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ARM AND LEG MOTOR IMPAIRMENT AFTER STROKE REHABILITATION: RELATION TO PARTICIPATION RESTRICTION IN THE TAMALE METROPOLITAN AREA

BY

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DECLARATION

I hereby declare that I have undertaken the study reported herein under the supervision of Dr. Joslin A. Dogbe. I have duly acknowledged all sources of information and I am personally responsible for any omissions or short comings.

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I declare that I have supervised the student in undertaking the study and I confirm that he has my permission to submit it for assessment.

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DEDICATION

This work is dedicated to my sister Ernestina Boateng for her unyielding support.

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ABSTRACT

Background: Residual arm and leg motor impairment persist in post-stroke patients despite rehabilitation. This motor impairment is further translated to participation restriction which impacts negatively on affected individuals' quality of life.

Objective: To examine the relationship between arm and leg motor impairment and participation restriction post rehabilitation in stroke survivors.

Methods: 102 post-stroke participants from the Tamale Metropolitan Area who had undergone at least 3 months of rehabilitation completed the study. Upper limb motor assessment was followed by lower limb motor assessment based on the Manual Muscle Test. Levels of participation restriction were measured using the London Handicap Scale. Correlation analyses of motor impairment and participation restriction were done using spearman rank correlation analysis.

Results: The mean age of post-stroke participants was 62.08 years (95% CI= 59.77-64.39) with men constituting 67.65% as against 32.35% by women**.** The spearman rank correlation coefficient between arm motor impairment and participation was 0.8343, depicting a strong positive relationship between the aforementioned variables. The correlation between leg motor impairment and participation yielded 0.8013. Leg motor impairment was discovered to have a stronger relationship with participation restriction compared to arm motor impairment.

Conclusion: The strong relationship between limb motor impairment and participation restriction suggests that clinicians and disability experts involved in rehabilitation should take cognizance of the social implication of motor impairment in order to make informed decisions.

Further to this, arm and leg assistive devices could be useful in reducing the levels of participation restriction in post-stroke patients within the Tamale Metropolis.

Keywords: Stroke, motor impairment, participation restriction, Tamale Metropolitan area.

LIST OF ACRONYMS

WHO World Health Organization

ADLS Activities of Daily Living

ICF International Classification of Functioning, Disability and Health

ULMS Upper Limb Motor Score

LLMS Lower Limb Motor Score

LHS London Handicap Scale

MMT Manual Muscle Test

CHAPTER ONE

1.0 INTRODUCTION

This chapter delves into the background of the study, problem statement, research questions, main and specific objectives, research hypotheses, justification of the study, delimitations as well as basic assumptions employed in the study. It is designed to serve as thorough introduction as well as highlight the importance and value of the research.

1.1 Background of the Study

Stroke is largely documented as a major cause of disability among stroke survivors and is one of the most frequent causes of difficulties in activities of daily living (ADLs) among older adults (Steineman et al, 1997). The World Health Organization (WHO, 2004) estimates that stroke, alongside heart disease will become the leading cause of death and disability worldwide, with the number of fatalities projected to increase to over 20 million a year and by 2030 to over 24 million a year. Over 60% of post-stroke patients require rehabilitation and close to half of all survivors never regain their functional independence (Ostir et al, 2002).

Majority of post-stroke survivors will have significant arm and leg impairments and disabilities that are likely to affect functional independence and contribute to participation restriction (Desrosiers et al, 2003). Up to 90% of stroke survivors have some form of neurologic deficits (Gresham et al, 1997), the most common of which is motor impairment contralateral to the stroke lesion side (Hankey et al, 2002). For post-stroke survivors with a paretic arm, Kwakkel et al (2003) reported a paltry 11.6% achieved complete arm recovery within 6 months. In many patients with severer forms of stroke, the affected upper limb (UL) hardly becomes useful, even after therapy (Nakayama et al, 1994).

Besides promoting physical recovery, a major task in post-stroke rehabilitation is to minimize psychosocial morbidity and to enhance the reintegration of stroke survivors into their families and communities (Chau et al, 2009). The WHO (2008) framework of Functioning, Disability and Health (ICF) reaffirms the importance of persons with disabilities (PWDs) participating in society. This often embodies social integration, potential to return to work and subsequent work performance (Chau et al, 2009).

The Tamale Metropolis is one of the 26 districts of the Northern region of Ghana and serves as the capital of the region. The Metropolis is centrally located within the region and has a total land area of 646.90sqkm with a population of 233,252 per the 2010 Population and Housing Census (GSS, 2014). The Census further reported 63.3% of the population aged 15 years and older in the metropolis are economically active with majority (33%) engaged as service and sales persons. The second largest occupation is craft and related trade workers who constitute 21.5% of the employed population.

Stroke rehabilitation in the metropolis begins with medical management in the various public and private hospitals within the metropolis including the leading referral hospital, Tamale Teaching Hospital (TTH). Patients are then referred to the physiotherapy department of the TTH to start physical rehabilitation on an out-patient basis. TTH additionally offers psychological rehabilitation through clinical psychologists for patients who require that service. Various nongovernmental organizations play a role in the rehabilitation process by providing a number of assistive devices for post-stroke patients.

The measurement of participation in society represents a more objective view of recovery that is important in estimating recovery itself (Wade & de Jong, 2000) and provides a broader picture of disability.

1.2 Problem Statement

The burden of stroke is enormous from the human (affected person), family and societal perspectives. Global reports on the incidence of stroke suggest close to 16 million first time strokes occur worldwide, with a subsequent total of over 5.7 million deaths (Strong et al, 2007). Over 85% of all strokes related deaths are on record to have occurred in low and middle income countries. Further to this, these same countries account for 87% of total losses due to stroke with reference to disability-adjusted life years (DALYs) (Lopez et al, 2006).

An international comparison of stroke related cost studies showed that an average of 0.27% of gross domestic product (GDP) was spent on stroke by individual national health systems, and the cost of stroke related care accounted for almost 3% of total health care expenditures (Evers et al, 2004).

Kengne and Anderson, (2006) reported that despite the lack of thorough research, accessible hospital-based data and community surveys are indicative of a higher and increasing incidence of stroke among younger adults in sub-Saharan Africa compared to developed countries. Further to this, awareness, diagnosis, treatment and management of stroke in these same countries are substandard, and the subsequent case fatality and related disabilities are high. The aforementioned problems are further compounded by the lack of attention to these trends. Stroke and its related issues are considerably overshadowed by the impact of human immunodeficiency virus (HIV) and other infectious diseases in Sub-Saharan Africa (Bradshaw et al, 2002).

