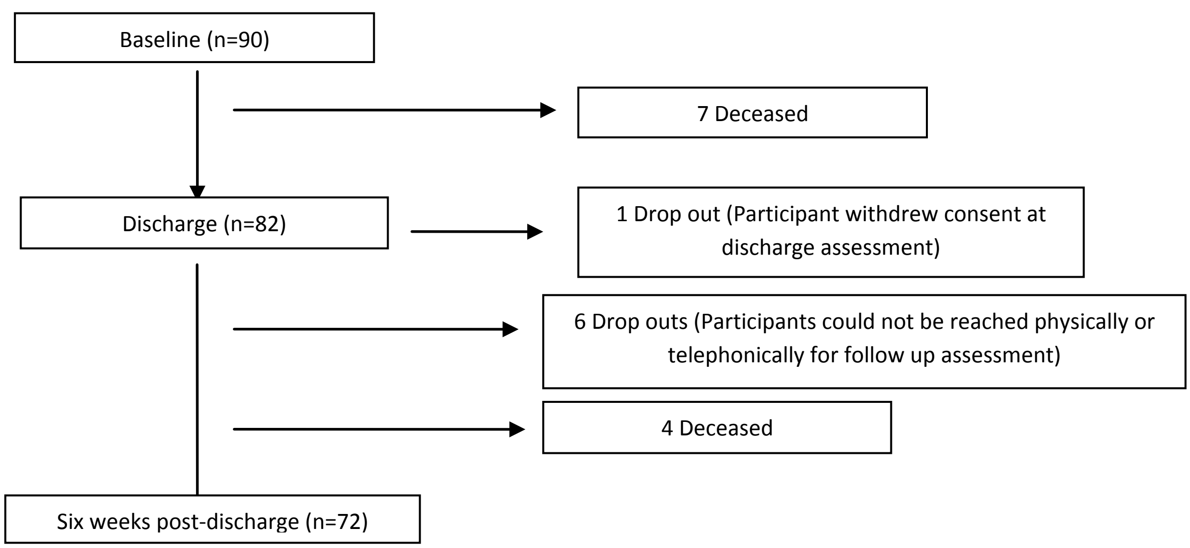


Table 4.11: Comparison of baseline data of deceased participants and participants who completed the final assessment (n=90).

Participants	n	Mean	Standard deviation	Median	IQR
New Mobility Score (NMS)					
Completed Assessment	79	7.8	1.8	9	2.3
Deceased	11	5.5	1.8	5	1.8
Mann-Whitney U		150.5			
P value		0.00			
Cumulated Illness Rating Scale for Geriatrics (CIRS-G)					
Completed Assessment	79	9.5	4.1	9	5.3
Deceased	11	10.3	2.8	10	2.8
Mann-Whitney U		329.5			
P value		0.36			
6 Item Cognitive Impairment Test (6CIT)					
Completed Assessment	79	12.6	9.5	11.5	17
Deceased	11	20.7	7.4	24	12.5
Mann-Whitney U		203			
P value		0.01			

Table 4.11 above clearly indicates that there is a significant difference in scores of the NMS ($p < 0.05$) and 6CIT ($p<0.05$) between the participants that completed the study and those who deceased during the course of the study. The participants who completed the study had better pre-fracture function and cognition baseline scores compared to those participants who deceased. There was no significant difference in the amount of pre-existing co-morbidities presenting in each group at baseline ($p=0.36$). The data of the participants who deceased or dropped out was not included in the next set of results as these results would affect the final regression analysis.

4.4. Pre-fracture functional level

The pre-fracture functional level was determined using the New Mobility Score whereby participants are expected to recall pre-fracture function.

Of the 72 participants that completed the study, 16 participants were dependent in mobility (22.2%) compared to the 56 participants (77.8%) that were independently mobile.

More specifically 62.5% of the participants scored a total of nine on the NMS, indicating that more than half of the participants were independent with mobility without an assistive device prior to sustaining a hip fracture. And almost 80% of the participants were independent with mobility with the occasional use of an assistive device. The mean score for the NMS was 7.83 (SD ± 1.83). The median was 9 (IQR = 1)

Table 4.12 describes the frequency and percentage of each score for indoor walking, outdoor walking and the ability to go shopping assessed using the New Mobility Score (NMS) (n=72)

Table 4.12: Frequency and percentage of individual NMS scores (n=72)

Variable	**Unable to perform activity**	**Needs assistance from another person**	**With the use of an assistive device**	**Independent**
	n (%)	**n (%)**	**n (%)**	**n (%)**
NMS (In)		2 (2.7%)	12 (16.7%)	58 (80.6%)
NMS (Out)		7 (9.7%)	13 (18.1%)	52 (72.2%)
NMS (Shop)	1 (1.4%)	12 (16.7%)	14 (19.4%)	45 (62.5%)
Mean (±SD)	**7.83 (±1.83)**			
Median (IQR)	**9 (1)**			

The results of table 4.5 clearly show that majority of participants were functionally independent with indoor walking (80.6%), outdoor walking (72.2%) and shopping (62.5%).

4.5. <u>Pre-existing co-morbidities</u>

The presence and grading of co-morbidities was determined using the Cumulative Illness Rating Scale for Geriatrics (CIRS-G). Total scores range from zero to 56. Lower scores reflect mild problems while higher scores reflect a more serious complication.

The lowest score obtained using the CIRS-G was 1 and the highest was 22. The most recurring score obtained was 10 points (15.3% of participants). These results can be found in Appendix M.

Table 4.13 below describes the frequency and percentage of each individual score obtained for each variable in the CIRS-G (n=72). The mean score using the CIRS-G was 9.32 (SD ± 4.07), the median was 9 (IQR = 6).

Table 4.13: Frequencies and percentages of individual CIRS-G scores (n=72)

Variable	**0 (No Problem)**	**1 (Minor)**	**2 (Moderate)**	**3 (Chronic)**
	Frequency (%)	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**
Cardiac	34 (47.2%)	6 (8.3%)	20 (27.8%)	12 (16.7%)
Vascular	12 (16.7%)	8 (11.1%)	46 (63.9%)	6 (8.3%)
Hematological	58 (80.6%)	10 (13.8%)	4 (5.6%)	
Respiratory	28 (38.9%)	16 (22.3%)	23 (31.9%)	5 (6.9%)
Ophthalmology	57 (79.2%)	15 (20.8%)		
Upper GIT	69 (95.8%)	2 (2.8%)	1 (1.4%)	
Lower GIT	68 (94.4%)	3 (4.2%)	1 (1.4%)	
Hepatic & Pancreatic	67 (93.1%)	3 (4.2%)	2 (2.7%)	
Renal	62 (86.1%)	5 (6.9%)	4 (5.6%)	1 (1.4%)
Genitourinary	63 (87.5%)	6 (8.3%)	3 (4.2%)	
Musculoskeletal & Teg	1 (1.4%)	1 (1.4%)	47 (65.3%)	23 (31.9%)
Neurological	58 (80.6%)	5 (6.9%)	6 (8.3%)	3 (4.2%)
Endocrine	37 (51.5%)	14 (19.4%)	14 (19.4%)	7 (9.7%)
Psychiatric	37 (51.4%)	11 (15.3%)	18 (25%)	6 (8.3%)
Mean (±SD)	**9.32 (±4.07)**			
Median (IQR)	**9 (6)**			

Table 4.13 clearly shows that none of the participants were rated with a four, indicating an extremely severe medical problem or organ failure, for any bodily system. The most significant co-morbidities were in the musculoskeletal and tegumental area with 31.9% of participants rated with a significantly disabling problem, and 65.3% rated with a moderate disabling problem. A chronic cardiac or vascular co-morbidity that requires daily treatment or first line therapy followed in 27.8 and 63.9% of participants respectively. Medical conditions affecting the

endocrine, metabolic, breast and psychiatric systems were present in 50% of participants. The least statistically significant co-morbidities included the upper and lower GIT, hepatic and pancreatic systems and the renal and genitourinary systems. Each of these bodily systems listed were rated as "no problem affecting that system" in over 85% of all subjects.

4.6. Cognitive function

The cognitive function of participants in the study was determined using the Six - Item Cognitive Impairment Test (6CIT). Scores of zero to eight are considered normal, scores of 9-19 indicate a moderate cognitive impairment and scores exceeding 20 are indicative of a severe cognitive impairment.

Table 4.14 below presents the frequencies and percentages of the total scores grouped into normal / minimal cognitive impairment (zero to eight), moderate cognitive impairment (nine to 19) and severe cognitive impairment (20+) using the 6CIT pre-operatively, at discharge and six weeks post discharge.

Table 4.14: Frequency and percentage of total group scores obtained using the 6CIT pre-operatively at discharge and six weeks post discharge (n=72)

	Pre-Operatively	**Discharge**	**6 Weeks post discharge**
6CIT (Ranges)	**n (%)**	**n (%)**	**n (%)**
0 - 8 Normal / Minimal Impairment	30 (41.7%)	37 (51.4%)	44 (61.2%)
9 - 19 Moderate impairment	20 (27.7%)	18 (25%)	14 (19.4%)
20+ Severe impairment	22 (30.6%)	17 (23.6%)	14 (19.4%)
Total	**72**	**72**	**72**

The results from Table 4.14 show a clear relationship between improved cognitive function and time. Scores of zero to eight which indicate normal or minimal cognitive impairment increased from the pre-operative assessment to the assessment at six weeks post discharge. Scores between nine and 19 and those exceeding 20 decreased over the same time frame.

The percentages of scores obtained for each variable using the 6CIT pre-operatively, at discharge and six weeks post discharge are listed in Table 4.15.

Table 4.15: Percentages of each individual score obtained using the 6CIT pre-operatively, at discharge and six weeks post discharge (n=72)

6CIT				
Variable		**Pre-operative n (%)**	**Discharge n (%)**	**6 weeks post discharge n (%)**
What year is it?	**Correct**	**60** (83.3%)	**62** (86.1%)	**65** (90.3%)
	Incorrect	**12** (16.7)	**10** (13.9%)	**7** (9.7%)
What month is it?	**Correct**	**57** (79.2%)	**59** (81.9%)	**63** (87.5%)
	Incorrect	**15** (20.8%)	**13** (18.1%)	**9** (12.5%)
About what time is it?	**Correct**	**36** (50%)	**46** (63.9%)	**52** (72.2%)
	Incorrect	**36** (50%)	**26** (36.1%)	**20** (27.8%)
Count backwards from 20-1	**Correct**	**31** (43.1%)	**39** (54.2%)	**40** (55.6%)
	1 Error	**20** (27.7%)	**20** (27.7%)	**17** (23.6%)
	More than 1 error	**21** (29.2%)	**13** (18.1%)	**15** (20.8%)
Say the months of the year in reverse	**Correct**	**20** (27.8%)	**26** (36.1%)	**27** (37.5%)
	1 Error	**17** (23.6%)	**18** (25%)	**21** (29.2%)
	More than 1 error	**35** (48.6%)	**28**(38.9%)	**24** (33.3%)
Repeat address phrase	**Correct**	**14** (19.4%)	**15** (20.8%)	**21** (29.2%)
	1 Error	**7** (9.7%)	**13** (18.1%)	**12** (16.7%)
	2 Errors	**15** (20.8%)	**11** (15.3%)	**13** (18.1%)
	3 Errors	**7** (9.7%)	**9** (12.5%)	**8** (11%)
	4 Errors	**3** (4.2%)	**6** (8.3%)	**5** (6.9%)
	All wrong	**26** (36.2%)	**18** (25%)	**13** (18.1%)
Mean (±SD)		**12.44 (±9.53)**	**10.40 (±9.33)**	**8.93(±9.03)**
Median (IQR)		**10.5 (17)**	**8 (17)**	**6 (15)**

From table 4.15 it is clear that patients found it much easier to answer questions relating to the year and month, with approximately 80% of participants answering correctly. Questions that involved memory and reverse listing were more difficult. More than half of the participants made one or more errors when asked to say the months of the year in reverse and 36.1% of participants could not remember any component of the address phase they were asked to memorise and repeat later on at the pre-operative assessment. This result improved at discharge and six weeks post discharge.

The mean and median scores indicate that majority of the subjects presented with a moderate cognitive impairment pre-operatively. At discharge the cognitive function in the sample population was borderline and at six weeks post discharge the mean and median scores indicate normal cognitive functioning.

Table 4.16 below indicates the median scores and Z-Statistic values of the 6CIT at baseline, discharge and six weeks post discharge. The Wilcoxon Signed Ranks Test was used to determine statistical changes from baseline to six weeks post discharge.

Table 4.16: Median 6CIT scores and statistical changes from baseline to six weeks post discharge (n=72).

6 CIT		
Wilcoxon Signed Ranks Test	**Baseline**	**Discharge**
Medians	10.5	8
Z-Statistic	-4.74	
p-value	0.003	
	Discharge	**Six weeks post discharge**
Medians	8	6
Z-Statistic	-3	
p-value	0.003	
	Baseline	**Six weeks post discharge**
Medians	10.5	6
Z-Statistic	-5.04	
p-value	0.000	

From the above results it is clear that many participants presented with moderate cognitive impairments pre-operatively, but these impairments resolved and improved leading up to the final assessment at six weeks post discharge. There was also significant advances in cognition from baseline to six weeks post discharge (Z-Statistic -5.04, p=0.000).

4.7. Post-operative functional level

The post-operative functional level for the participants was determined using the Elderly Mobility Scale (EMS) and the Lower Extremity Functional Scale (LEFS). The EMS is a physical assessment of function and was demonstrated by each of the participants to determine a score out of 20. Scores less than 10 indicate dependence in mobility, scores ranging between 10 and 13 indicate borderline mobility, these participants will require assistance once discharged. A participant scoring 14 to 20 is able to manoeuvre safely and is independent in basic activities of daily living.

Table 4.17 demonstrates the frequency and percentage of the total grouped scores obtained using the EMS at discharge and 6 weeks post discharge. Table 4.18 demonstrates the percentages of individual scores obtained using the EMS at discharge and 6 weeks post discharge.

Table 4.17: Frequency and percentage of total group scores obtained using the EMS at discharge and six weeks post discharge (n=72)

		Discharge	**6 weeks post discharge**
EMS (Ranges)		**n (%)**	**n (%)**
< 10 Dependent		**26** (36.1%)	**18** (25%)
10-13 Borderline		**16** (22.2%)	**6** (8.3%)
14-20 Independent		**30** (41.7%)	**48** (66.7%)
Mean (±SD)		**11.47 (SD ± 5.56)**	**14.9 (SD ± 5.973)**
Median (IQR)		**12 (8)**	**16 (11)**
Wilcoxon Signed Ranks Test	**Z-Statistic**	**-5.767**	
	p-value	**0.000**	

Table 4.17 clearly indicates that at discharge 36% of participants were independent with mobility and the remaining 63% were borderline or dependent with mobility according to the EMS. At the six week post discharge assessment, two thirds of the participant sample was completely independent with mobility. The mean score for the EMS at discharge was 11.47 (SD ± 5.56), the median was 12 (IQR = 8). A score of this for this group of participants represents borderline mobility, where assistance with mobility will be required. The mean score for the EMS at six

weeks post discharge was 14.9 (SD ± 5.973), the median was 16 (IQR = 11), these scores represent independence in mobility. To determine if there was a statistically significant improvement in post-operative function using the EMS, a Wilcoxon Signed Ranks Test was used. A Z-Statistic value of -5.767 with a p-value of 0.000 indicates that a statistically significant improvement was made from discharge to six weeks post discharge using the EMS.

Table 4.18: Percentages of each individual score obtained using the EMS at discharge and six weeks post discharge (n=72)

Elderly Mobility Scale				
Variable		**Discharge (%)**	**6 Weeks Post Discharge (%)**	**Chi-Square (Fisher's Exact Test p-value)**
Lying to Sitting	Independent	74.6%	84.7%	45.7 (0.000)
	Needs help of 1 person	19.6%	9.7%	
	Needs help of 2+ people	5.8%	5.6%	
Sitting to Lying	Independent	46.3%	75%	45.7 (0.000)
	Needs help of 1 person	43.9%	19.4%	
	Needs help of 2+ people	9.8%	5.6%	
Sit to Stand	Independent in under 3 sec	29.3%	59.7%	64.3 (0.000)
	Independent in over 3 sec	37.8%	18.1%	
	Needs help of 1 person	17.1%	15.3%	
	Needs help of 2+ people	15.8%	6.9%	
Standing	Stands without support and reaches an arms length	25.6%	56.9%	69.2 (0.000)
	Stands without support - needs help to reach	39%	19.4%	
	Stands, but requires support	17.1%	11.1%	
	Stands, with only physical support	18.3%	12.6%	
Gait	Independent	20.7%	38.9%	76.2 (0.000)
	Independent with frame	40.2%	40.3%	
	Mobile with walking aid but erratic turning	15.9%	8.3%	
	Requires physical assistance or constant supervision	23.2%	12.5%	
Timed walk	Under 15 sec	20.7%	38.8%	54.6 (0.000)
	16 - 30 sec	29.3%	30.6%	
	Over 30 sec	50%	30.6%	
Functional Reach	Over 16cm	7.3%	34.7%	41.7 (0.000)
	8 - 16cm	40.3%	33.4%	
	Under 8cm or unable	52.4%	31.9%	

Table 4.18 indicates that majority of participants (74.6 and 84.7%) find the activity of coming from lying to sitting the easiest after sustaining a hip fracture. The functional reach at discharge was the activity that most participants fared poorly in or were unable to perform it all. Functional activities such as sit to stand (Chi-Square = 64.3, p= 0.000), standing (Chi-Square = 69.2, p= 0.000) and gait (Chi-Square = 76.2, p= 0.000) were the most statistically improved items using the EMS at discharge and six weeks post discharge. Timed walk (Chi-Square = 54.6, p= 0.000) was only relatively significant.