A 2003 data on in-patient causes of death in 32 sentinel hospitals in the 10 regions of Ghana revealed stroke as the fourth leading in-patient cause of death in the 10 regions of Ghana (deGraft, 2007). Wiredu and Nyame, (2001) reported that mortality from stroke constituted 11% of autopsies carried out at the Korle Bu Teaching Hospital, Accra, Ghana in the five-year period 1994 to 1998. The Komfo Anokye Teaching Hospital in Kumasi reported 1054 stroke cases between January 2006 and December 2007 with a mortality rate of 43.4% (Agyemang et al, 2012).

For stroke survivors, the need for assistance in executing activities of daily living does not only affect their quality of life but those of relatives who assume the role of caregivers at home and the community level. Thus otherwise economically active family members are forced to put their jobs on hold to assist survivors at home as well as commute them to and from rehabilitation centres, leading to a loss of productivity at a personal level and subsequently, the national level.

Studies that have scrutinized the time progress of motor recovery after stroke discovered the greatest gains in motor function occur within the first month post-stroke, with some additional gains observed up to 6 months after onset (Hendricks et al, 2002; Duncan et al, 1992). Minute to no motor gains are expected beyond 6-12 months (Fascoli et al, 2004). Thus despite therapy (including physical rehabilitation), post-stroke individuals must live with significant arm and leg motor impairments that are likely to contribute to participation restriction. This participation restriction experienced by post-stroke patients is reflected in terms of mobility, orientation, occupation, physical independence, social integration and economic self-sufficiency.

Improving functional independence of stroke survivors through rehabilitation would not only enhance their quality of life and make them less dependent on relatives but more importantly, increase their participation in society. Linking arm and leg motor impairment of stroke survivors to their level of participation in society brings into proper perspective their unique experiences as they attempt to re-integrate into mainstream society within the Tamale Metropolis.

1.3 Research Questions

1. What is the relationship between arm motor impairment and participation restriction in post-stroke patients within the Tamale Metropolis?
2. What is the relationship between leg motor impairment and participation restriction in post stroke patients within the Tamale Metropolis?
3. Which limb (arm or leg) motor impairment is more closely related to participation restriction in post stroke patients within the Tamale Metropolis?

1.4 Main Objective

The main objective of the study is to examine the relationship between arm and leg motor impairment and participation restriction in post-stroke patients within the Tamale Metropolis.

1.5 Specific Objectives

1. To establish the correlation between arm motor impairment and participation restriction in post-stroke patients within the Tamale Metropolis.
2. To establish the correlation between leg motor impairment and participation restriction in post-stroke patients within the Tamale Metropolis.
3. To ascertain whether arm or leg motor impairment is more closely related to participation restriction in post-stroke patients within the Tamale Metropolis.

1.6 Research Hypotheses

The major research hypotheses are

1. There is significant correlation between arm motor impairment and participation

restriction.

2. There is significant correlation between leg motor impairment and participation restriction.

1.7 Justification of the Study

Over the years, the incidence of stroke has been on the increase in Ghana (Wiredu and Nyame, 2001). Rehabilitation including medical, physical and psychological interventions are the main modalities aimed at improving the functional abilities and psychological well-being of stroke survivors. Despite the interventions, significant numbers of stroke survivors live with arm and leg impairments that affect their functioning as well as participation in society.

Traditionally in Ghana, disability is defined in terms of impairment (Biomedical model) and the social aspect of disability is often ignored. These social aspects include the facilitators and barriers within society that respectively enhance and restrict the participation of persons with disability due to stroke in society.

An emphasis on functional recovery as well as participation gives a more complete picture of the experiences of stroke patients (Chau et al, 2009). Again, linking impairment to participation (restriction) is more in tune with the standard definition of disability as espoused in the ICF (WHO, 2001).

The study would have useful implications at the stroke survivor level, rehabilitation level and government/institutional level.

For stroke survivors, the study would highlight the challenges they face as they attempt to reintegrate into mainstream society within the Tamale Metropolis thereby informing remedial action. It would also indicate which assistive device (arm or leg) relates more towards the reduction of participation restriction within the metropolis.

At the rehabilitation level, the study is vital due to the fact that prevention of participation restriction is at its very core. It would serve as a timely reminder the societal implications of arm and leg impairments post-stroke, hence the need for clinicians and disability experts to adopt interventions that limit such impairments. Further to this, it could serve as a basis for proffering advice in terms of patients making choices of assistive devices.

At the government/institutional level, the study would inform policy in terms of procuring assistive devices for disabled persons in general as it would determine which impairment (arm or leg) relates more to participation restriction.

1.8 Delimitations of Study

The study is delimited to

1. Measuring motor impairment in terms of muscle power (ability to perform voluntary movement). Muscle power assessment provides an objective means of testing the motor ability of post-stroke patients. Sensory disturbances and co-ordination difficulties are equally useful components of motor impairment but are quite subjective in evaluation and have the potential to unduly influence the outcome of the study.

2. Examining relationship between motor impairment and participation restriction in terms of correlation analysis. Correlation analyses, though limited to test of associations provide an objective means of assessing the relationship between motor impairment and participation restriction.

1.9 Basic Assumptions

1. All responses would be nothing but the truth.
2. All questions are relevant to elicit the needed information for the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction to Literature Review