The Lower Extremity Functional Scale (LEFS) is a questionnaire containing 20 questions about a person's ability to perform everyday tasks. The maximum score is 80. The lower the score the greater the disability.

The results of Table 4.19 demonstrate that a significant improvement exists between the discharge assessment and the six weeks post discharge LEFS median values (Z-Statistic -6.42, p=0.000).

Table 4.19: Differences in discharge and six weeks post discharge median LEFS values (n=72).

Wilcoxon Signed Ranks Test	**LEFS**	
	Discharge	Six weeks post discharge
Medians	21.50	32.00
Z-Statistic	-6.42	
p-value	0.000	

Tables 4.20 to 4.21 demonstrate the percentages and frequencies of the individual scores obtained using the LEFS.

Table 4.20: Percentages of each individual score obtained using the LEFS at discharge (n=72)

Lower Extremity Functional Scale (Discharge)					
Variable	**Unable**	**Quite a bit of difficulty**	**Moderate difficulty**	**A little bit of difficulty**	**No difficulty**
Usual work or housework	20.7%	31.7%	32.9%	13.4%	1.3%
Hobbies, recreation, sporting	7.3%	28.0%	48.8%	14.6%	1.3%
Getting in and out of the bath	25.6%	34.1%	35.4%	4.8%	
Walking between rooms	15.9%	8.5%	13.4%	20.7%	41.5%
Putting on shoes or socks	22.0%	32.9%	24.4%	18.3%	2.4%
Low sitting position	24.4%	43.9%	20.7%	11.0%	
Lifting an object (bag of groceries)	46.3%	31.7%	14.6%	6.1%	1.3%
Performing light activities around the home	13.4%	14.7%	13.4%	32.9%	25.6%
Performing heavy activities around the home	50.0%	31.7%	14.6%	3.7%	
Getting into or out of a car	36.6%	31.7%	25.6%	6.1%	
Walking to the shop	84.1%	12.2%	3.7%		
Walking 1km	92.7%	6.1%	1.2%		
Going up or down 10 stairs	82.9%	7.3%	8.5%	1.3%	
Standing for 1 hour	91.5%	4.9%	3.6%		
Sitting for 1 hour	3.7%		6.1%	35.4%	54.8%
Running on the pavement	100.0%				
Running on sand	100.0%				
Making sharp turns while running fast	100.0%				
Hopping	98.8%		1.2%		
Rolling over in bed	35.4%	29.3%	22.0%	8.4%	4.9%

Table 4.20 depicts the percentage of participants that can perform specific tasks without any difficulty ranging to completely unable. At discharge, 100% of participants reported that they would be completely unable to run on pavement, run on sand or make sharp turns while running fast. Tasks that were reported to be easiest were walking between rooms and sitting on a chair for one hour. Table 4.21 below also indicates that at six weeks post discharge, 100% of participants are still unable to run on pavement, run on sand or make sharp turns while running fast. Table 4.22 further below presents the statistical differences for each variable of the LEFS from discharge to six weeks post discharge.

Table 4.21: Percentages of each individual score obtained using the LEFS at 6 weeks post discharge (n=72).

Lower Extremity Functional Scale (6 Weeks Post Discharge)					
Variable	**Unable**	**Quite a bit of difficulty**	**Moderate difficulty**	**A little bit of difficulty**	**No difficulty**
Usual work or housework	9.7%	16.7%	36.1%	30.6%	6.9%
Hobbies, recreation, sporting	11.1%	11.1%	31.9%	34.8%	11.1%
Getting in and out of the bath	15.4%	20.7%	31.9%	25.1%	6.9%
Walking between rooms	11.1%	1.4%	9.7%	15.3%	62.5%
Putting on shoes or socks	15.3%	13.9%	38.9%	20.8%	11.1%
Low sitting position	19.4%	27.8%	29.2%	12.5%	11.1%
Lifting an object (bag of groceries)	23.6%	25%	27.8%	12.5%	11.1%
Performing light activities around the home	13.9%	1.4%	13.9%	13.9%	56.9%
Performing heavy activities around the home	26.4%	20.8%	40.3%	8.3%	4.2%
Getting into or out of a car	16.7%	20.8%	23.6%	29.2%	9.7%
Walking to the shop	62.5%	18.1%	6.9%	9.7%	2.8%
Walking 1km	79.2%	12.5%	2.7%	5.6%	
Going up or down 10 stairs	58.3%	23.6%	11.1%	2.8%	4.2%
Standing for 1 hour	76.4%	12.5%	8.3%	1.4%	1.4%
Sitting for 1 hour	4.2%		1.4%	19.4%	75%
Running on the pavement	100%				
Running on sand	100%				
Making sharp turns while running fast	100%				
Hopping	95.8%	2.8%	1.4%		
Rolling over in bed	11.1%	20.8%	34.7%	26.5%	6.9%

Table 4.22. Comparison of individual LEFS variables at discharge and six weeks post discharge (n=72).

Variables	Chi-Square	Degrees of Freedom	p-value
Usual work or housework	76.283	16	0.000
Hobbies, recreation, sporting	61.143	16	0.000
Getting in and out of the bath	63.902	12	0.000
Walking between rooms	97.298	16	0.000
Putting on shoes or socks	74.550	16	0.000
Low sitting position	74.536	12	0.000
Lifting an object (bag of groceries)	62.062	16	0.000
Performing light activities around the home	54.719	16	0.000
Performing heavy activities around the home	68.514	12	0.000
Getting into or out of a car	46.183	12	0.000
Walking to the shop	43.703	8	0.000
Walking 1km	29.412	6	0.000
Going up or down 10 stairs	69.193	12	0.000
Standing for 1 hour	55.608	8	0.000
Sitting for 1 hour	85.101	9	0.000
Running on the pavement	NA	NA	NA
Running on sand	NA	NA	NA
Making sharp turns while running fast	NA	NA	NA
Hopping	72	2	0.000
Rolling over in bed	30.01	16	0.018

Table 4.22 demonstrates that the three most improved items on the LEFS from discharge to six weeks post discharge were, carrying out usual work or house work (Chi-Square = 76.3, p= 0.000) ,walking between rooms (Chi-Square = 97.3, p= 0.000) and putting on shoes and socks (Chi-Square = 74.6, p= 0.000).

In conclusion, the post-operative functional level in the sample population was admirable. The level of functional mobility improved substantially from discharge to the point of final assessment six weeks after discharge. At discharge only 37.8% of all participants were independent with mobility, at six weeks following the discharge assessment this figure rose to 66.67%. Activities that participants struggled with were tasks that included running or walking far distances.

4.8. Factors influencing post-operative outcome in elderly patients with a hip fracture

4.8.1. Correlation coefficients

The Spearman's rho Correlation Coefficient was used on ordinal data to determine these relationships with $p \leq 0.05$.

Table 4.24 describes the correlations between pre-fracture functional level, cognitive function and pre-existing co-morbidities with functional outcome at discharge and six weeks post discharge.

Table 4.23: Correlations with functional outcome (n=72).

Assessment Period	Spearman Correlations					
	Elderly Mobility Scale			Lower Extremity Functional Scale		
	NMS (r)	6CIT (r)	CIRS (r)	NMS (r)	6CIT (r)	CIRS (r)
Discharge	0.663**	-0.554**	-0.456**	0.691**	-0.550**	-0.530**
Six weeks post discharge	0.665**	-0.692**	-0.477**	0.652**	-0.596**	-0.467**

****Correlation is significant (p≤0.01)**

From the results of Table 4.23 it can be concluded that the correlations range from mild to good and all correlations are significant. Pre-fracture functional level has the strongest relationship with the post-operative functional level at discharge and six weeks post discharge using the EMS and LEFS. The pre-fracture functional level is directly related to post-operative functional outcome, while the presence of a cognitive impairment and pre-existing co-morbidities is indirectly related to post-operative functional outcome.

4.8.2. Regression analysis

A multiple regression analysis was run to determine which factors influence the early post-operative functional level. The independent variables consisted of the pre-fracture functional level, the presence of pre-existing co-morbidities and the level of cognitive function pre-operatively. Table 4.24 and 4.25 demonstrates the results of the regression analysis at discharge and six weeks post discharge respectively.

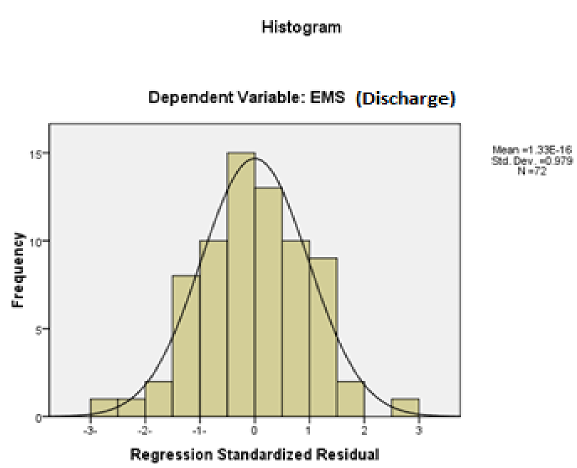
Table 4.24: Regression analysis (Discharge assessment) (n=72)

Model Specification		Regression Results					Model Fit		
Dependent Variable	Independent Variable	Regression Coefficient	95% Confidence Interval for B	Standardized Regression Coefficient			Regression ANOVA Results		
		β		β	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	NMS	1.4	0.69 - 2.1	0.46	3.9	0.000	21.46	0.000	0.46
	6CIT (Pre-Op)	-0.14	-0.27 - -0.01	-0.24	-2.14	0.036			
	CIRS	-0.16	-0.43 - 0.1	-0.12	-1.24	0.220			
Lower Extremity Functional Scale	NMS	2.4	0.92 - 3.8	0.39	3.28	0.002	21.51	0.000	0.46
	6CIT (Pre-Op)	-0.28	-0.54 - -0.02	-0.24	-2.13	0.037			
	CIRS	-0.63	-1.17 - -0.1	-0.23	-2.38	0.020			

A multiple regression analysis using the data collected at discharge (Table 4.24) revealed that both the NMS (β = 1.40, p = 0.000) and 6CIT (β = -0.14, p = 0.036) assessed pre-operatively are strong predictors of early post-operative functional outcome using the EMS at discharge. The NMS (β = 2.4, p = 0.002), 6CIT (β = -0.28, p = 0.037), and CIRS (β = -0.63, p = 0.020) are all strong predictors of early post-operative functional outcome using the LEFS at discharge.

Figures 4.2 to 4.4 represent the multiple regression analysis result graphs.

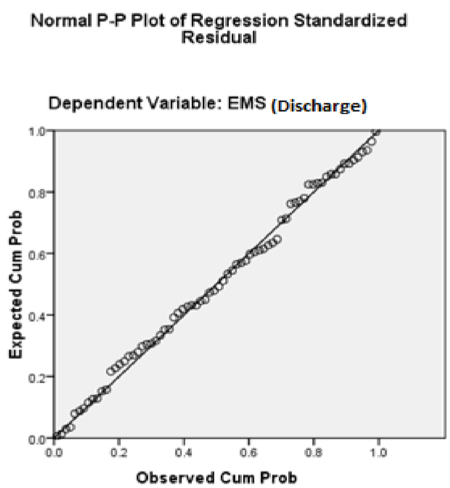
Figure 4.2:



Histogram of EMS (discharge) regression analysis

Figure 4.2 clearly indicates that the distribution of residuals falls under a bell shaped curve, thus indicating that the residuals are normally distributed.

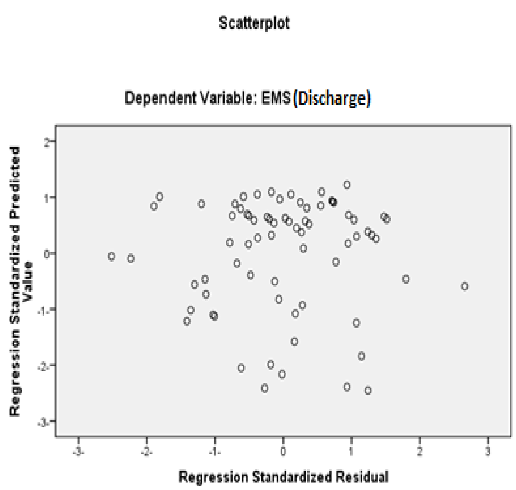
Figure 4.3:



P-P Plot of EMS (discharge) regression analysis

Figure 4.3 clearly indicates that the distribution of residuals falls within the expected cumulated probability, thus demonstrating that the residuals are normally distributed.

Figure 4.4:



Scatterplot of EMS (discharge) regression analysis

Figure 4.4 clearly indicates that there is no obvious pattern in the distribution of the residuals, thus proving that there is evidence of constant variance.

Table 4.25: Regression analysis (Six weeks post discharge assessment) (n=72).

<table>
<tr><th colspan="10">Six weeks post discharge</th></tr>
<tr><th colspan="2">Model Specification</th><th colspan="5">Regression Results</th><th colspan="3">Model Fit</th></tr>
<tr><th rowspan="2">Dependent Variable</th><th rowspan="2">Independent Variable</th><th>Regression Coefficient</th><th>95% Confidence Interval for B</th><th colspan="3">Standardized Regression Coefficient</th><th colspan="3">Regression ANOVA Results</th></tr>
<tr><th>β</th><th></th><th>β</th><th>t-statistic</th><th>p-value</th><th>F-Statistic</th><th>p-value</th><th>Adj R-Sqr</th></tr>
<tr><td rowspan="3">Elderly Mobility Scale</td><td>NMS</td><td>1.30</td><td>0.56 - 2.04</td><td>0.39</td><td>3.51</td><td>0.001</td><td rowspan="3">25.05</td><td rowspan="3">0.000</td><td rowspan="3">0.50</td></tr>
<tr><td>6CIT (Pre-Op)</td><td>-0.22</td><td>-0.35 - -0.09</td><td>-0.35</td><td>-3.27</td><td>0.002</td></tr>
<tr><td>CIRS</td><td>-0.16</td><td>-0.43 - 0.12</td><td>-0.11</td><td>-1.13</td><td>0.261</td></tr>
<tr><td rowspan="3">Lower Extremity Functional Scale</td><td>NMS</td><td>2.08</td><td>0.23 - 3.92</td><td>0.27</td><td>2.24</td><td>0.028</td><td rowspan="3">21.36</td><td rowspan="3">0.000</td><td rowspan="3">0.46</td></tr>
<tr><td>6CIT (Pre-Op)</td><td>-0.60</td><td>-0.94 - -0.27</td><td>-0.40</td><td>-3.60</td><td>0.001</td></tr>
<tr><td>CIRS</td><td>-0.65</td><td>-1.33 - 0.04</td><td>-0.18</td><td>-1.88</td><td>0.064</td></tr>
</table>

A multiple regression analysis using the data collected at six weeks post discharge (Table 4.25) revealed that both the NMS (β = 1.30, p = 0.001) and 6CIT (β = -0.22, p = 0.002) assessed pre-operatively are strong predictors of early post-operative functional outcome using the EMS at six weeks post discharge. The NMS (β = 2.08, p = 0.028), 6CIT (β = -0.60, p = 0.001), and CIRS (β = -0.65, p = 0.064) are all strong predictors of early post-operative functional outcome using the LEFS at six weeks post discharge.

Cognitive impairment assessed at discharge and six weeks post discharge using the 6CIT was also analysed using a multiple regression analysis. A beta value of -0.37 (p=0.000) was calculated against the EMS and a beta value of -0.68 (p=0.000) was calculated against the LEFS at discharge. At six weeks post discharge, a beta value of -0.49 (p=0.000) was calculated against the EMS and a beta value of -1.02 (p=0.000) was calculated against the LEFS. The tables of the regression outputs using the 6CIT at discharge and six weeks post discharge can be found in Appendix N.

The histogram, P-P plot and scatterplot for the multiple regression analysis of the pre-operative variables at six weeks post discharge, as well as the isolated 6CIT multiple regression analyses reveal similar finding to that of figures 4.2 to 4.4 above. These graphs can be found in Appendix O.

Expanding on the regression analyses, the demographic factors obtained at baseline that may influence the early post-operative functional level following a hip fracture was also determined. A brief summary will follow with these results. The regression analyses results and graphs can be found in Appendix P.

- Fracture type

  No significant effects were found with regards to the effect of fracture type on the post-operative functional outcome at discharge or six weeks post discharge.

- Number of days lapsed between admission and surgery

  No significant effects were found with regards to the number of days lapsed between admission and surgery on the post-operative functional outcome at discharge or six weeks post discharge.

- Type of surgical procedure performed

  There were no statistically significant effects of type of surgical procedure performed on the post-operative functional outcome at discharge. However, at six weeks post discharge, participants who had undergone a PFNA or THR had significantly higher scores using the EMS compared to those participants who had undergone insertion of cannulated screws of a HA.

- Number of post-operative physiotherapy sessions received

  No significant effects were found with regards to the number of post-operative physiotherapy sessions received on the post-operative functional outcome at discharge or six weeks post discharge.

- Complications developed during the course of the study

  The development of pulmonary and cognitive complications have statistically significant effects on the post-operative functional level at discharge, assessed using the EMS and LEFS. At six weeks post discharge, pulmonary and cognitive complications were found to not be as significant.