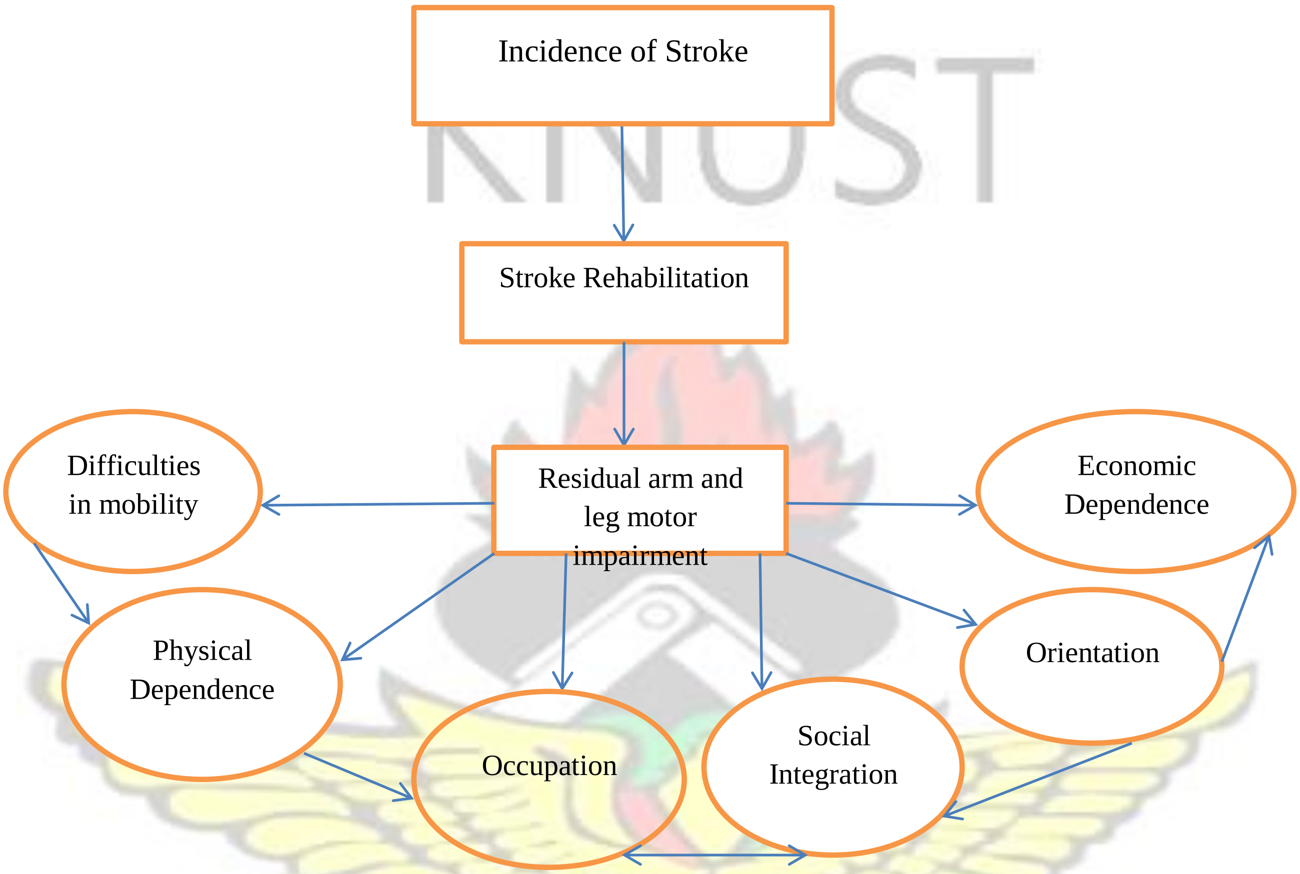
The literature review covers the areas of conceptual framework of the research, definition of stroke, epidemiology and risk factors associated with stroke, pathophysiology and classification of stroke,

stroke management, functional recovery after stroke, stroke related disabilities and the concept of participation restriction. It is designed to capture the various clinical and academic work related to the research.

2.2 Conceptual Frame Work of the Research

The conceptual framework of the research is as presented below. Incidence of stroke within the Tamale metropolis leads to patients seeking rehabilitation in the absence of a curative therapy. Despite rehabilitation there is residual arm and leg motor impairment that lead to difficulties in mobility, physical independence, occupation, social integration, orientation and economic independence.

Figure 1.0: Conceptual Framework



Source: Author's Creation, 2015

2.3 Definition of Stroke

Stroke also known as cerebrovascular accident (CVA) refers to neurological signs and symptoms that result from disease involving blood vessels (Carr and Shepherd, 1998). It is defined by the World Health Organization (WHO) as "a rapidly developed clinical sign of focal (or global) disturbance of cerebral function, lasting more than 24-hours or leading to death with no apparent cause other than of vascular origin" (Aho et al, 1980, pp. 114). However the WHO definition is problematic. Recent forms of brain imaging have proven the 24-hour inclusion criterion for cerebral infarction is incorrect and distorted, due to the fact that permanent brain injury can ensue sooner than the 24 hours. Furthermore, global cerebral dysfunction may not be initiated by cerebrovascular disease (Sacco et al, 2013). Sacco et al (2013) postulate that "stroke" should be used as a broad term to encompass the definitions of central nervous system (CNS) infarction, ischemic stroke, silent CNS infarction, cerebral venous thrombosis, intra-cerebral hemorrhage, silent cerebral hemorrhage and subarachnoid hemorrhage . Owing to the emergency nature of stroke, it is increasingly being referred to as "brain attack" (National Stroke Association, USA, 2015).

If signs and symptoms last less than 24 hours, the condition is termed as transient ischemic attack (TIA) (Baer and Durward, 2004). However, modern studies conducted in various regions of the world have proven that this time threshold was overly broad because 30% to 50% of typically defined TIAs display permanent brain injury on diffusion-weighted magnetic resonance imaging (Easton et al, 2009). Albers et al (2002, pp. 1715) defines TIA as "A brief episode of neurologic dysfunction caused by a focal brain or retinal ischemia with clinical symptoms typically lasting less than one hour, and without evidence of acute infarction".

2.4 Epidemiology and Risk Factors of Stroke

In 2008, stroke claimed approximately 6.2 million lives worldwide (WHO, 2011). Stroke is a major cause of death in middle and low income countries and approximately 87% of all stroke related deaths occur in these countries (Strong et al, 2007). Stroke is the third highest cause of death in the developed world after coronary heart disease and cancer (Baer and Durward, 2004). Approximately 795,000 Americans suffer a stroke annually and is a primary cause of severe, long-term disability among adults (Centre for Disease Control, USA, 2015). Stroke kills approximately 130, 000 Americans each year (Centre for Disease Control, USA, 2015).

Incidence of stroke is higher in men (30-80%) as against women, and blacks have a 50-130% higher incidence than whites. The incidence rises with age with the rate rising nine-fold between the ages of 55 and 85 years with over 60% of stroke survivors being over age 65 years (Roth, 2002). A retrospective study of in-patients with stroke at the Komfo Anokye Teaching Hospital over a two year period yielded a mean age of 63.7 years (Agyemang et al, 2012). Stroke accounts for approximately 4% of the total annual National Health Service expenditure in the United Kingdom (Govern and Rudd, 2003), costs over $1.3 billion per annum in Australia (National Stroke Foundation, Australia, 2005) and $34 billion annually in the United States (Mozaffarian et al, 2015).

Generally, the risk factors associated with stroke are either modifiable or non-modifiable (Roth and Harvey, 1999). The risk factors modifiable with behavior change include obesity, alcohol abuse sedentary lifestyle and cigarette smoking; those modifiable with medical care include hypertension, transient ischemic attack (TIA), previous stroke, atrial fibrillation, fibro-muscular dysplasia and diabetes. Hypertension in particular accounts for over 70% of stroke in women and 40% of stroke in men and serves as the single most important potent risk factor (O’Brien et al, 1999).

The non-modifiable risk factors include age, gender and heredity (Stroke Foundation of Australia, 2015)

2.5 Classification and Pathophysiology of Stroke

Strokes can be classified into two major categories: ischemic and hemorrhagic (NINDS, 2015). Ischemic strokes are caused by the disruption of the blood supply to the brain, while hemorrhagic strokes result from the rupture of a blood vessel or an abnormal vascular structure. About 87% of strokes are ischemic, the rest being hemorrhagic (Donnan et al, 2008). However some studies do report a slightly higher rate of ischemic stroke. In a study involving 39484 post-stroke patients Andersen et al (2009) reported nearly a 90% ischemic stroke incidence as against hemorrhagic stroke.

Ischemic stroke occurs due to a loss of blood supply to a portion of the brain, initiating the ischemic cascade (Deb et al, 2010). Brain tissue ceases to function if deprived of oxygen for more than 60 to 90 seconds, and after approximately three hours will suffer irreversible injury possibly leading to death of the tissue (infarction). Atherosclerosis may disrupt the blood supply to a portion of the brain by constricting the lumen of blood vessels leading to a reduction of blood flow, by instigating the formation of blood clots within the vessel or by releasing bursts of small emboli through the disintegration of atherosclerotic plaques (Snell, 2006).

At the cellular level of the brain, ischemia has the following effects

- Reduction of cellular energy reserve due to mitochondrial dysfunction and subsequent cell death by apoptosis (Karaszewski et al, 2009).
- Rapid engorgement of neurons and glia due to loss of membrane ion pump function (Deb et al, 2010).
- Release of excitatory neurotransmitters which further deplete cell energy and activation of deleterious enzyme systems that lead to cell death (Nakanishi et al, 2009).

Besides the direct harmful effects of ischemia on brain cells it has an effect on the overall structural integrity of the brain. The discharge of proteases causes the collapse of blood-brain barrier which ultimately causes cerebral edema, damaging the structural integrity of the brain (Adibhatla and Hatcher, 2008).

Hemorrhagic strokes arise from bleeding within the parenchyma of the brain or intra-ventricular spaces, and are classified based on their underlying pathology. Its harmful effects are a resultant of;

- Hypoxia due to disrupted blood supply.
- Direct irritant effect of unconfined blood on brain parenchyma and vascular structures.
- Increased intracranial pressure (ICP) due to continued bleeding.

Some examples of hemorrhagic stroke are hypertensive hemorrhage, ruptured aneurysm, ruptured arteriovenous fistula, drug induced bleeding and transformation of prior ischemic infarction (Longo, 2012). They result in direct brain tissue injury by causing compression of surrounding tissue. This direct injury is further exacerbated by expanding hematoma or hematomas (Eastwood et al, 2003). Further to this, the pressure leads to a loss of blood supply to adjacent tissue with subsequent infarction. The blood released by brain hemorrhage tends to have direct noxious effects on brain tissue and its associated blood vessels (Wang, 2010).

- The preceding scenario implies hemorrhagic strokes are more dangerous in terms of threat to life than ischemic strokes and constitutes about 10-15% of all strokes (Augusto et al, 2008).

2.5.1 Signs and symptoms of stroke

The National Institute of Neurological Disorders and Stroke (NINDS, 2015) lists the signs and symptoms of an acute stroke as follows

- Sudden numbness or weakness around the face, arm or leg, usually on one half of the body.
- Sudden confusion, difficulties in speaking or perceiving speech.
- Sudden difficulty with vision in one eye or both.
- Difficulties with walking, dizziness, lack of coordination or loss of balance.
- Sudden severe headache with no known cause.

Other signs and symptoms include double vision, drowsiness, nausea and vomiting.

2.6 Stroke Management

2.6.1 Management Team

Management of stroke requires a multidisciplinary team approach (Clarke, 2010) and comprise of stroke physicians, physiotherapists, occupational therapists, speech and language therapists, nurses, healthcare assistants, dieticians, clinical psychologists, social workers and case/disability managers.

Reported benefits of effective multidisciplinary team working include more patient-centered decision making (McCallin and McCalling, 2009), a lessening in the fragmentation of care (Kilbride et al, 2005), increased staff satisfaction (Clarke, 2010) as well as more effective and efficient use of resources (Schmitt, 2001).

2.6.2 Medical Management of Stroke

Current recommendations for medical management based on research evidence indicate stroke ought to be considered as a medical emergency that necessitates public education, specialist referral and quick management (Baer and Durward, 2004). Emergency treatment of stroke caused by a blood clot is directed at dissolving the clot (thrombolytic therapy) which is currently performed most often with tissue plasminogen activator, or t-PA (American Stroke Association, 2015). Haemorrhagic stroke may be treated surgically which is aimed at providing a pathway for blood to get to the brain (Brass, 1992).

2.6.3 Stroke Rehabilitation

The absence of a curative therapy makes rehabilitation the most viable modality targeted at improving quality of life after stroke (Gresham et al, 1995). Although primary prevention of stroke is central and remains paramount in the fight against stroke and stroke-related disability, there is convincing evidence that enhanced, methodical stroke management including rehabilitation, can reduce mortality and morbidity (Langhorne and Duncan, 2001). Rehabilitation consists of expansive array of biomedical, psychological, social, vocational, and educational interventions that can be implemented in a variety of institutional and community-based settings.

Rehabilitation services are usually provided by a multidisciplinary team, whose composition depends on the patient's physical, psychological (cognitive) and emotional disabilities. The availability of rehabilitative resources (including human resources) plays a crucial role in determining the type of rehabilitation employed in the community or institution (Gresham et al, 1995).

The key aim in stroke rehabilitation is to assist each patient in achieving the highest possible degree of individual physical independence as well as enhance their psychological well-being. This physical independence and psychological well-being are not just useful at the personal level but are designed to enhance patients' reintegration into mainstream society. Rehabilitation in other words can be described as the gradual withdrawal of support and services in which services are only provided when needed (Roth, 1998).

Overall there is no unanimity as to when rehabilitation should begin, what optimum intensity is and at what duration. The following factors are documented to enhance effective rehabilitation:

- Multidisciplinary communication on regular basis (Langhorne & Pollock, 2002).
- Better trained staff offering more specialized services (Hamrin, 1982).
- Better organization of services and family integration into the rehabilitation program (Kalra, 1994).
- Earlier implementation of rehabilitation services and mobilization policies (Asberg, 1989).
- Higher intensity of daily training (Kwakkel et al, 1997).
- More use of parenteral fluids, aspirin, antipyretics and antibiotics during the early phase of stroke management (Langhorne and Pollock, 2002)

2.6.4 Physiotherapy in Stroke Rehabilitation

The basic essence of physiotherapy in stroke rehabilitation is to assist affected individuals achieve their full physical potential and functional independence and to speed up their reintegration into larger society (Charted Society of Physiotherapy, 2015). Modern evidence suggests that physiotherapy very early after stroke (including passive and active exercises) and at high intensity leads to better outcomes (Cumming et al, 2013, Kwakkel et al, 2004) and is costeffective (NIHCE, 2013). Physiotherapists offer a range of evidence-based physical rehabilitation interventions depending on the patient's unique clinical needs and goals. Specific treatment may involve gait re-education to aid walking, constraint-induced movement therapy aimed at improving upper limb functioning, task-specific training that aids specific activities and falls management (ISWP, 2013). With reference to long term management, physiotherapists have expertise in promoting physical activity, reablement and empowering post-stroke patients (and other long term neurological conditions) through self-management techniques (Lennon et al, 2013). Enhancing physical activity is of particular significance as it serves to reduce cardiovascular risk factors (Michael et al, 2005) and subsequently, recurrent stroke.