In summary, the multiple regression analysis reveals that the pre-fracture functional mobility is the strongest predictor of functional outcome. Cognitive impairment is also a relatively strong predictor of functional outcome. The presence of pre-existing co-morbidities is more closely related to the LEFS measure of functional outcome compared to the EMS. As a result, it is also the weakest predictor of functional outcome. With regards to demographic information, surgical procedures such as a PFNA and THR yield significantly better EMS scores at six weeks post discharge and the development of pulmonary and cognitive complications significantly affect the post-operative functional outcome at discharge only. There is an interesting trend in the relationships between cognitive impairment at the three levels and functional outcome. The relationship gets stronger as you move through the different levels (i.e. from pre-operatively to six weeks post discharge), indicating that as time progresses and cognition improves, the functional outcome improves as well.

4.9. Summary

In this study, participants were generally independent with pre-fracture mobility at baseline. Participants presented with approximately three pre-existing co-morbidities. The presence of cognitive impairments in the participants decreased during the duration of the study. At six weeks post-discharge 60% of participants presented with normal cognitive function or a minimal impairment. The post-operative functional level in this population improved from discharge to six weeks post discharge. At the six week post discharge assessment, almost 60% of the study population were independent with mobility. Statistical analyses determining the changes in functional outcome and cognitive function at discharge and six weeks post discharge were significant. The correlation results of the factors influencing early post-operative functional level indicate that the pre-fracture functional level is strongly related to post-operative functional outcome. The presence of co-morbidities and impaired cognitive function are also indirectly related. The multiple regression analysis revealed that pre-fracture functional mobility is a strong predictor of early post-operative functional outcome, when adjusted for the factors of cognitive function and pre-existing co-morbidities. With regards to demographic information, only surgical procedures performed and development of pulmonary and cognitive complications significantly affect the post-operative functional outcome.

Chapter 5 - Discussion

5.1. Introduction

The main purpose of this study was to determine the early post-operative functional outcome in elderly patients with a hip fracture. In addition to establishing the factors that influence the early post-operative functional outcome in elderly patients with a hip fracture. The discussion will begin with the demographic results, followed by the pre-fracture functional level and the presence of pre-existing co-morbidities in the elderly population after sustaining a hip fracture. Thereafter, the cognitive level in this frail sample of the population and the post-operative functional level at discharge and six weeks post discharge will be discussed. This chapter will provide a detailed discussion of the results of the present study in light of the literature reviewed. The wider implications of this study, the limitations and suggestions for future research will be included in this chapter.

5.2. Demographic representation

The participants in the current study had a mean age of 75.7 years (SD ± 9.54). Participants aged 80 years and above had a lower pre-fracture functional levels, impaired cognitive function and more co-morbidities compared to those participants aged between 60 and 79. Similarly these older participants presented with poorer functional outcomes compared to their younger counterparts at discharge and six weeks post discharge. These findings were expected and are consistent with those of Thorngren et al (2005) who concluded that those patients over the age of 85 were more likely to be discharged into a nursing facility due to poorer outcomes post-operatively. Semel et al (2010) reiterated this finding citing the cause to be poor rehabilitation potential. These findings by Semel et al (2010) closely relate to the present study as the mean age of 75.9 (SD ± 11.8) is almost exact to the mean age in the present study.

Shebubakar et al (2009) assessed 123 patients to determine if older age had an effect on functional outcome after a partial total hip replacement for hip fractures. The authors concluded that patients aged 75 years or older at the time of surgery presented with poorer post-operative functional scores. This study did not investigate the effects of older age on mortality following a hip fracture, however studies such the one conducted by Kristensen et al (2011) concluded that older age is a significant predictor of increased mortality following a hip fracture in the elderly.

Gender distribution consisted of n=22 (30.6%) male and n=50 (69.4%) female participants. In this current study female participants presented with poorer functional outcomes at discharge and six weeks post discharge, compared to their male counterparts. The results of this study are not consistent with those of Costa et al (2009), who reported that after sustaining a hip fracture, the elderly male patient is more likely to be bed ridden and unable to walk independently. The discrepancy between the current study and the one carried out by Costa et al (2009) may be due to the fact that Costa et al (2009) did not take into consideration the participants pre-fracture functional level.

Kannegaard et al (2010) also concluded that males have a higher risk of mortality compared to females following a hip fracture in the elderly. Kannegaard et al (2010) concluded that males present with more severe co-morbidities such as pulmonary diseases and chronic cardiac complications compared to females whose primary co-morbidities are musculoskeletal in nature. In the current study, females presented with more co-morbidities when compared to males. Kristensen et al (2011) reported that the recovery of male patients following a hip fracture may need a higher priority in the rehabilitation program in the future due to the presence of more severe co-morbidities.

Arinzon et al (2010) investigated the influence of gender differences on the outcome of geriatric rehabilitation after a hip fracture. The authors found that, males had more co-morbidities at the time of the fracture, they also recovered better from a depressed mood in comparison with females during the rehabilitation. The functional gain was higher in males (24.47) in comparison with females (19.22, $p = 0.036$). Females were more functionally dependent in locomotion, transfers and sphincter control. These functional differences are consistent with those found in this study. In the study by Arinzon et al (2010), as well as the current study, community-dwelling elderly individuals who were functionally independent or required minimal assistance prior to the fracture were studied. This finding is once again consistent with the hypothesis that an elderly patients level of function prior to sustaining a hip fracture is a strong predictor of post-operative functional outcome

In the current study, seven (9.7%) participants died during hospital admission, and 1 (1.3%) participant withdrew participation prior to discharge. After participating in the assessment at discharge and prior to following up at six weeks post discharge, 4 (5.6%) participants died and 6 (8.3%) participants could not be followed up. The percentage of participants that deceased while admitted in hospital in this study is significantly similar to that of Dubljanin- Raspopovic et al (2012), who reported an in-hospital mortality rate of 9.2%. The percentage of participants that desceased (20.8%) and were lost (13.1%) before follow up was remarkably higher than that reported in the current study. These variations in results can be attributed to the length of time passed between follow up assessments. Six weeks post discharge in the current study versus four months in the study by Dubljanin- Raspopovic et al (2012)

In the current study, the type of fracture sustained had no statistical significance on the early post-operative functional outcome. However, according to the descriptive statistics it was noted that those participants who sustained a neck of femur fracture performed slightly better at assessments of functional outcome compared to those participants who sustained an intertrochanteric fracture. This finding is similar to that of Haentjens et al (2007) who compared the functional outcome and survival rates in women who had sustained a neck of femur fracture or intertrochanteric fracture. Haentjens et al (2007) concluded that patients who sustained a neck of femur fracture are more likely to walk independently at hospital discharge.

The number days lapsed between admission and surgery and the number of post-operative physiotherapy sessions received also had no statistical significance on the early post-operative functional outcome. Ngobeni (2010) also conducted a study in south Africa on mortality rates after sustaining a hip fracture in the elderly and concluded that the number of days between admission and surgery had no effect on mortality as long as surgery was performed within one week. This current study found no statistical differences between participants operated on in less than one week and those operated on after one week of being admitted. Ngobeni (2010) did not take into account the pre-fracture function of the patients and only included intertrochanteric fractures. Doruk et al (2004) contradicted the above findings and concluded that surgical procedures performed within five days post admission is associated with improved quality of life. Griffiths et al (2013) stated that distinguishing whether the delay to surgery was due to necessary medical optimisation or surgeon/implant availability is a major limitation when publishing data on surgical delay for hip fracture patients. Therefore discrepancies between studies establishing the effect of length of time to surgery is common.

With regards to the type of surgical procedure performed, this study concluded that undergoing a total hip replacement (THR) or proximal femoral nailing arthrosis (PFNA) after sustaining a hip fracture results in improved physical function at six weeks post operatively. Thorngren et al (2005) also concluded that participants receiving total hip replacements were more likely to be discharged to their own home and had lower mortality rates. During the course of the current study, THR were performed on younger healthier patients while hemi-arthroplasties were performed on more functionally impaired patients.

In this study there were only two types of developed complications that had any statistical significance on early post-operative functional outcome. These complications were cognitive and pulmonary in nature. These complications were only significant at the time of discharge. At six weeks post discharge there were no complications that significantly impacted post-operative function. This finding can be attributed to the fact that majority of the participants who deceased while in hospital had developed complications and hence at the follow up period six weeks later these participants data could not be analysed. Benjamin et al (2013) found that one of the risk factors for re-admission to hospital after sustaining a hip fracture is the development of respiratory failure. This finding is consistent with that of the current study with regards to the development of pulmonary complications influencing post-operative function. Mnif et al (2009) examined the mortality rates in patients who sustained intertrochanteric fractures of the hip. During the course of their study they encountered many post-operative complications. Majority of these complications were vascular and surgically related. This finding is inconsistent with the results of this study in this regard. The differences can be explained by the types of sample population studied. In this study 69% of participants were female, compared to 40% in the study by Mnif et al (2009), also Mnif et al (2009) only included participants who had sustained intertrochanteic fractures.

5.3. Pre-fracture functional level

Pre-fracture functional level is a description of the level mobility and the ability to perform activities of daily living before sustaining the fracture (Penrod et al, 2008).

In the current study, pre-fracture functional mobility was the strongest determinant of early post operative functional outcome ($r= 0.69$ $p \leq 0.01$). These results were expected and are consistent with those of Kristensen et al (2010), who found that the pre-fracture functional level is a strong predictor of in-hospital outcome in elderly patients with a hip fracture. Similar findings were also reported by Penrod et al (2008) and Parker and Palmer (1993).

Kristensen et al (2010) reported that 50% of participants used a walking aid prior to the fracture. In the current study only 20% of participants occasionally required an assistive device. Of the 72 participants that completed this study, 22.2% of participants were dependent in mobility while 77.8% of participants were independently mobile. In the study by Kristensen et al (2010), 47%

of participants were dependent with mobility while 53% were independent. These discrepancies could be due to the fact that the mean age in the study by Kristensen et al (2010) was 81 years, whereas in the current study the mean was 75.7 years of age. As discussed above, older age does have negative implications on function.

Dubljanin- Raspopovic et al (2012) hypothesised that pre-fracture functional mobility is an independent predictor of functional outcome at four months post discharge. This result is consistent with that of the current study. Dubljanin- Raspopovic et al (2012) compared pre-fracture functional level in those patients presenting with a cognitive impairment and those with intact cognition. Patients with better cognitive scores using the Short Portable Mental Questionnaire presented with better pre-fracture functional levels. Participants in the study by Dubljanin- Raspopovic et al (2012) were followed up telephonically and 34.1% of participants were lost from initial assessment to the four month follow up. In the current study, participants were followed up personally and only 20% of participants were lost.

Pre-fracture functional level assessed using the Barthel Index predicts the ability to walk independently at discharge. This score significantly fails to predict functional outcome following discharge (Bellelli et al, 2012). The NMS used in this study to determine pre-fracture functional mobility was both a strong predictor of functional outcome at discharge and six weeks post discharge.

The pre-fracture functional mobility is also a strong indicator of post-operative mortality (Holt et al, 1994) and discharge placement (Hagino et al, 2011). The overall post-operative mortality rate in the United Kingdom where Holt et als' (1994) study was conducted was 12.6%. In South Africa, Ngobeni (2010) reported post-operative mortality rate to be 14%. Despite more than a decade later, and differing continents these post-operative mortality rates are relatively consistent.

5.4. <u>Presence of pre-existing co-morbidities</u>

In the context of this study, the presence of pre-existing co-morbidities is a rating of the chronic medical illness burden. Co-morbidities were graded according to severity in order to minimise clinical bias.

The current study revealed that the presence of pre-existing co-morbidities is inversely related to the early post-operative functional outcome in elderly patients with a hip fracture ($r = -0.53$ $p \leq$

0.01). This finding was expected and is comparable to that of Shebubakar et al (2009) who concluded that the presence of pre-existing co-morbidities is one of the independent risk factors for a poor post-operative functional outcome in elderly patients after receiving partial hip replacement surgery for a traumatic fracture.

In the present study, a chronic cardiac or vascular co-morbidity that requires daily treatment or first line therapy occurred in 27.8% and 63.9% of participants respectively. In a study by Lin et al (2004), 27.2% of participants presented with heart disease. This result correlates almost 100% to the number of participants presenting with a cardiac disease in the current study. Hagino et al (2011) concluded that the presence of systemic chronic diseases positively correlated to poor functional outcomes and hence not being discharged directly home. Other studies by Ozturk et al (2010) and Roche et al (2005) concluded that the presence of three or more co-morbidities, respiratory disease or malignancy on admission is a strong post-operative risk factor and leads to increased mortality at one year. This study however did not investigate the effect of co-morbidities on one year mortality rates.

Penrod et al (2008) found that congestive cardiac failure, chronic obstructive pulmonary disease and cancer decreases the odds of survival at six months. Penrod et al (2008) also concluded that arrhythmia, stroke, dementia and Parkinson's disease affect functional outcomes. Participants who presented with Parkinson's disease were excluded from this study.

5.5. <u>Cognitive function</u>

A cognitive impairment in the context of this study includes the presence of any acute confusion states or the development of incident cognitive impairment during hospital admission. A cognitive impairment was diagnosed according to the score obtained on the 6CIT.

The current study revealed that the presence of a cognitive impairment pre-operatively has a negative influence on the post-operative functional level at discharge and six weeks post discharge ($r= -0.55$ discharge, -0.69 six weeks post discharge $p \leq 0.01$). These results are consistent with that of Lenze et al (2004), who examined the adverse effects of cognitive impairment [Mini-Mental State Examination (MMSE)] in elderly hip fracture patients receiving inpatient rehabilitation. Fifty seven elderly participants were recruited from a rehabilitation hospital in Pittsburgh, USA. Lenze et al (2004) concluded that cognitive impairment predicted poorer functional outcomes because these patients are unable to participate as well in their therapy sessions. Lenze et al (2004) evaluated participants level of participation in therapy using a new developed Rehabilitation Participation Scale. This scale was found to have a ceiling effect and was modified later. Similar findings were reported by Söderqvist et al (2006), Horgan et al (2003), and Penrod et al (2008).

Kristensen et al (2011) concluded that those patients who are cognitively impaired may have the same rehabilitation potential than those patients who are cognitively intact if they are mobile prior to the fracture. The strength in the current study that differs from those studies using the MMSE is that the 6CIT lacks a functional aspect in its assessment, therefore those participants with motor deficits are not biased in any way when being assessed on a cognitive level. Dubljanin- Raspopovic et al (2012) stated that the MMSE is best administered in a sitting position due to manual handling and drawing, and thus the MMSE is a weak screening test when assessing bed-bound patients. Despite the use of different cognitive impairment screening tools used in each of these studies, the concluding result of cognitive impairments hampering post-operative functional level was standard throughout.

Improvement of cognitive function occurred during the course of this study. At six weeks post-discharge only 19.4% of participants presented with a severe cognitive impairment compared to 30.6% pre-operatively. These results are consistent with those of Johansson et al (2012) who demonstrated that the incidence of acute confusion after sustaining a hip fracture in the elderly population was 32% on admission and the day after surgery and 14% the day before discharge. Marcantonio et al (2000) also reported that the incidence of a cognitive impairment declines over time after surgical management of a hip fracture in the elderly.

Continuous prescription of medication was significantly more common among confused patients. Semel et al (2010) reported that multiple medications impact negatively on the rehabilitation outcome in these elderly patients. Anti-psychotics were prescribed to 22% of participants in this study. This finding can be attributed to the reason why cognitive impairments improve once the participant is discharged from the hospital and continuous prescriptions of medications have ended.

A finding that was unexpected in this study was the presence of a stronger correlation of cognitive impairment and functional outcome at six weeks post discharge ($r = -0.69$, $p \leq 0.01$)

compared to that at discharge ($r= -0.55$, $p \leq 0.01$). This result could be explained by the development of incident cognitive impairment following the trauma of sustaining a hip fracture. Gruber-Baldini et al (2003) found that incident cognitive impairment first detected in hospital, lasted up to two to 12 months in 40% of patients and led to poorer functional outcomes later on.

5.6. Post-operative functional level

Post-operative functional level in this study reflects the ability of an elderly individual to ambulate or perform activities of daily living following surgical fixation after sustaining a hip fracture.

The post-operative functional outcome in this current study was good. The level of functional mobility improved substantially from discharge to the point of final assessment, six weeks post discharge. At discharge 41.7% of all participants were independent with mobility, at six weeks following the discharge assessment this figure rose to 66.7%. Studies that compare the post-operative functional outcome at discharge and six weeks post discharge were unavailable.

An improvement in mobility was expected. Ross et al (2002) reported that the patient's level of mobility in the first few days post-operatively is a good predictor of short term outcome. Lin et al (2004) reported that activities such as walking on level ground, transferring and climbing stairs had improved from the time to discharge to three months later. This comparison at three months was the closest to the present study which compared mobility at discharge and six weeks later.

Majority of participants in this study (74.4% at discharge, 84.7% at six weeks post discharge) found the activity of coming from lying to sitting the easiest after sustaining a hip fracture. Ross et al (2004) found that the two most significant factors predictive of independence in transfers and ambulation after a hip fracture are the level of assistance required to transfer from lying to sitting and the maximum distance walked. The similarities in these results explain why participants in this study fared well during assessments of function post-operatively.

Dawson (2000) stated that individuals may struggle to perform basic activities such as bathing, toileting and dressing following a hip fracture. In this study, 95.1% and 68.1% of participants were completely unable or experienced extreme or moderate difficulty with getting in and out of the bath at discharge and six weeks post-discharge respectively.

Costa et al (2009) found that post discharge 51.7% of males and 68.9% of females were bedridden and 44% of males and 32.8% of females were unable to walk again on their own. These results of Costa et al (2009) reflect poorer outcomes compared to that of this study. At six weeks post discharge only 25% of participants were dependent with mobility. The variance in these results can be attributed to the lack of adjusting for pre-fracture mobility in Costa et als' (2009) study.