2.6.5 The Role of the Disability/Case Manager in Stroke Rehabilitation

The disability/case manager basically serves as a link between the stroke patient and the available opportunities that would maximize his/her recovery. The Heart and Stroke Foundation of Ontario (2015) enumerates the role of the case manager as follows

- Assessment in the form of accumulating and analyzing information in a standardized and methodical manner from clients, physicians, caregivers and other specialists so as to identify unique needs and goals of individual clients.
- Providing information about available health and support services and assisting clients to obtain access to appropriate services to meet immediate and long term needs.
- Formulating an action plan to fulfill established client needs and goals using a combination of formal and informal services and readjusting the plan as client needs evolve.

- Providing advocacy for client and education about available rights responsibilities.

- Reviewing the service plan at regular intervals with the client and community team members to ensure that it is in tune with client needs and to estimate outcomes against previously stated goals and agenda.

- Optimizing all available formal and informal resources to achieve stated goals; defining which services are needed and in what quantity, what time and duration as well as ascribing to ethics that ensure fairness and equity in terms of resource allocation.

- Applying ongoing discharge scheduling throughout the time services are provided as explicit targets are realized.

- Working in conjunction with other health organization partners to identify and fix system integration and coordination issues as well as initiate, develop and implement innovative approaches.

2.7 Functional Recovery after Stroke

Recent findings from several longitudinal research suggest that irrespective of the type (hemorrhagic or ischemic) and frequency of therapy, the main pattern of recovery after stroke is determined by certain ill-defined biological processes, often described as "spontaneous neurological recovery" (Greshman, 1986). The very nature and trend of this observed recovery of spontaneous neurological recovery is not adequately understood. Very little clinical and experimental studies have addressed the issue why some extent of 'spontaneous' recovery is possible in the face of severe cerebral injury (Heddings et al, 2000).

Almost all patients with stroke experience a certain degree of functional recovery within the first six months after stroke. Most recovery of motor and functional performance is seen in the first month after stroke (Kong et al, 2011). Verheyden et al (2008) observed most improvement for trunk, arm, leg and functional recovery from 1 week to 1 month after stroke and then to a lesser extent between 1 and 3 months after stroke. Only small, not statistically significant changes could be seen between 3 and 6 months after stroke, indicating that a "plateau phase" was already reached at 3 months after stroke. Further improvement after 6 months can be expected but is mostly limited (Hendricks et al., 2002; Desrosiers et al., 2003; Kwakkel et al., 2004). However intensive therapeutic exercise has led to significant improvements in motor function in persons more than 1 year post-stroke (Lum et 2002, Fasoli et al, 2003). A general consensus among rehabilitation experts is that the lower limb recovers faster and more completely than the upper limb (Duncan et al, 1994).

Only 60% of post-stroke patients with initial hemiparesis are able to achieve functional independence in the most basic activities of daily living such as bathing, toileting and walking short distances six months after stroke (Mayo et al., 1999; Patel et al., 2000). Many daily activities, especially ambulation, require optimal function of thigh and leg muscles. A good number of studies affirm that lower extremity muscles are weaker in post-stroke patients compared to healthy controls (Newham & Hsiao, 2001; Bohannon, 2007b; Sullivan et al., 2007; Horstman et al., 2008). Furthermore, the inability to generate normal amounts of force in the lower limb has been demonstrated to positively correlate with reduced physical activities (Mercier & Bourbonnais, 2004; Ada et al., 2006). Specifically, intrinsic strength capability including the ability to maximally activate the knee extensors correlates strongly with functional performance (activities of daily living) in post-stroke patients (Patterson et al., 2007; Horstman et al., 2008). Horstman et al (2012) concluded that improving muscle speed and strength could have the potential to improve functional performance in post-stroke patients.

2.8 Stroke Related Disabilities

Disability is a broad term that covers impairments, activity limitations and participation restrictions. It symbolizes the undesirable features of the constant interaction between an individual's health condition(s) and his/her contextual factors (environmental and personal factors) (WHO, 2001). Impairments are problems in body structure and function including a significant deviation or loss whiles activity limitations denotes difficulties an individual may have in executing specific activities (WHO, 2001). Motor impairments on the other hand specifically refer to difficulties in the capacity of the body or of a body part to move, regardless of the goal and intended function of the movement produced (International Encyclopedia of Rehabilitation, 2015).

Hemiplegia is a common clinical consequence of stroke (Teasell, 1991). Teasell (1991) proceeds to describe musculoskeletal characteristics in hemiplegic patients following stroke as follows; flexor tone is dominant in the hemiplegic upper limb and subsequently results in depression and retraction of the scapular, adduction of shoulder and internal rotation, pronation of the forearm and flexion of the elbow, wrist and fingers. Extensor tone is dominant in the hemiplegic lower limb and subsequently gives rise pelvic elevation and retraction, hip extension, adduction and internal rotation. Knee extension, ankle plantar flexion and inversion of the foot are equally prevalent. In a study that utilized 317 patients with ischemic stroke, Hedna et al (2013) concluded that left hemisphere stroke (right hemiplegia) was more common and severer than left hemisphere stroke.

Post-stroke survivors with hemiplegia have been documented to display reduced stride/step length relative to normal controls (Wagenaar and Beek, 1998), increased step length on the affected lower limb (Lehmann et al, 1987), a slightly wider base of support and greater toe-out angles (Burdett et al, 1988).

Close to two thirds of stroke survivors have residual neurological deficits that translates to functional difficulties and nearly 50% are left with disabilities that make them dependent on others for activities of daily living (Gresham et al, 1975). The specific nature of the impairment is quite diverse and varies with the specific areas of the central nervous system (CNS) that have sustained the damage (Staines et al, 2009). Prime among these impairments are physical impairments in upper limb functioning and walking. A paltry 5% of stroke survivors regain full function of the upper limb and nearly 20% regain no functional use of the same limb (Basmajian et al, 1982). Kwakkel et al (1999) reported similar findings in which most stroke survivors regained the ability to walk whereas only between 30%-66% of survivors were able to use their affected upper limb.

The limitations associated with functional walking in post-stroke survivors is further compounded by physical deconditioning of those same muscles involved in walking (Duncan et al, 1998, Macko et al, 2005). The consequence of physical deconditioning is far reaching due the increased energy demands associated with the performance of everyday activities among these individuals (Staines et al, 2009). Desrosiers et al (2003) deduced that arm and leg impairments positively correlated with handicap situations.

Aside physical disabilities, cognitive impairment is equally prevalent in post-stroke survivors with rates of 24% to 39% among ischemic stroke survivors (Pérez et al, 2011, Douiri et al, 2013). This cognitive impairment could range from the mild to the more severe or dementia type (Zou et al, 2004) and often sets in 3 months post-stroke (Nys et al, 2005).

2.9 Concept of Participation Restriction

The International Classification of Functioning, Disability and Health (ICF) defies mainstream ideas on how disability is conceptualized (biomedical model), and recognizes the social aspects of disability (WHO, 2001). The ICF proceeds to describe disability on three levels; impairment, activity limitation and participation restriction. Impairments are problems in body structure or function. Activity limitation is at the level of the individual and involves difficulties an individual may experience in executing activities. Participation restriction is at the level of society and refers to problems disabled persons may face in involvement in life situations.

The ICF concedes environmental factors serve as facilitators or barriers to the functioning of individuals. These environmental factors include the physical, social and attitudinal environments in which individuals live and conduct their lives. Physical environment includes climate, terrain and building design. Social factors include institutions, laws and norms. Products and technology, support and relationships, services, systems and policies are equally important environmental factors in the functioning of individuals.

Participation restriction connotes the personal and societal implications of health conditions. Specifically it refers to the difficulties an individual may have in an involvement in life situations (WHO, 2001). Participation in society such as being responsible for others and work, not precluding psychological well-being (Hawker and Gignac, 2006) may be of more concern to disabled individuals than the underlying impairments and activity limitation (Harwood et al, 1994).

Reduced social interaction and social isolation are common consequences of stroke due to cognitive and physical impairments as well as communication disorders (Mukherjee et al, 2006). One-fifth of stroke survivors require institutional care for the remainder of their lives (Semple and

Sacco, 2003) and around one-third require rehabilitation services and long term care support (CDCP, 2005).

Chau et al (2009) concluded that rehabilitation services for stroke patients need to continue to focus on restoring functional independence but also need to recognize and treat depressive symptoms in order to minimize the restrictions to participation in society. Improving communication with stroke survivors and caregivers, and avoiding categorizing stroke survivors by their impairments, (Bendz, 2000, Anderson and Marlett, 2004) could help raise stroke survivors' self-esteem and in turn contribute to their societal participation. Hamzat and Peters (2009) deduced a positive association between motor function and participation in society in post-stroke patients.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction to Methodology

The methodology of the research covered the areas of study population definition, sample size determination, sampling technique, study design, profile of study area, pilot study, field data collection, data management and analyses, validity and reliability of research scales as well as issues of ethics and confidentiality. It is a systematic representation of the methods used in the research.

3.2 Definition of Study Population and Inclusion Criteria

The study population was post-stroke patients who had undergone at least 3 months of physical rehabilitation within the Tamale Metropolitan Area.

Further inclusion criteria were the absence of severe co-morbid conditions and participant being able to communicate.

3.3 Sample Size Determination

Sample size was determined using the precision (estimation) method.

P, is the proportion of post stroke patients with arm and leg motor impairment (after a minimum of 3 months of rehabilitation) obtained from the pilot study. This proportion included all participants who obtained a score of less than 5 in either the affected upper limb or lower limb (or both) based on the manual muscle testing.

Z, is the significance level using a 95% confidence level. ***d***, is the precision level

Thus $P = 63.33\%$ $Z = 1.96$ $d = (+/-)\ 8\%$

$$n = \frac{Z^2 P(1-P)}{d^2}$$

$$n = \frac{1.96^2(0.6333)(1-0.6333)}{0.08^2}$$

n= 139

3.4 Sampling Technique

A sampling frame was developed based on the history of attendance of physical rehabilitation sessions at the Tamale Teaching Hospital. The sampling frame was numbered from the first unit to the last unit. A total of 302 participants made up the sampling frame.

The numbers corresponding to the participants were entered into *stata* version 12. The command "*sample 46"* was then issued with *stata* automatically selecting 139 numbers by simple random sampling without replacement. These numbers were then juxtaposed against the sampling frame to select the participants.

3.5 Study Design

The study was a non-intervention type that employed a cross-sectional design. A largely quantitative approach was adopted in measuring dependent and independent variables.

3.6 Profile of Study Area

The Tamale Metropolis is one of the 26 districts of the Northern region of Ghana and serves as the capital of the region. The Metropolis is centrally located within the region and has a total land area of 646.90sqkm with a population of 233,252 per the 2010 Population and Housing Census (GSS, 2014). The Census further reported 63.3% of the population aged 15 years and older in the metropolis are economically active with majority (33%) engaged as service and sales persons. The second largest occupation is craft and related trade workers who constitute 21.5% of the employed population.

Stroke rehabilitation in the metropolis begins with medical management in the various public and private hospitals within the metropolis including the leading referral hospital, Tamale Teaching Hospital (TTH). Patients are then referred to the physiotherapy department of the TTH to start physical rehabilitation on an out-patient basis. TTH additionally offers psychological rehabilitation through clinical psychologists for patients who require that service.

Various non-governmental organizations play a role in the rehabilitation process by providing various assistive devices for post-stroke patients.

3.7 Report on Pilot Study

The study was piloted primarily to obtain the proportion of post-stroke participants with arm and leg motor impairment as well test the feasibility of the study. An external pilot approach was used.

Participants for the pilot study were selected from the Sagnarigu district. The district borders the Tamale Metropolis to the north and west. It was carved out of the Tamale Metropolis in 2012 by Legislative Instrument 2066.