In a study by Intiso et al (2009), 41% of participants regained gait without an aid and were able to maintain this level of independent ambulation. This result by Intiso et al (2009) is inferior to that of the current study. A total of 66.7% of participants were independent with mobility at discharge at six weeks post discharge. The difference between the two studies was the mean age of the participants. In the current study, the mean age of the participants was 75.7 years (SD ± 9.54). Intiso et al (2009) reported a mean age of 92.6 years (SD ± 3.5).

5.7. <u>Limitations of the study</u>

Although the research had reached its aims, there were two noteworthy limitations in this study: Firstly further longitudinal follow up assessments were beyond the scope of this study. Six month or one year follow up assessments would have provided important data for analysis of long term function following a hip fracture in the elderly, as well as long term mortality rates in South Africa. Secondly, variables such as length of time to surgery, surgical experience and length and quality of rehabilitation that ultimately have an effect on post-operative functional outcome following a hip fracture could not be standardised.

Further longitudinal follow up assessments were not part of this study due to poor compliance in the public health sector in South Africa, in addition to the increased age of many of the participants studied. The combination of these two factors would increase the ratio of loss to follow up and in turn this would reduce the quality of the results. Variables such as length of time to surgery, surgical experience and length and quality of rehabilitation were unavoidably varying due to data being collected from both Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital. However, collecting data from two different hospitals provided the study with a more accurate picture of patient demographics in Johannesburg South Africa, over and above assisting with time constraint limitations.

These limitations can be avoided in the future by using a controlled study population and environment where most other influencing variables can be adjusted and participants can be easily accessible.

There were an additional two limitations in this study that involved the data collection of the demographic information. The number of physiotherapy session received was not always specified as pre-operative and post-operative treatments and the administration of medications was not always separated into pre-operative and post-operative groups. This discrepancies were due to different treating physiotherapists at both Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital. For statistical purposes to determine the effect of the number of physiotherapy sessions received on early post-operative functional outcome, only the number of post-operative physiotherapy sessions was analysed. The adverse effects of medications prescribed on early post-operative functional outcome could not be analysed due to the complexity and limitation with collection of this data.

5.8. Implications

The finding that, in order of priority, poor pre-fracture functional level, impaired cognitive function and the presence of pre-existing co-morbidities affects the early post-operative functional outcome following a hip fracture in the elderly has important implications for clinical practice.

Patients presenting with poorer pre-fracture function, impaired cognition and more co-morbidities should be especially encouraged to participate in intensive rehabilitation. Identifying these patients who are at risk of not regaining mobility post-operatively may assist in effective allocation of rehabilitation resources.

Those patients who adopt a sedentary lifestyle or remain bed-ridden following surgical fixation of a hip fracture impact on the financial burden in the health profession, therefore more intensive rehabilitation should be implemented in order to facilitate a more rapid return to function in this elderly population.

5.9. <u>Recommendations for practice and future studies</u>

"Prevention is better than cure" is a well known idiom that perfectly suits the extent of hip fractures resulting from falls in the elderly population. Increased public awareness on the risks and consequences of falls in the elderly population is needed in South Africa.

A falls prevention program implemented at a primary health care level would positively impact the prevalence of falls and hip fractures and the consequences thereof in South Africa. Kalula (2012) discussed interventions to reduce the incidence of falls. Some of these intervention methods included regular exercise that assists in balance and gait training and other exercises aimed at improving strength and flexibility, in addition to vitamin D supplementation and withdrawal of offending drugs that predispose older individuals to falls. Annual visual assessments for refractive errors and home safety interventions were also included.

Specialised rehabilitation units serving majority orthopaedic conditions should be developed and be available to South Africans as a step down unit following traumatic injuries resulting in hip fractures in the elderly. Many patients are discharged from the acute care setting into nursing facilities and old age homes that provide the necessary basic care required by these individuals. However intensive rehabilitation to facilitate independence is not provided at these institutions.

A future study investigating the effects of a falls prevention program on the prevalence of hip fractures in South Africa would be greatly beneficial to health professionals in South Africa as well as abroad

Chapter 6 - Conclusion

The results of this prospective pre-test post-test observational study to establish the early post-operative functional outcomes and the factors that influence the early post-operative functional outcome in elderly patients with a hip fracture indicate that the early post-operative functional outcome following a hip fracture in a selected population in the public health system of South Africa is good. The factors that predict better functional outcomes following a hip fracture in the elderly include, independent pre-fracture functional mobility, intact cognition and fewer pre-existing co-morbidities.

The early post-operative functional outcome assessed at discharge improved substantially to the following assessment at six weeks post discharge. Pre-fracture functional mobility was found to be the strongest determinant of post-operative functional outcome, followed by cognitive function and the presence of pre-existing co-morbidities.

Hip fracture is a common, serious injury that occurs predominantly in the elderly (Holt et al, 2008). Hip fractures are a major cause of morbidity and mortality and occur in 20 to 30 percent of older people who fall (Kalula, 2012). The most important intervention that can be offered to these elderly patients by health care professionals is education and preventative measures to protect these patients from the trauma associated with a fall and subsequently a hip fracture. For those patients who do sustain a hip fracture, intensive rehabilitation is especially necessary for the patient that presents with poor pre-fracture function, impaired cognition and a variety of pre-existing medical co-morbidities.

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Appendix A

New Mobility Score

(Palmer and Parker, 1993)

Mobility	No difficulty	With an aid	With help from another person	Not at all
Able to get about the house	3	2	1	0
Able to get out of the house	3	2	1	0
Able to go shopping	3	2	1	0

Score: ____

Appendix B

Six-Item Cognitive Impairment Test (6CIT)

	Scoring system	**Score obtained**
1. What year is it?	Correct - 0 points Incorrect - 4 points	
2. What month is it?	Correct - 0 points Incorrect - 3 points	
3. Give the patient an address phrase to remember with 5 components Eg. John, Smith, 42, High St, Bedford		
4. About what time is it (within 1 hour)	Correct - 0 points Incorrect - 3 points	
5. Count backwards from 20-1	Correct - 0 points 1 error - 2 points More than one error - 4 points	
6. Say the months of the year in reverse	Correct - 0 points 1 error - 2 points More than one error - 4 points	
7. Repeat address phrase	Correct - 0 points 1 error - 2 points 2 errors - 4 points 3 errors - 6 points 4 errors - 8 points All wrong - 10 points	
		6CIT score = ____ **28**

Appendix C

Cumulative Illness Rating Scale for Geriatrics (CIRS – G)

(Miller et al, 1992)

Systems	**Scores [a]**				
	0	**1**	**2**	**3**	**4**
Cardiac					
Vascular					
Haematological					
Respiratory					
Ophthalmological and ORL					
Upper gastrointestinal					
Lower gastrointestinal					
Hepatic and pancreatic					
Renal					
Genitourinary					
Musculoskeletal and tegumental					
Neurological					
Endocrine, metabolic, breast					
Psychiatric					
Total score [b]					

[a] Only one score is given to each system

[b] Total score = Sum of all the scores

Appendix D

Elderly Mobility Scale (EMS)

Elderly Mobility Scale	
Lying to sitting • **2** - Independent • **1** – Needs help of 1 person • **0** – Needs help of 2+ people	**Gait** • **3** – Independent (incl. Use of sticks) • **2** – Independent with frame • **1** –Mobile with walking aid but erratic/unsafe turning • **0** – Requires physical assistance or constant supervision
Sitting to lying • **2** - Independent • **1** – Needs help of 1 person • **0** – Needs help of 2+ people	**Timed walk** • **3** – Under 15 seconds • **2** – 16–30 seconds • **1** – Over 30 seconds
Sit to stand • **3** – Independent in under 3 seconds • **2** – Independent in over 3 seconds • **1** – Needs help of 1 person (verbal or physical) • **0** – Needs help of 2+ people	**Functional Reach** • **4** – Over 16 cm • **2** – 8-16 cm • **0** – Under 8 cm or unable
Standing • **3** – Stands without support & reaches within arms length • **2** – Stands without support but needs help to reach • **1** – Stands, but requires support • **0** – Stands, only with physical support (1 person) *Support = uses upper limbs to steady self*	
Total	

Interpretation of scores

14 – 20: Manoeuvres alone and safely. Independent in basic ADLs. These patients are generally safe to go home but may need some help.

10 – 13: Borderline in terms of safe mobility and independence in ADLs. These patients will require some help with mobility manoeuvres

< 10: Dependent in mobility manoeuvres & requiring help with basic ADLs (transfers, toileting, dressing etc.).

Appendix E

Lower Extremity Functional Scale (LEFS)

Instructions:

We are interested in knowing whether you are having any difficulty with all the activities listed below **because of your lower limb problem** for which you are currently seeking attention. Please provide an answer for **each** activity.

Today, do you or would you have any difficulty at all with:

	Activities	**Extremely difficult or unable to perform activity**	**Quite a bit of difficulty**	**Moderate difficulty**	**A little bit of difficulty**	**No difficulty**
1	Any of your usual work or housework	0	1	2	3	4
2	Your usual hobbies, recreation or sporting activities	0	1	2	3	4
3	Getting into or out of the bath	0	1	2	3	4
4	Walking between rooms	0	1	2	3	4
5	Putting on your shoes or socks	0	1	2	3	4
6	Squatting	0	1	2	3	4
7	Lifting an object, like a bag of groceries from the floor	0	1	2	3	4
8	Performing light activities around your home	0	1	2	3	4
9	Performing heavy activities around your home	0	1	2	3	4
10	Getting into or out of a car	0	1	2	3	4
11	Walking 2 blocks	0	1	2	3	4
12	Walking a mile	0	1	2	3	4
13	Going up or down 10 stairs (about 1 flight of stairs)	0	1	2	3	4
14	Standing for 1 hour	0	1	2	3	4
15	Sitting for 1 hour	0	1	2	3	4
16	Running on even ground	0	1	2	3	4
17	Running on uneven ground	0	1	2	3	4
18	Making sharp turns while running fast	0	1	2	3	4
19	Hopping	0	1	2	3	4
20	Rolling over in bed	0	1	2	3	4
	TOTAL					

Modified Lower Extremity Functional Scale (LEFS)

Instructions:

We are interested in knowing whether you are having any difficulty with all the activities listed below **because of your lower limb problem** for which you are currently seeking attention. Please provide an answer for **each** activity.

Today, do you or would you have any difficulty at all with:

	Activities	Extremely difficult or unable to perform activity	Quite a bit of difficulty	Moderate difficulty	A little bit of difficulty	No difficulty
1	Any of your usual work or housework	0	1	2	3	4
2	Your usual hobbies, recreation or sporting activities	0	1	2	3	4
3	Getting into or out of the bath	0	1	2	3	4
4	Walking between rooms	0	1	2	3	4
5	Putting on your shoes or socks	0	1	2	3	4
6	Low sitting position	0	1	2	3	4
7	Lifting an object, like a bag of groceries from the floor	0	1	2	3	4
8	Performing light activities around your home	0	1	2	3	4
9	Performing heavy activities around your home	0	1	2	3	4
10	Getting into or out of a car	0	1	2	3	4
11	Walking to the shop	0	1	2	3	4
12	Walking 1 km (to the taxi rank)	0	1	2	3	4
13	Going up or down 10 stairs (about 1 flight of stairs)	0	1	2	3	4
14	Standing for 1 hour	0	1	2	3	4
15	Sitting for 1 hour	0	1	2	3	4
16	Running on the pavement	0	1	2	3	4
17	Running on sand	0	1	2	3	4
18	Making sharp turns while running fast	0	1	2	3	4
19	Hopping	0	1	2	3	4
20	Rolling over in bed	0	1	2	3	4
	TOTAL					

Appendix F

Demographic Details Form

Patient code: ______________________ Date of fracture: ____________________________

Type of fracture: ____

Date of admission: ____________________ Date of surgery: ______________________

Type of surgical procedure performed: ____

Date of discharge: ____________________ Number of physiotherapy sessions: ____________

Development of in-hospital complications:

____

____

____

____

____

Medication prescribed:

____

____

____

____

____

Appendix G

Letter

To the physiotherapy and orthopaedic departments of Helen Joseph Hospital/Charlotte Maxeke Johannesburg Academic Hospital

I, Saadiya Adam, am doing my physiotherapy Masters dissertation on the factors influencing the early post-operative functional outcome in elderly patients with a hip fracture. I will be looking at pre-fracture functional level, presence of pre-existing co-morbidities and cognitive function in each participant, and the effect these conditions have on early post-operative functional outcome after a hip fracture.

In order to carry out the above study, I will require patients who meet the following inclusion criteria:

Patients admitted to Helen Joseph Hospital/ Charlotte Maxeke Johannesburg Academic Hospital

- With a first hip fracture that requires surgical management.
- Patients above the age of 60

Patients with the following conditions will be excluded:

- Bilateral hip fractures
- Polytrauma
- Patients re-admitted with complications of a previous surgery
- Patients managed conservatively
- Patients with co-morbidities affecting lower extremity movement (CVA, Parkinsons disease or a spinal cord injury)

When a patient that meets the above criteria is admitted, I would appreciate it if you could inform me. I will also screen the wards for any new admissions. Please see below for my contact details.

Thanking you,

Saadiya Adam

011 489 0336

082 947 4268

adam.saadiya@gmail.com

Appendix H

Information Sheet

Study title:

Factors influencing early post-operative functional outcome in elderly patients with a hip fracture.

Greeting:

Hello

Introduction:

My name is Saadiya Adam, I am a physiotherapist and a masters student in physiotherapy, University of the Witwatersrand. For my masters I am doing research on the factors influencing early post-operative functional outcome in elderly patients with a hip fracture. Research is a way of finding an answer to a question. In this study, I want to learn what the early functional outcome is after a hip fracture and what factors would influence the outcome. This study is not routine for all patients who come to the hospital.

Invitation to participate:

I am inviting you to be a part of this research study.

What is involved in the study:

If you agree to participate, I will come interview you before your operation for an initial assessment. This assessment will comprise of two interviews that you will need to partake in and it should take approximately 20 minutes. The questions will be directed at your function before the fracture (when you broke your hip) and your memory. This assessment will not require you to do any activities that may cause you any sort of pain or discomfort. A caregiver known to you will be contacted to confirm answers that you might be unsure about.

You will still receive the usual care that the hospital offers; this will include physiotherapy treatment by the ward physiotherapist. Your second assessment will be conducted once your operation has been performed and you are receiving rehabilitation. This assessment will be done in the physiotherapy gym at the hospital. I will bring you down to the gym. This assessment will consist of a few basic activities that you will have to perform, for example;

standing up from a chair and walking. If there are any activities that you are unable to do, you will not be forced to do them. You will also be interviewed again by myself. The questions are to help me identify what activities you find difficult to perform since injuring your leg and to assess your memory. The entire assessment should take approximately 40 minutes. After this assessment you will be able to return home.

Six weeks after leaving the hospital, you will be required to return to the hospital for your routine check-up with the orthopaedic doctors, during this visit I will conduct the third and final assessment. This assessment will be exactly the same as the second one that was done the day you were leaving the hospital.

Risks:

There are no risks involved in participating in this study. During your assessments I will be there to provide you with additional support to prevent falling.

Benefits:

There are no benefits of being in the research study. By participating in this study you will help future therapists and health care professionals to improve the way in which they care for persons with hip fractures.

Alternative:

If you chose to not be a part of this research study you will receive the usual treatment. You will not lose the benefits you are otherwise entitled to as a result of the refusal, you will not be penalised for refusal. Participation in this study is completely voluntary and you may withdraw at point during the study without having to explain yourself.

Reimbursements:

For your third and final assessment, if you do not have a scheduled appointment with the doctors and come to the hospital solely for the research study, I will give you R40 for your travel costs on your arrival for the assessment.

Confidentiality:

Efforts will be made to keep all personal information confidential. Your name will not be mentioned in any of the data, a participant code will be allocated to you to maintain anonymity.

Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law. Organisations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the Research Ethics Committee.

Contact details or researcher:

If you would like to contact me at any time, you can reach me on 011 489 0336 or 082 947 4268.

Contact details of REC administrator and chair:

If you have any complaints that you would like to report, you can contact Prof Cleaton-Jones (Chairman of the Research Ethics Committee) on 011 717 1234

Thank you,

Miss Saadiya Adam

011 489 0336

082 947 4268

Appendix I

Informed Consent

I, the patient, have been fully informed of what the study entails and what will be required of me. I have read the information sheet and any questions that I had concerning the study have been answered to my satisfaction. I understand that my participation is voluntary and that my personal information will remain confidential. By signing this document, I give consent to participate in this study.

Name of patient: ____

Signature of patient: ______________________________________

Date: _____________________

Appendix J

Consent Form: Use of clinical information

Dear Patient

As part of the treatment you receive at Helen Joseph Hospital/Charlotte Maxeke Johannesburg Academic Hospital, as well as your participation in this research study, information will need to be extracted from your records. The use of such information is subject to:

1. Approval from the Human Research Ethics Committee of the University of Witwatersrand.
2. Anonymity ie: the identity of the patient whose file information is extracted is never revealed to anyone but the researcher.

I would like to obtain your consent to use information from your file for the purpose of research. If you choose to not give consent, this will not compromise your treatment in any way.