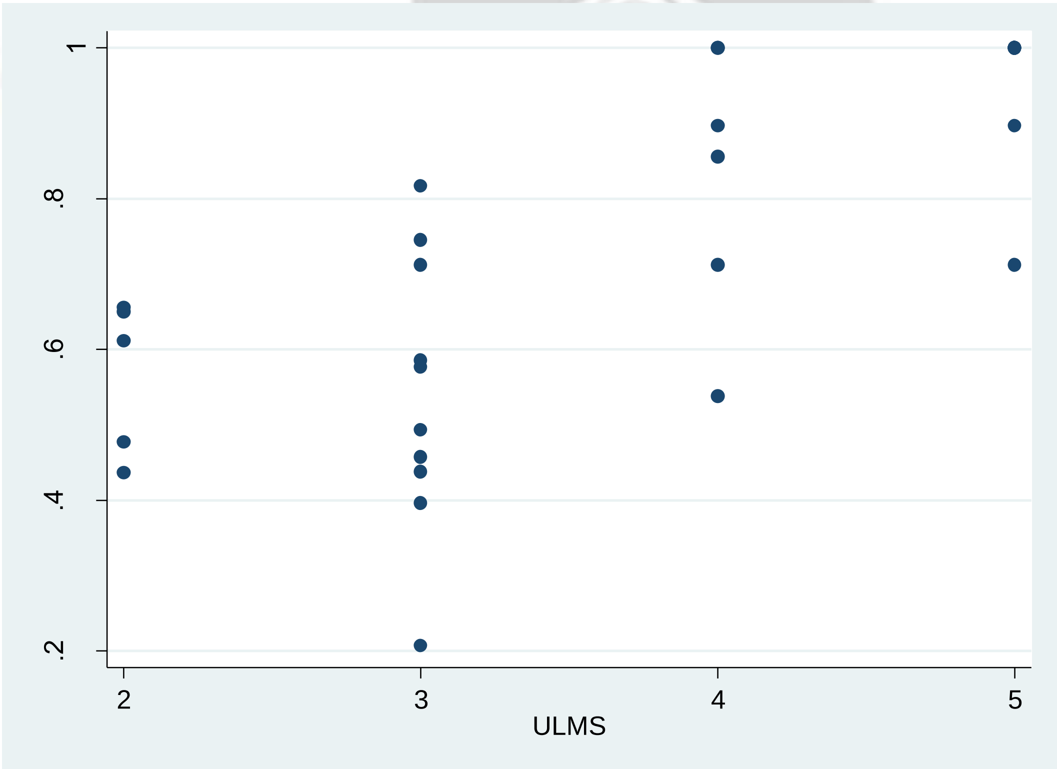
40 participants were selected by simple random sampling from a sampling frame of 71 units based on history of attendance of physical rehabilitation sessions. A nonresponse rate of 20% was recorded with a final of 32 participants completing the pilot study.

Table 1.0 Demographic profile and Stroke Characteristics of Pilot Participants

Age (mean ± SD)	58.12 ± 9.15
Gender	
Men	25 (78.12%)
Women	7 (21.88%)
Type of stroke	
Ischemic	26 (81.25%)
Hemorrhagic	2 (6.2%)
Unknown	4 (12.5%)
Hemiplegic Side	
Right	15 (46.87%)

Left	17 (53.12%)
Bilateral	0 (0%)
No. of months post-stroke (mean ± SD)	9.38 ± 6.13
No. of months on rehab (mean± SD)	6.47 ± 4.11

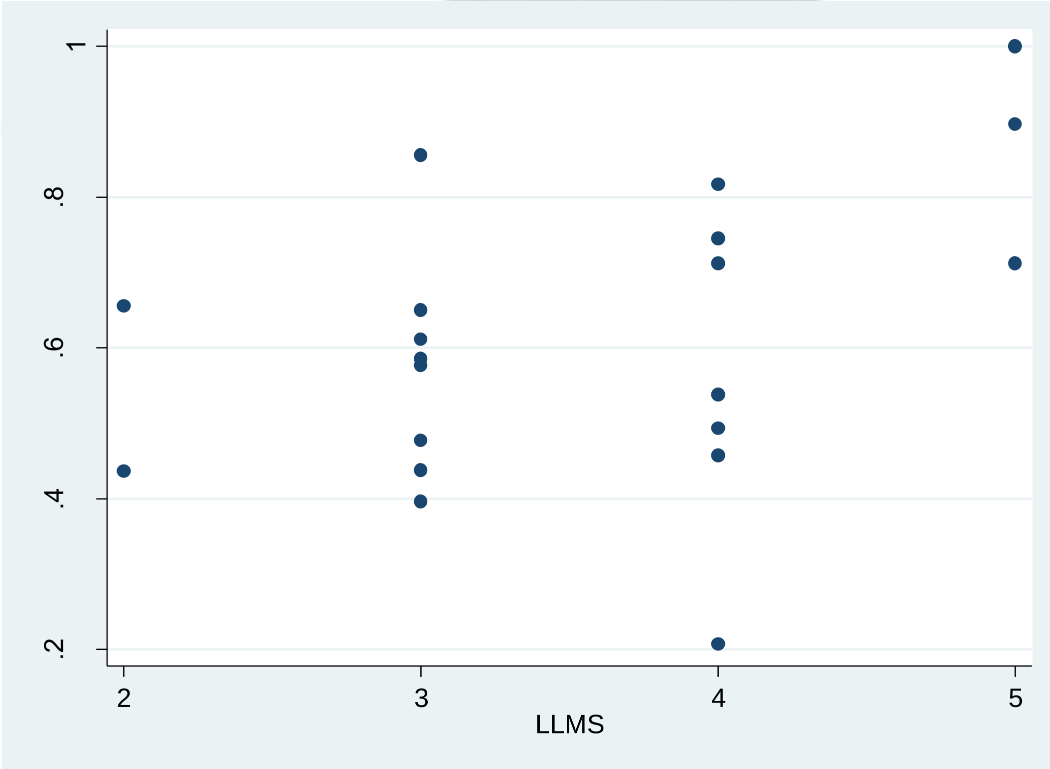
Figure 2.0: A scatter graph depicting LHSS scores versus ULMS scores of pilot participants



Key: LHSS: London Handicap Scale Score (Participation restriction)

ULS: Upper limb motor score (Motor impairment)

Figure 3.0: A scatter graph depicting LHSS scores versus LLMS scores of pilot participants.



Key: LHSS: London Handicap Scale Score (Participation Restriction)

ULS: Upper limb motor score (Motor impairment)

3.8 Field Data Collection

Selected participants who were still undergoing rehabilitation (physical/medical) had data collected at the physiotherapy department of the Tamale Teaching Hospital. Selected participants who had completed their rehabilitation were followed up to their homes where motor assessment was followed by the measurement of participation restriction.

Motor assessment was scored by making participant lie in the supine position. Affected upper limb motor score was obtained by assessing shoulder flexors, elbow flexors and grip, first against gravity then with gravity eliminated if participant found moving against gravity extremely difficult. In most cases, the score of the three individual movements were the same. Thus an overall upper limb motor score of say 3 was awarded based on the manual muscle scale. In cases where the scores of those three movements vary the median score was used as the overall upper limb score.