Should you wish to contact the researcher at any stage regarding this consent, contact Saadiya Adam at Helen Joseph hospital at 011 489 0336 or 082 947 4268

I, ____ hereby give consent for my records to be used as per the above mentioned conditions for the purposes of research:

Signature

____

Date:

____

Appendix K

Participant Details Form

Name	
Surname	
Date of Birth	
Hospital number	
Patient code	
Contact number 1	
Contact number 2	
Area of residence	
Name of caregiver	
Caregiver relationship	

Appendix L

Ethical clearance certificate

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

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Miss Saadiya Adam

CLEARANCE CERTIFICATE	**M110403**
PROJECT	Early Post-Operative Functional Outcome in Elderly Patients with a Hip Fracture
INVESTIGATORS	Miss Saadiya Adam.
DEPARTMENT	Department of Physiotherapy
DATE CONSIDERED	06/05/2011
DECISION OF THE COMMITTEE*	Approved unconditionally
	06/05/2011

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

DATE 06/05/2011 **CHAIRPERSON** ....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Mr L Godlwana

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 M

Frequencies and percentages of the total CIRS-G score (n=72)

CIRS-G (Total scores)	n (%)
1	**1** (1.4%)
3	**2** (2.8%)
4	**3** (4.2%)
5	**6** (8.3%)
6	**7** (9.7%)
7	**8** (11%)
8	**5** (6.9%)
9	**7** (9.7%)
10	**11** (15.3%)
11	**3** (4.2%)
12	**7** (9.7%)
13	**1** (1.4%)
14	**3** (4.2%)
15	**2** (2.8%)
16	**1** (1.4%)
17	**2** (2.8%)
18	**1** (1.4%)
19	**1** (1.4%)
22	**1** (1.4%)
Mean (±SD)	**9.32 (SD ± 4.07)**
Median (IQR)	**9 (6)**

Appendix N

Multiple regression analyses outputs

Multiple regression analysis of discharge cognitive function and early post operative function

Discharge										
Model Specification		**Regression Results**						**Model Fit**		
Dependent Variable	**Independent Variable**	**Regression Coefficient**	**95% Confidence Interval for B**		**Standardized Regression Coefficient**			**Regression ANOVA Results**		
		β	**Lower Bound**	**Upper Bound**	**β**	**t-statistic**	**p-value**	**F-Statistic**	**p-value**	**Adj R-Sqr**
Elderly Mobility Scale	6CIT	-0.370	-0.479	-0.260	-0.626	-6.719	0.000	45.141	0.000	0.383
Lower Extremity Functional Scale	6CIT	-0.680	-0.911	-0.449	-0.575	-5.880	0.000	34.574	0.000	0.321

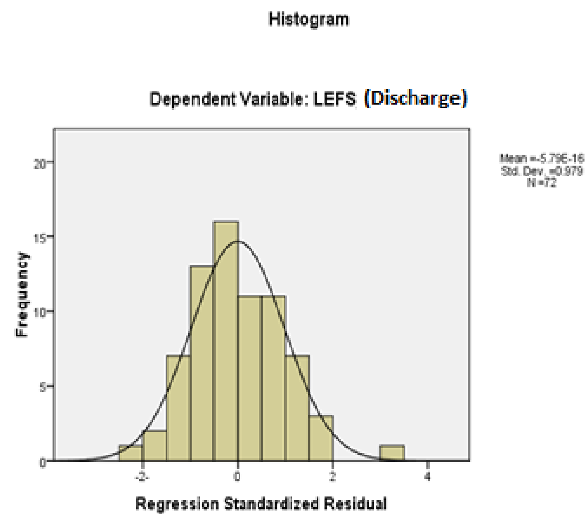
Multiple regression analysis of six weeks post discharge cognitive function and early post operative function

Six weeks post discharge										
Model Specification		**Regression Results**						**Model Fit**		
Dependent Variable	**Independent Variable**	**Regression Coefficient**	**95% Confidence Interval for B**		**Standardized Regression Coefficient**			**Regression ANOVA Results**		
		β	**Lower Bound**	**Upper Bound**	**β**	**t-statistic**	**p-value**	**F-Statistic**	**p-value**	**Adj R-Sqr**
Elderly Mobility Scale	6CIT	-0.490	-0.596	-0.384	-0.740	-9.217	0.000	84.961	0.000	0.542
Lower Extremity Functional Scale	6CIT	-1.022	-1.312	-0.732	-0.643	-7.032	0.000	49.452	0.000	0.406

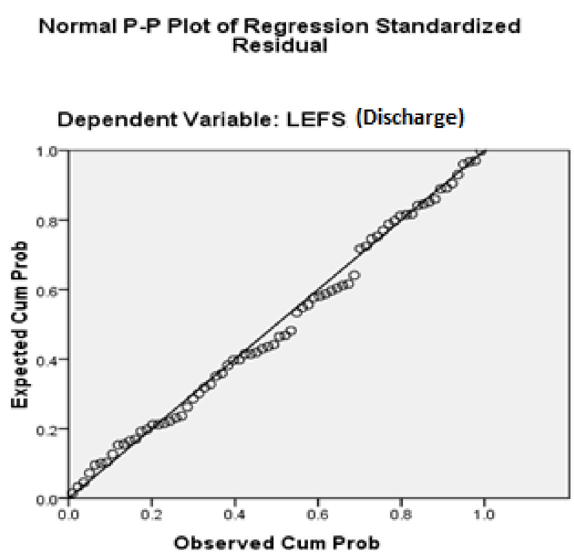
Appendix O

Multiple regression analyses graphs

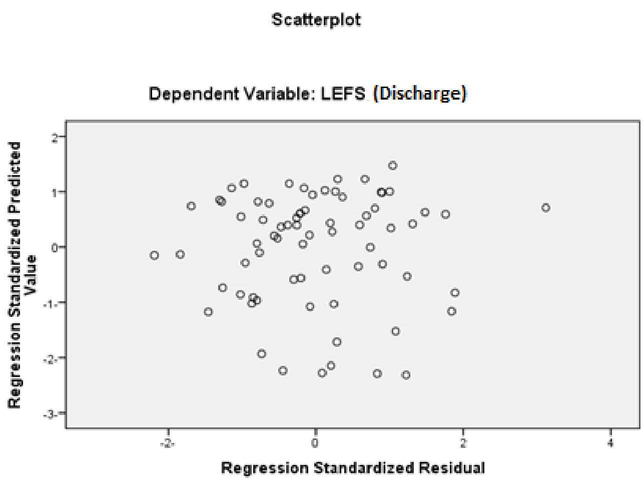
Multiple regression analysis histogram using LEFS at discharge



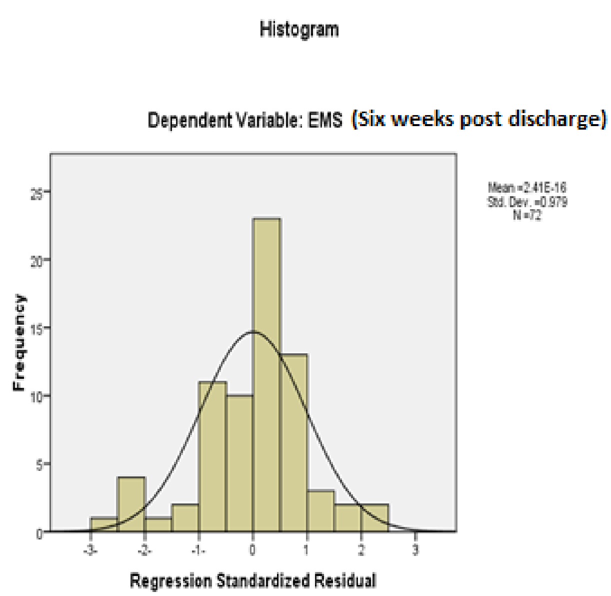
Multiple regression analysis P-P Plot using LEFS at discharge



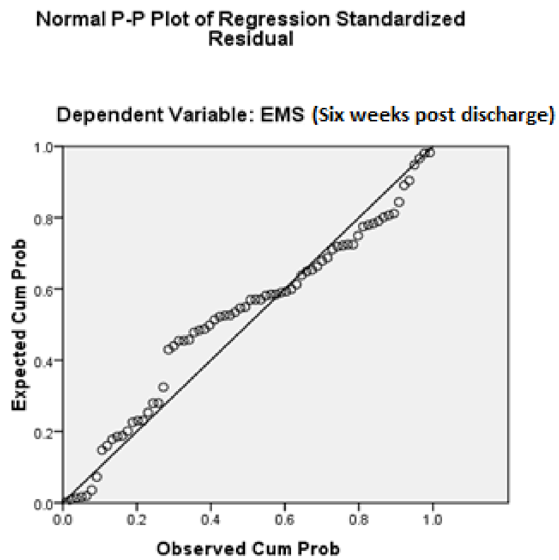
Multiple regression analysis scatterplot using LEFS at discharge



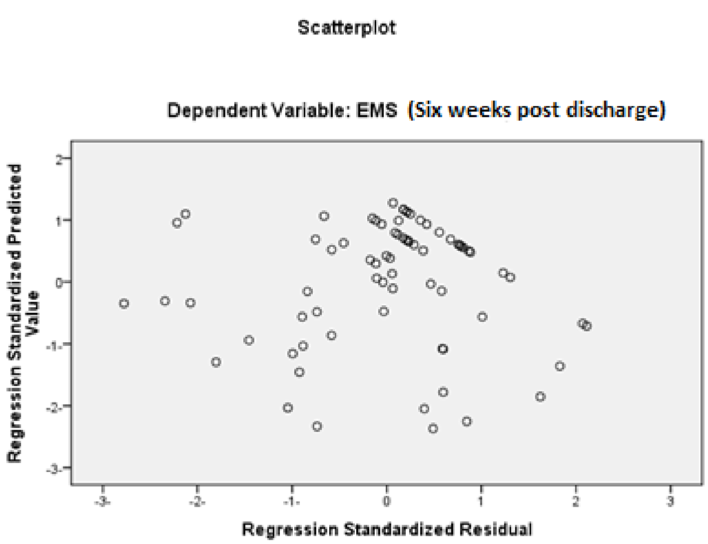
Multiple regression analysis histogram using EMS at six weeks post discharge



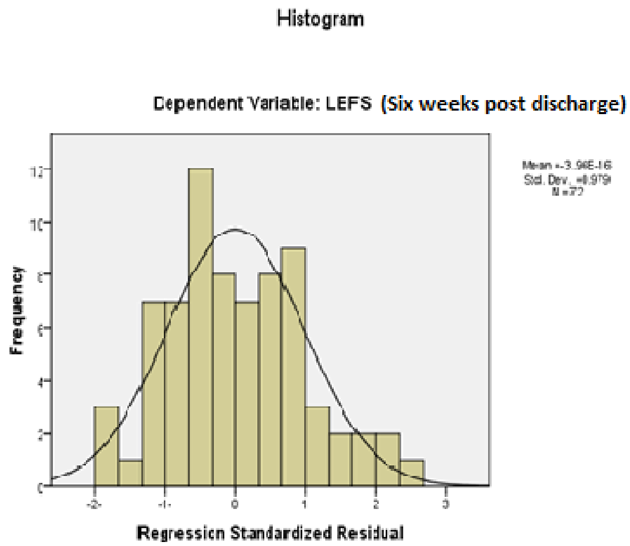
Multiple regression analysis P-P Plot using EMS at six weeks post discharge



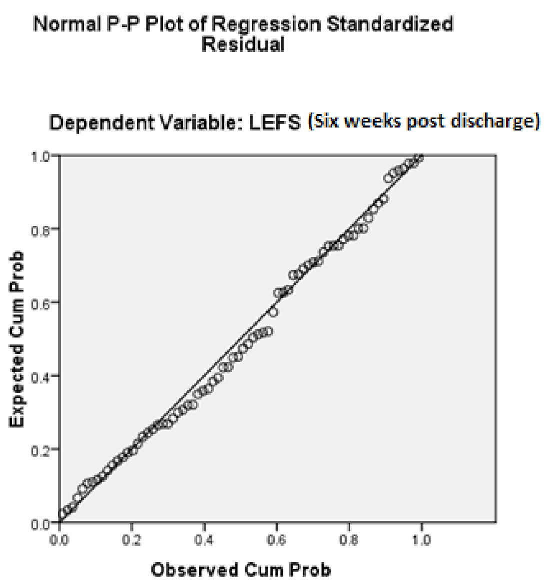
Multiple regression analysis scatterplot using EMS at six weeks post discharge



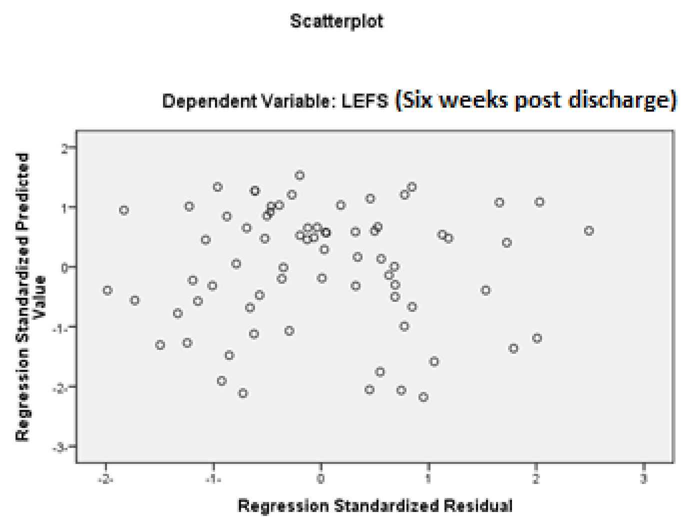
Multiple regression analysis histogram using LEFS at six weeks post discharge



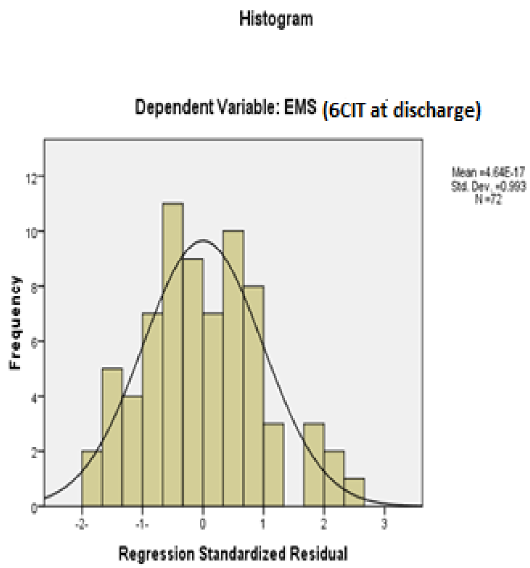
Multiple regression analysis P-P Plot using LEFS at six weeks post discharge

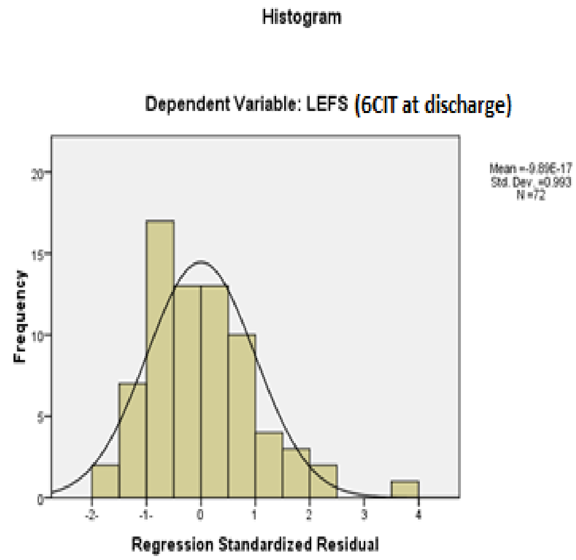


Multiple regression analysis scatterplot using LEFS at six weeks post discharge

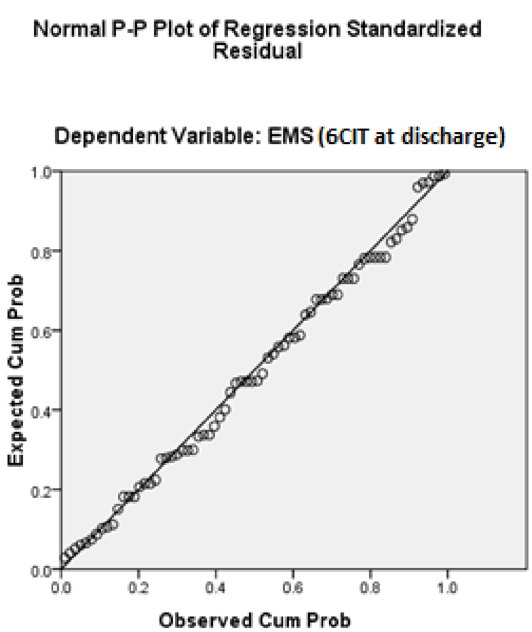


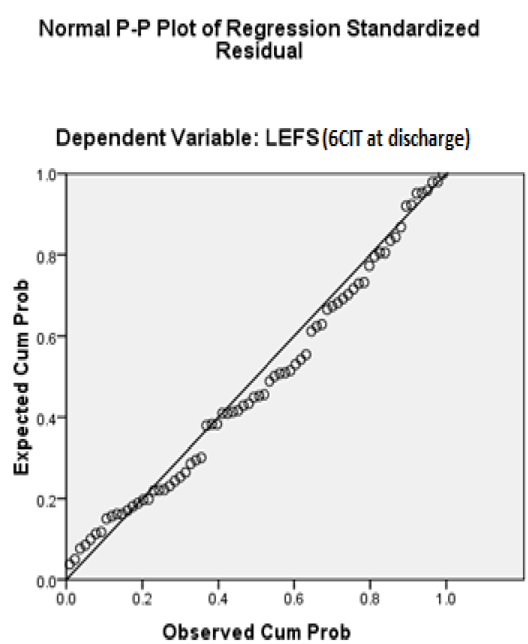
Multiple regression analysis histogram - 6CIT on post operative functional outcome at discharge



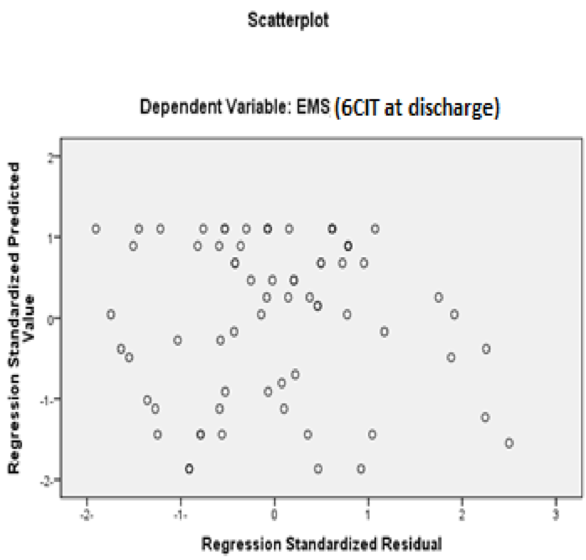


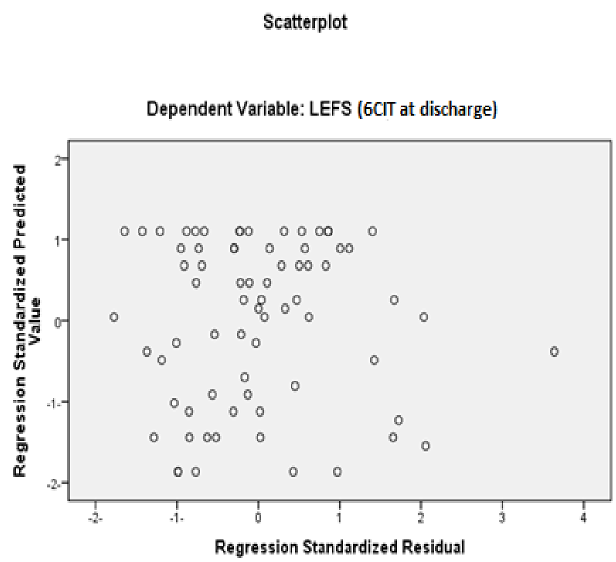
Multiple regression analysis P-P Plot - 6CIT on post operative functional outcome at discharge



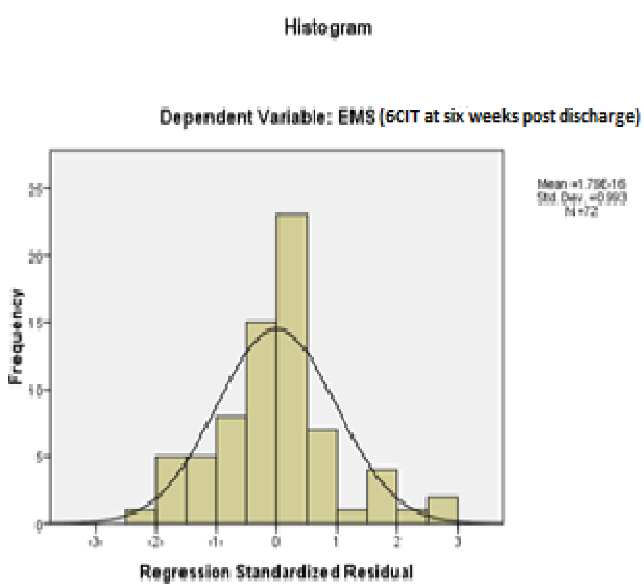


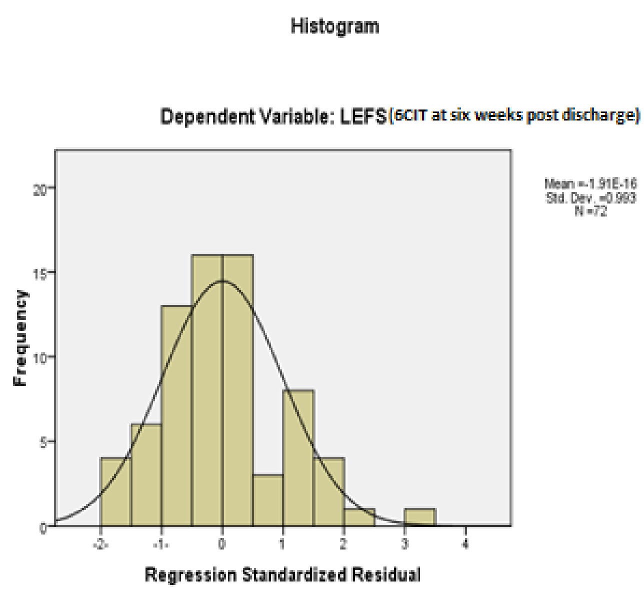
Multiple regression analysis scatterplot - 6CIT on post operative functional outcome at discharge



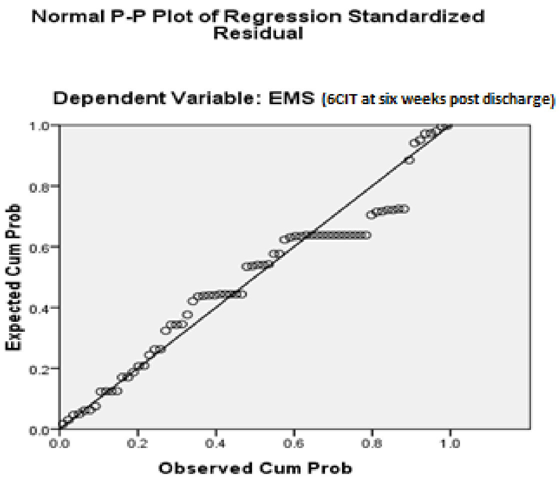


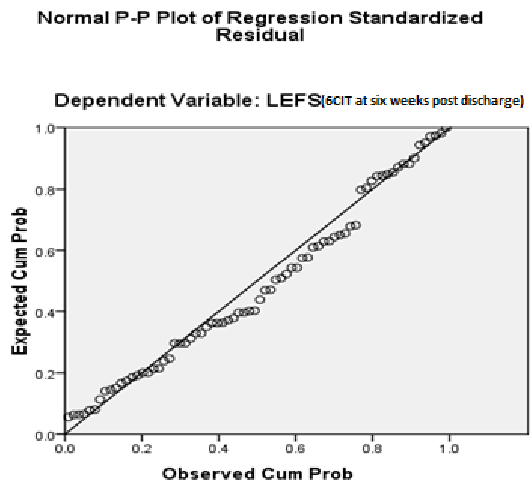
Multiple regression analysis histogram - 6CIT on post operative functional outcome at six weeks post discharge



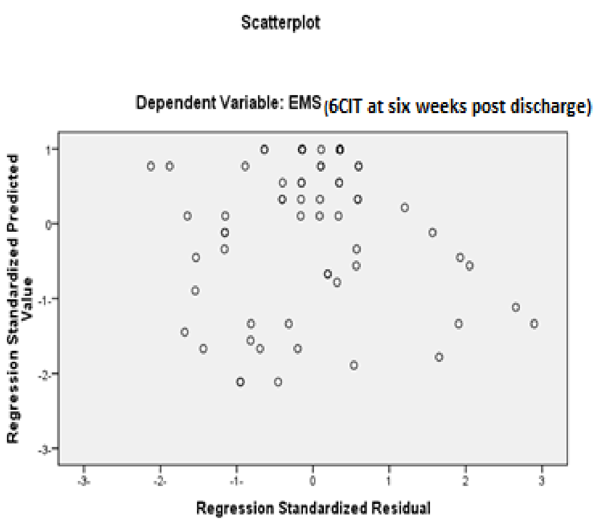


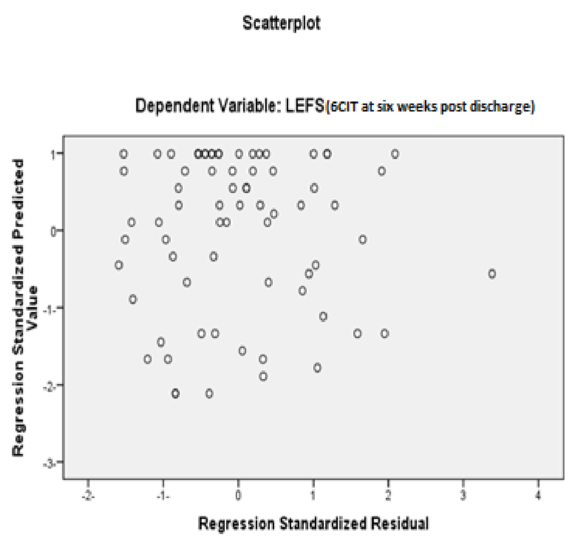
Multiple regression analysis P-P Plot - 6CIT on post operative functional outcome at six weeks post discharge





Multiple regression analysis scatterplot - 6CIT on post operative functional outcome at six weeks post discharge





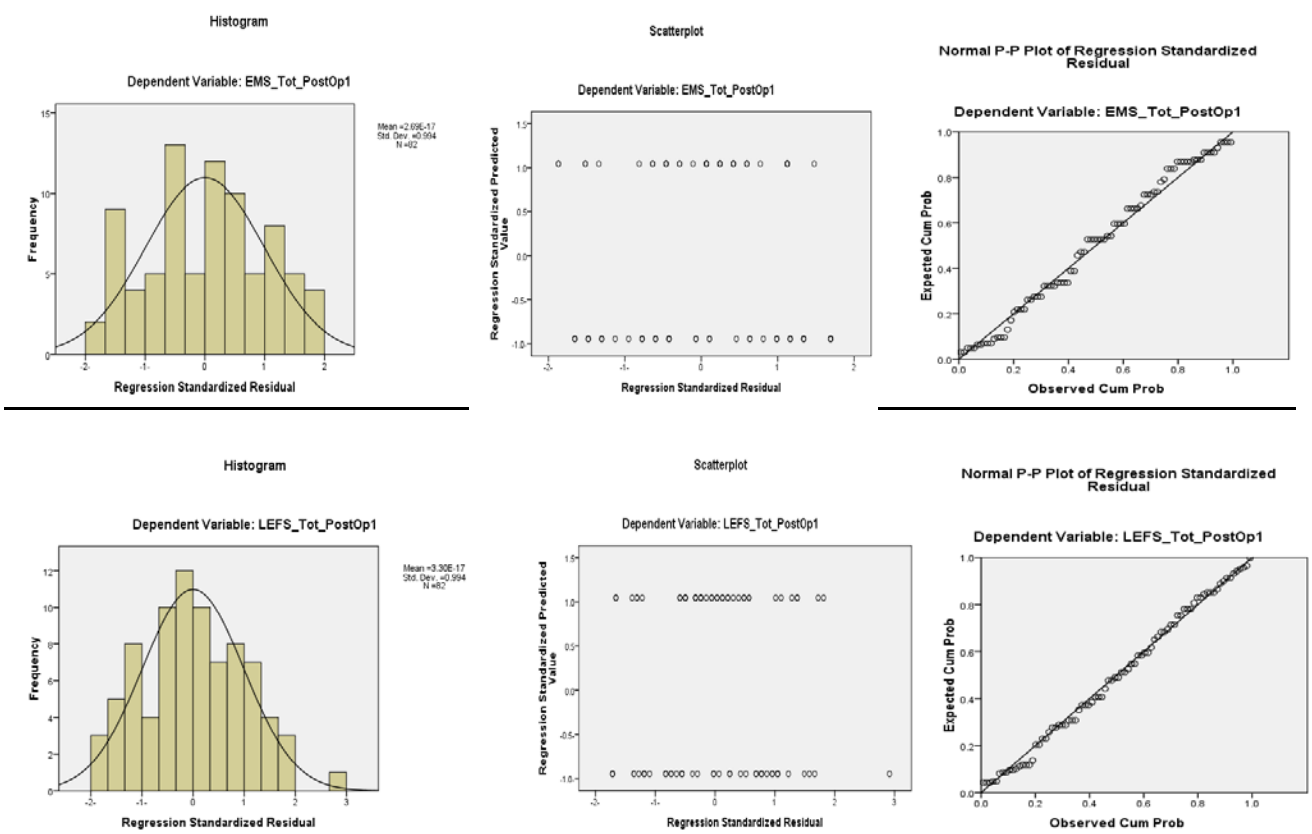
Appendix P

Multiple regression analyses of demographic information

1. Fracture type

Multiple regression results of fracture type on post-operative functional outcome at discharge

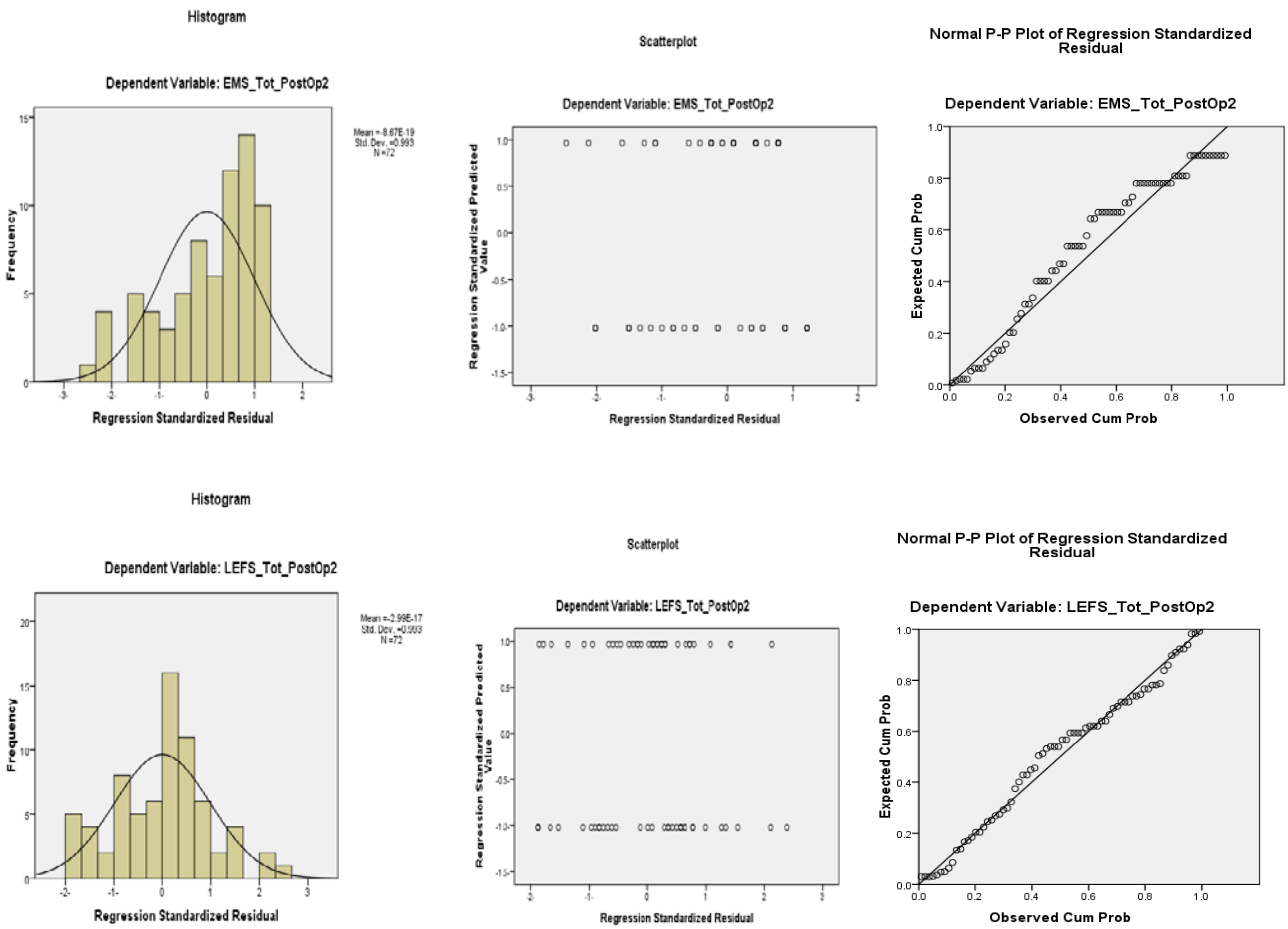
Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	Intertrochanteric	10.4	8.67	12.1		12	0.000	0.945	0.3	-0.001
	Neck of femur	1.2	-1.3	3.7	0.1	0.9	0.334			
Lower Extremity Functional Scale	Intertrochanteric	19.3	15.9	22.7		11.3	0.000	0.301	0.6	-0.009
	Neck of femur	1.4	-3.6	6.3	0.06	0.5	0.585			



Multiple regression graphs of fracture type on post-operative outcome (EMS and LEFS) at discharge

Multiple regression results of fracture type on post-operative functional outcome at six weeks post discharge

Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	Intertrochanteric	12.9	10.9	14.8		12.9	0.000	3.5	0.064	0.034
	Neck of femur	2.6	-0.1	5.4	0.2	1.9	0.064			
Lower Extremity Functional Scale	Intertrochanteric	26.9	22	31.7		11.1	0.000	1.2	0.272	0.003
	Neck of femur	3.7	-2.9	10.5	0.1	1.1	0.272			

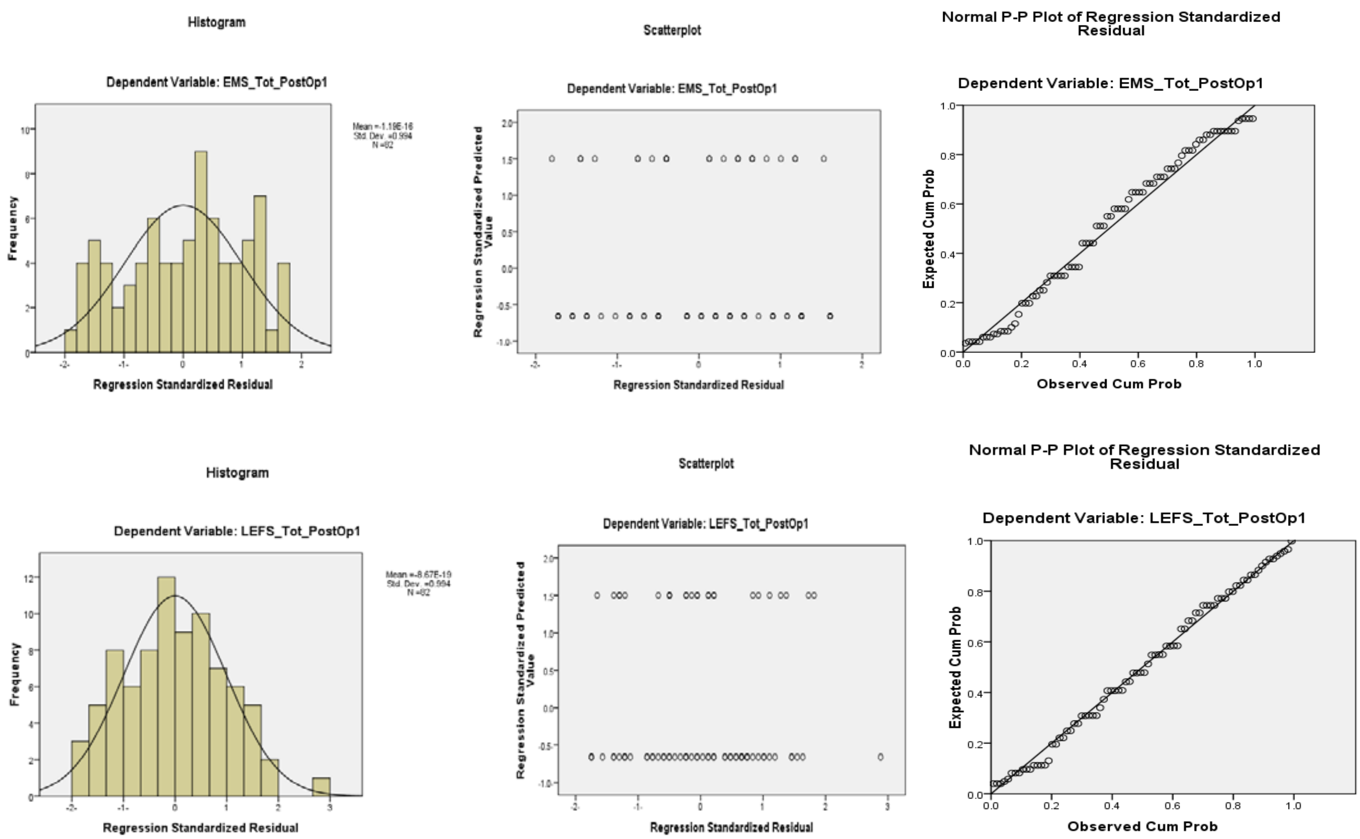


Multiple regression graphs of fracture type on post-operative outcome (EMS and LEFS) at six weeks post discharge

2. Number of days lapsed between admission and surgery

Multiple regression results of number of days between admission and surgery on post-operative functional outcome at discharge

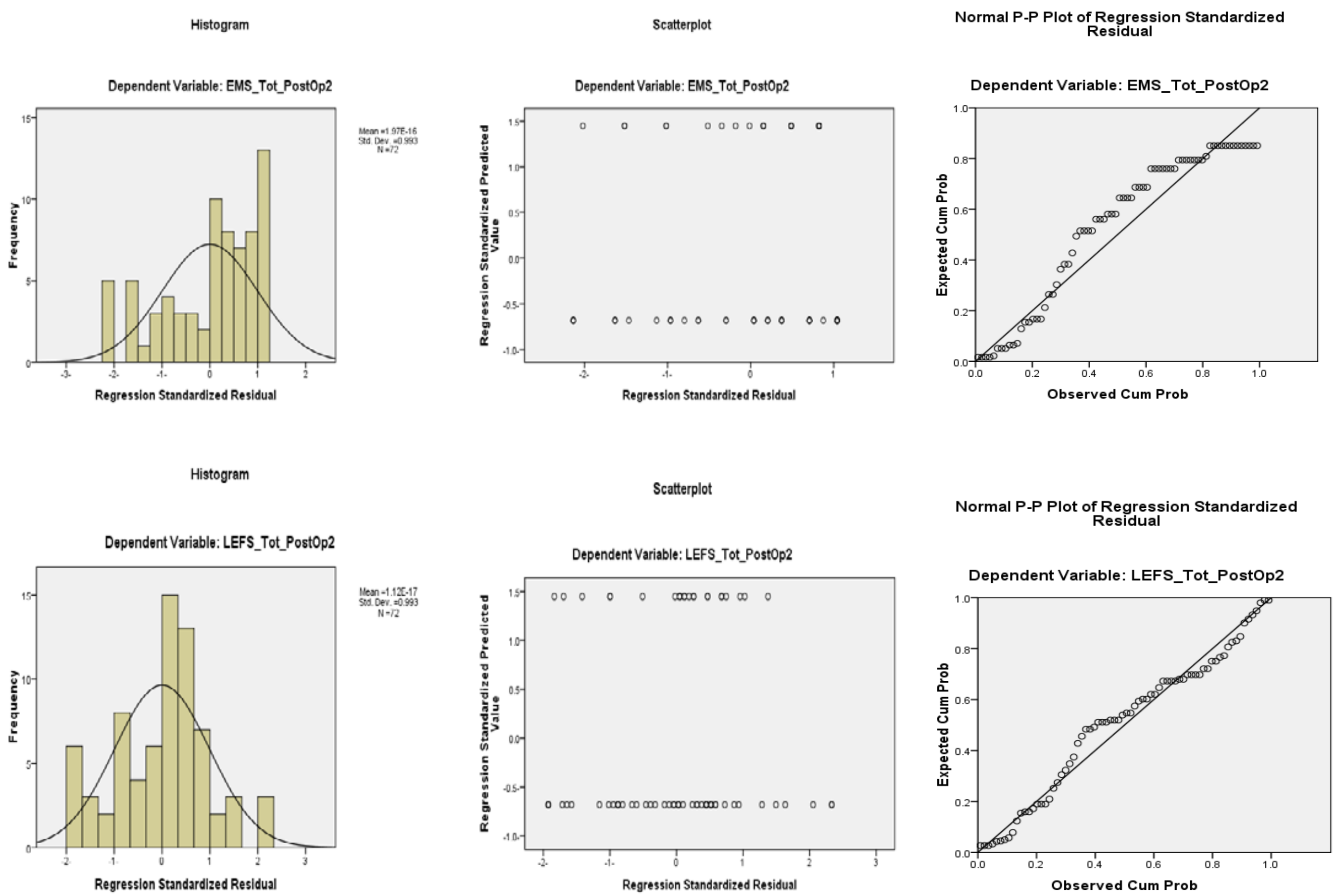
Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	Less than 7 Days	10.8	9.3	12.3		14.3	0.000	0.102	0.750	-0.011
	7 or more Days	0.4	-2.3	3.2	0.036	0.3	0.750			
Lower Extremity Functional Scale	Less than 7 Days	19.6	16.7	22.6		13.2	0.000	0.129	0.720	-0.011
	7 or more Days	0.9	-4.4	6.3	0.040	0.4	0.720			



Multiple regression graphs of number of days between admission and surgery on post-operative functional outcome (EMS and LEFS) at discharge

Multiple regression results of number of days between admission and surgery on post-operative functional outcome at six weeks post discharge

Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	Less than 7 Days	13.8	12.1	15.5		16.1	0.000	0.752	0.389	-0.004
	7 or more Days	1.3	-1.7	4.3	0.103	0.9	0.389			
Lower Extremity Functional Scale	Less than 7 Days	27.6	23.5	31.7		13.5	0.000	1.050	0.309	0.001
	7 or more Days	3.7	-3.5	10.9	0.122	1	0.309			

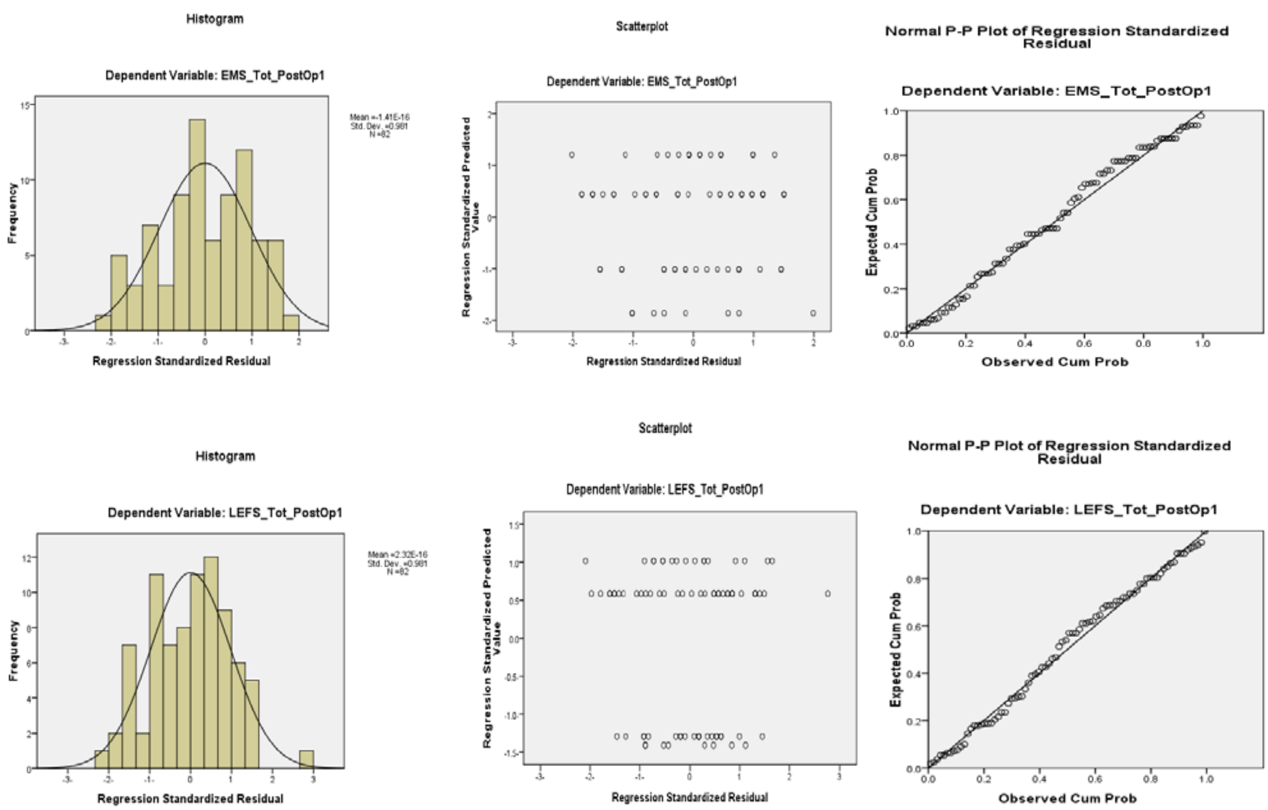


Multiple regression graphs of number of days between admission and surgery on post-operative functional outcome (EMS and LEFS) at six weeks post discharge

3. Type of surgical procedure performed

Multiple regression results of the type of surgery performed on post-operative functional outcome at discharge

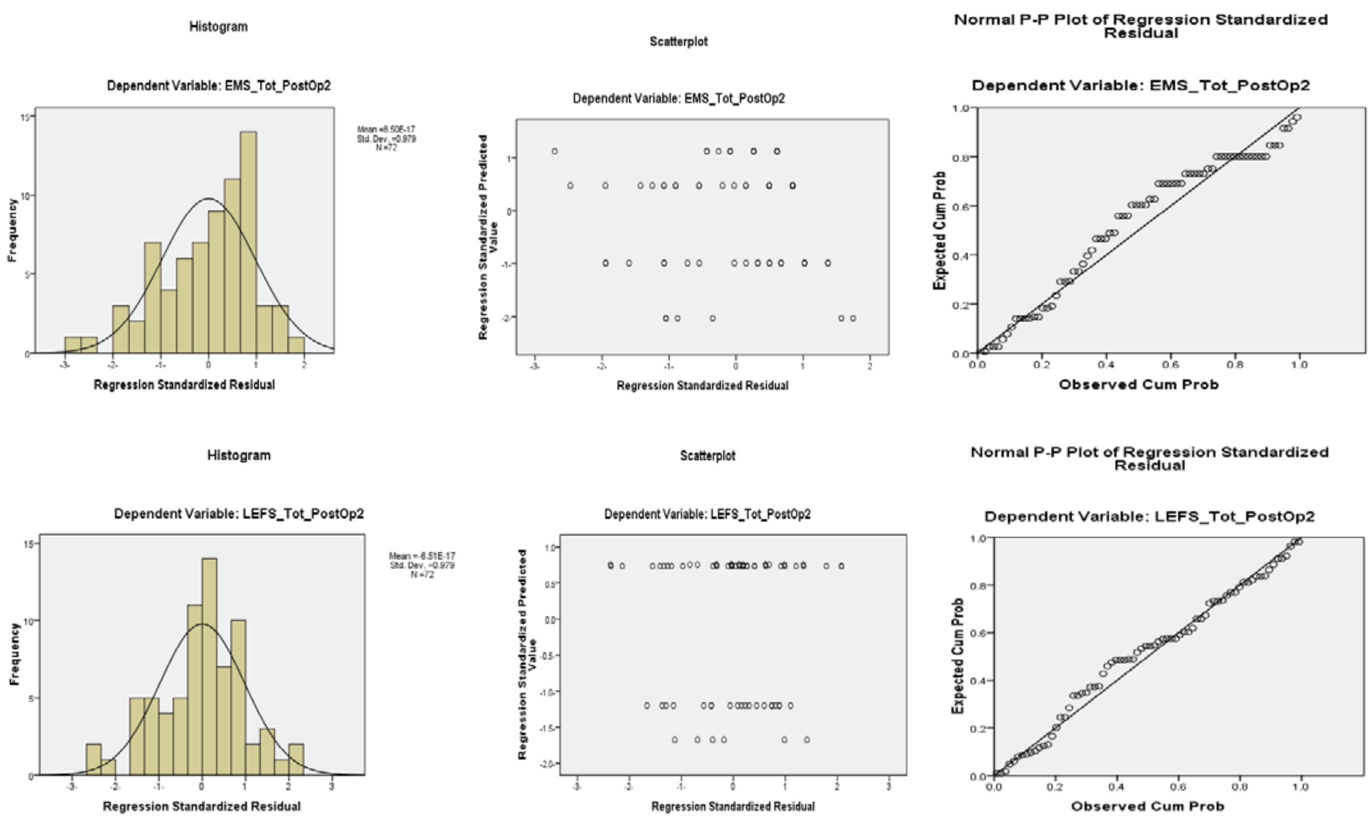
Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	ORIF	8.8	4.8	12.7		4.4	0.000	1.205	0.314	0.008
	PFNA	2.7	-1.6	7.1	0.2	1.2	0.217			
	THR	3.6	-1.2	8.4	0.3	1.5	0.135			
	HA	1.	-3.7	5.7	0.1	0.4	0.668			
Lower Extremity Functional Scale	ORIF	15.8	8	23.5		4.1	0.000	1.969	0.126	0.035
	PFNA	5.9	-2.6	14.5	0.3	1.4	0.172			
	THR	7.2	-2.2	16.6	0.3	1.5	0.130			
	HA	0.3	-8.7	9.4	0.01	0.08	0.940			



Multiple regression graphs of the type of surgery performed on post-operative functional outcome (EMS and LEFS) at discharge

Multiple regression results of the type of surgery performed on post-operative functional outcome at six weeks post discharge

Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	ORIF	10	5.3	14.7		4.3	0.000	3.074	0.033	0.081
	PFNA	5.2	0.05	10.3	0.4	2	0.048			
	THR	6.5	1.03	11.9	0.4	2.4	0.021			
	HA	2.2	-3.2	7.5	0.2	0.8	0.423			
Lower Extremity Functional Scale	ORIF	20.5	9.3	31.7		3.6	0.001	3.045	0.035	0.080
	PFNA	11.9	-0.4	24.2	0.4	1.9	0.057			
	THR	12	-1.1	25.1	0.3	1.8	0.073			
	HA	2.4	-10.4	15.1	0.07	0.4	0.715			

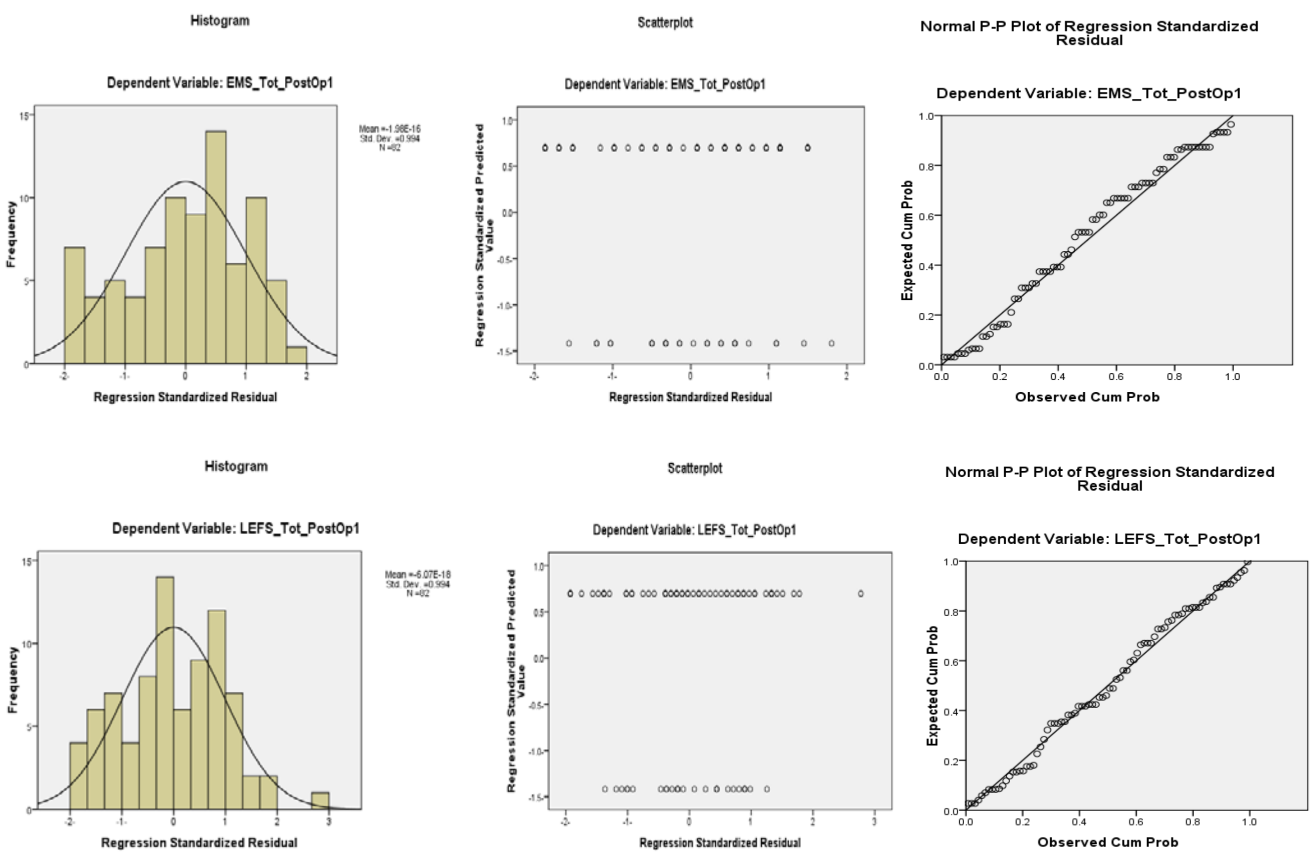


Multiple regression results of the type of surgery performed on post-operative functional outcome (EMS and LEFS) at six weeks post discharge

4. Number of post-operative physiotherapy sessions received

Multiple regression results of the number of post-operative physiotherapy sessions received on post-operative functional outcome at discharge

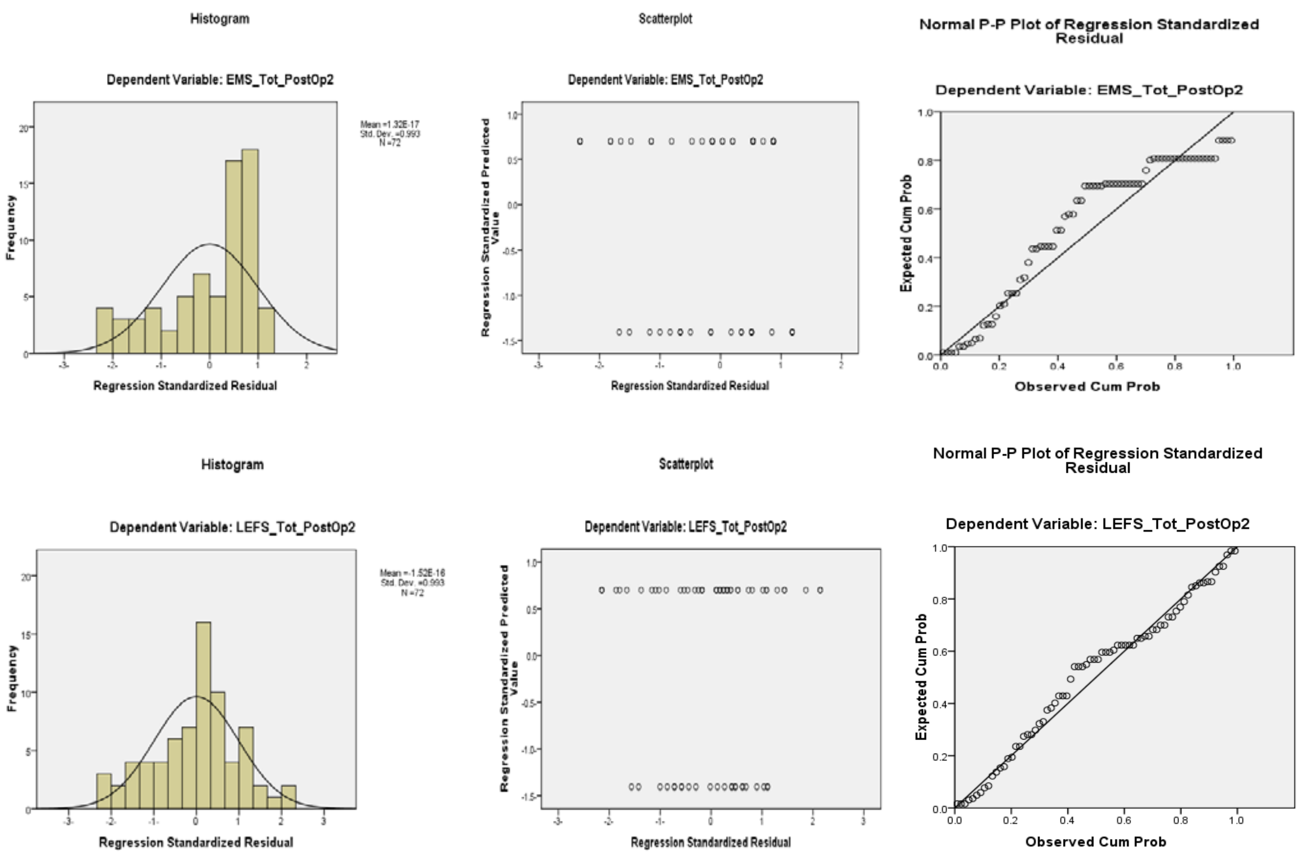
Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	Less than 7 Days	11.5	10	13.1		15.2	0.000	1.699	0.196	0.009
	7 or more Days	-1.7	-4.4	0.9	-0.14	-1.3	0.196			
Lower Extremity Functiona l Scale	Less than 7 Days	21.3	18.3	24.3		14.3	0.000	2.609	0.110	0.019
	7 or more Days	-4.2	-9.4	0.9	-0.18	-1.6	0.110			



Multiple regression graphs of the number of post-operative physiotherapy sessions received on post-operative functional outcome (EMS and LEFS) at discharge

<u>Multiple regression results of the number of post-operative physiotherapy sessions received on post-operative functional outcome at six weeks post discharge</u>

Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	Less than 7 Days	14.8	13.1	16.5		17.2	0.000	1.554	0.217	0.008
	7 or more Days	-1.8	-4.8	1.1	-0.147	-1.2	0.217			
Lower Extremity Functional Scale	Less than 7 Days	30.5	26.4	34.6		14.7	0.000	2.216	0.141	0.017
	7 or more Days	-5.3	-12.4	1.8	-0.175	-1.5	0.141			

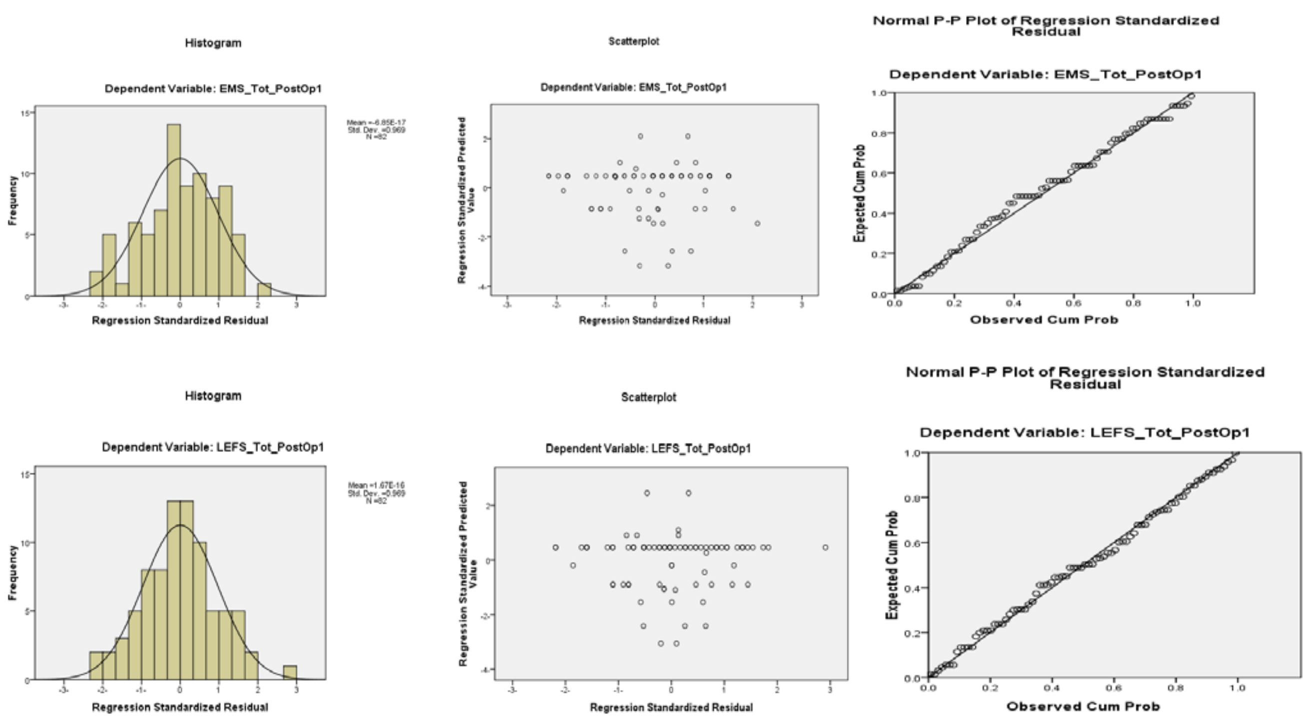


<u>Multiple regression graphs of the number of post-operative physiotherapy sessions received on post-operative functional outcome (EMS and LEFS) at six weeks post discharge</u>

5. Complications developed during the course of the study

Multiple regression results of the number of complications developed on post-operative functional outcome at discharge

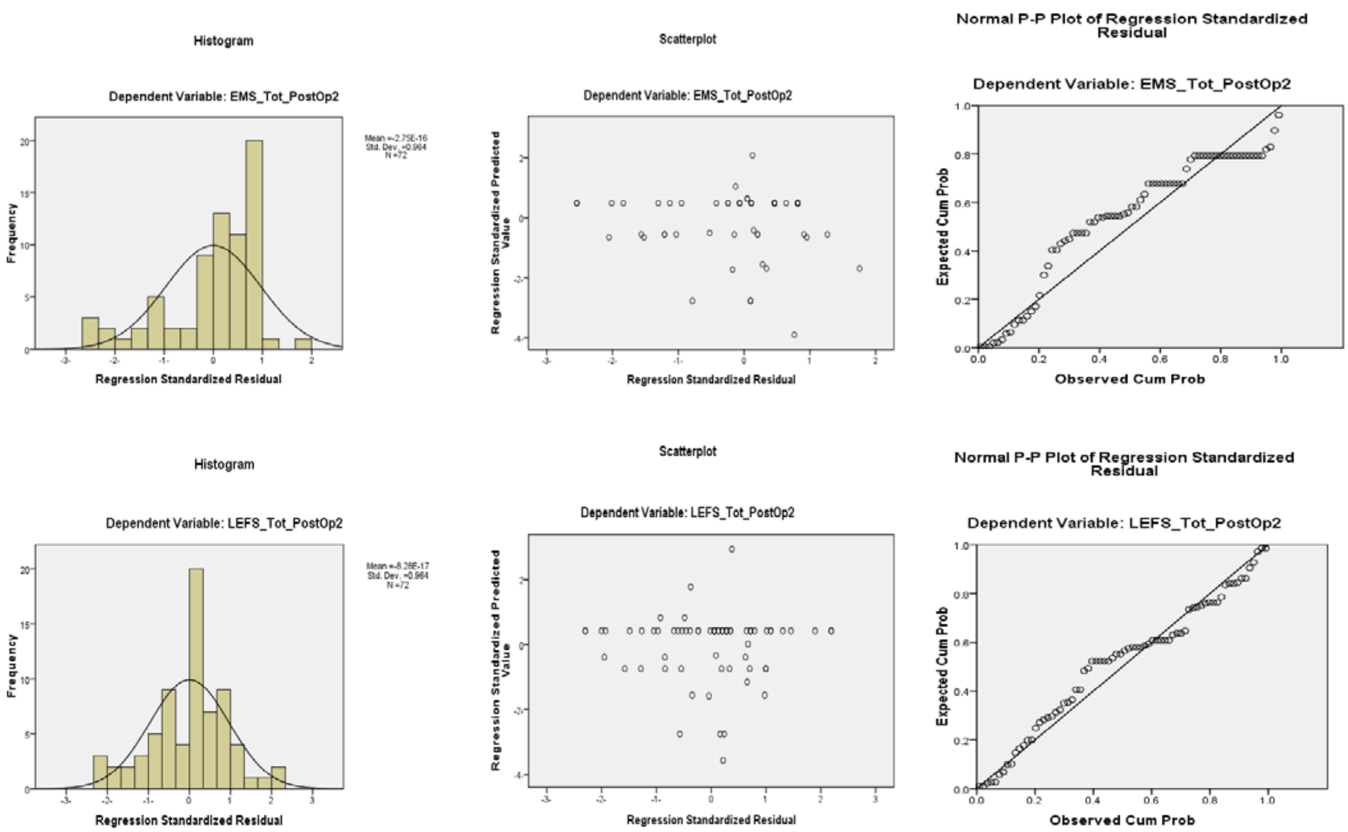
Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	Neuro	12.2	10.8	13.6	NA	17.3	0.000	4.212	0.002	0.165
	Vascular	-1.5	-5.1	1.9	-0.1	-0.9	0.383			
	Cognitive	-3.5	-6.3	-0.6	-0.3	-2.4	0.017			
	Surgical error	4.3	-1.8	10.4	0.1	1.4	0.166			
	Gastro	1.5	-2.9	5.9	0.1	0.7	0.512			
	Pulmonary	-4.5	-8.9	-0.2	-0.2	-2.1	0.041			
Lower Extremity Functional Scale	Neuro	22.3	19.5	25.1	NA	16.1	0.000	4.217	0.002	0.166
	Vascular	-3.4	-10.3	3.6	-0.1	-0.9	0.338			
	Cognitive	-7	-12.6	-1.4	-0.3	-2.5	0.014			
	Surgical error	10.4	-1.7	22.4	0.2	1.7	0.091			
	Gastro	2.3	-6.5	11.1	0.1	0.5	0.600			
	Pulmonary	-7.9	-16.5	0.7	-0.2	-1.8	0.071			



Multiple regression graphs of the number of complications developed on post-operative functional outcome (EMS and LEFS) at discharge

Multiple regression results of the number of complications developed on post-operative functional outcome at six weeks post discharge

Model Specification		Regression Results						Model Fit		
Dependent Variable	Independent Variables	Regression Coefficient	95% Confidence Interval for B		Standardized Regression Coefficient			Regression ANOVA Results		
		B	Lower Bound	Upper Bound	Beta	t-statistic	p-value	F-Statistic	p-value	Adj R-Sqr
Elderly Mobility Scale	Neuro	15.4	13.8	16.9	NA	19.2	0.000	2.636	0.031	0.166
	Vascular	-2.8	-7.3	1.7	-0.2	-1.2	0.220			
	Cognitive	-2.5	-5.9	0.8	-0.2	-1.5	0.138			
	Surgical error	3.9	-4.3	12.1	0.1	0.9	0.347			
	Gastro	0.3	-5.1	5.8	0.01	0.1	0.900			
	Pulmonary	-5.4	-11.1	0.3	-0.2	-1.9	0.061			
Lower Extremity Functional Scale	Neuro	31.2	27.4	35.1		16.2	0.000	2.598	0.033	0.101
	Vascular	-4.7	-15.5	6	-0.1	-0.9	0.382			
	Cognitive	-6.8	-14.9	1.3	-0.2	-1.7	0.101			
	Surgical error	14.6	-5.1	34.4	0.2	1.5	0.143			
	Gastro	2.4	-10.8	15.5	0.04	0.4	0.720			
	Pulmonary	-11.7	-25.2	1.9	-0.2	-1.7	0.091			



Multiple regression graphs of the number of complications developed on post-operative functional outcome (EMS and LEFS) at six weeks post discharge