Affected lower limb motor score was obtained by assessing hip flexors, knee flexors and ankle dorsiflexors first against gravity then with gravity eliminated if participant found moving against gravity extremely difficult. In most cases, the score of the three individual movements were the same. Thus an overall lower limb motor score of say 3 was awarded based on the manual muscle scale. In cases where the scores of those three movements vary the median score was used as the overall lower limb score.

Level of participation restriction was measured by administering the six level London Handicap Scale (LHS). The scale was thoroughly explained to participants with emphasis on measuring the extra disadvantage experienced due to the absence of physical, social and attitudinal facilitators that would have mitigated the impact of their motor impairment.

3.9 Data Management and Analyses

Data management involved a daily electronic entry and cleaning of all completed data collection sheets by principal investigator. Data was stored in *stata* version 12 and backed up on *google drive* for easy retrieval and safety. The data sheets were then safely kept under lock and key.

Data was analyzed using *stata* version 12. Continuous numeric variables were summarized using mean and standard deviation. Categorical variables were summarized using percentages and frequency counts. Scatter plots were utilized to depict the visual correlation between limb motor scores and levels of participation restriction.

Inferential statistics involved the use of spearman rank correlation analysis that compared limb motor scores to levels of participation restriction.

3.10 Validity and Reliability of the London Handicap Scale

The London Handicap Scale (LHS) is a measure of perceived disadvantage encountered as a result of chronic illness (Harwood et al, 1994). Minimizing handicap situations is at the centre of rehabilitation programmes and interventions designed for patients with neurological conditions

(Ebrahim, 1990). Measures including the LHS have an inherent ability in estimating results both in research scenario and in the assessment of clinical interventions (Jekinson et al, 2000).

Whereas many scales that attempt to measure perceived disadvantage associated with ill health lack a clear conceptual base (McDowell and Newell 1996, McDowell and Jekinson, 1996), the LHS is constructed via the descriptive framework of handicap instituted by the WHO in the International Classification of Impairments, Disabilities and Handicaps (ICIDH) (WHO, 1980). The ICIDH defines handicap in six dimensions: mobility, orientation, occupation, physical independence, social integration and economic self-sufficiency. In the LHS each of these six domains is classified on a six point scale. Respondents complete the questionnaire by selecting one category per dimension that corresponds to their perceived level of disadvantage (on a six point scale from "no disadvantage" to "most severe disadvantage").

Though the concept of handicap has been superseded by the model of participation in the latest framework of the WHO (WHO, 1997), the specific dimensions of the LHS are still appropriate and are equally represented in the newer classification. The LHS is a valid, reliable and generally acceptable measure of perceived disadvantage due to ill health (Harwood 1994, Harwood and Ebrahim, 1995) and was discovered to be responsive to differences between groups in a randomized control trial of occupational therapy (Walker et al, 1999).

3.11 Validity and Reliability of Manual Muscle Testing (MMT)

Manual muscle testing (MMT) is a method for the assessment of the function and strength of individual muscles or muscle groups centered on the effective performance of a movement with respect to the forces of gravity or manual resistance (Wintz, 1959).

The Daniels and Worthingham Scale, the Medical Research Council Scale and the Kendall and McCreary Scale are popular scales associated with MMT. The Daniels and Worthingham grading system is touted as the most effective of the aforementioned scales because it involves motion that calls into action most muscle groups associated with a specific motion (Palmer and Epler, 1990) and interpreted as follows:

- Grade 5 – Normal; muscle movement through the complete range of movement against gravity and full resistance.
- Grade 4 – Good; Muscle movement through the complete range of movement against gravity and moderate resistance.
- Grade 3 – Fair; Muscle movement through the full range of motion against gravity alone.
- Grade 2 – Poor; Muscle movement through the full range of movement with gravity eliminated.
- Grade 1 – Trace; Palpable muscle contraction but not through complete range of movement, with gravity eliminated.
- Grade 0 – Zero; No palpable contraction.

Perry et al (2004) found the MMT to be valid and reliable in assessing the strength of hip extensor muscles with participants in a supine position. In terms of reliability, Pollard et al (2011) concluded MMT showed a fair to substantial agreement between examiners in examining the strength of lower limb muscles.

3.12 Ethical and Confidentiality Consideration

Ethical approval was sought and granted by ethical committee of the Committee on Human Research, Publications and Research of KNUST. A second ethical approval was sought and granted by Tamale Teaching Hospital. Participant and researcher signed an informed consent form that allowed participants to withdraw from the study at any time if they so wish.

Proper records keeping and storage ensured confidentiality of data related to participants.

CHAPTER FOUR

4.0 FINDINGS

4.1 Introduction to Findings

This chapter outlines the results obtained in the study in strict compliance with the research objectives. Tables and graph are complemented with succinct text to bring further clarity. The chapter covers the areas of demographic profile and stroke characteristics of participants, correlation of arm motor impairment and participation restriction, correlation of leg motor impairment and participation as well statistical test of hypotheses.

4.2 Demographic Profile and Stroke Characteristics of Study Participants

Table 2.0 below presents the demographic and stroke characteristics of the study participants and associated 95% confidence interval for each variable. A non-response rate of 26.61% was recorded with a total of 102 participants completing the study. Just under a third of participants were women with over two thirds being men. Ischemic stroke was the most dominant stroke type with hemorrhagic stroke affecting less than 11% of participants. Nearly 9% of participants had stroke undiagnosed as ischemic or hemorrhagic. Over half of participants had left sided stroke with the remainder being right sided stroke. No participant had stroke affecting both right and left halves.

Table 2.0 Demographic Profile and Stroke Characteristics of Study Participants

		95% confidence interval
Age (mean ± SD)	62.08 ± 11.76	59.77 – 64.39
Gender		
Men	69 (67.65%)	57.66% – 76.58%
Women	33 (32.35%)	23.42% – 42.33%
Type of Stroke		
Ischemic	82 (80.39%)	79.82% – 93.95%
Hemorrhagic	11 (10.78%)	6.05% – 20.19%
Unknown	9 (8.82%)	
Hemiplegic Side		
Right	42 (41.18%)	31.52% – 51.36%
Left	60 (58.82%)	48.64% – 68.48%
Bilateral	0 (0%)	
No. of months post stroke	13.40 ± 8.20	11.79 – 15.01
No. of months on rehab	6.18 ± 3.30	5.53 – 6.83

Table 2.1 below presents the arm and leg motor scores of study participants. 3 and 4 are the bimodal scores for arm motor impairment with the score of 1 having the least frequency. Leg motor impairment has the score of 5 as its mode with score of 1 having the least frequency.

Table 2.1 Arm and Leg Motor Scores of Study Participants

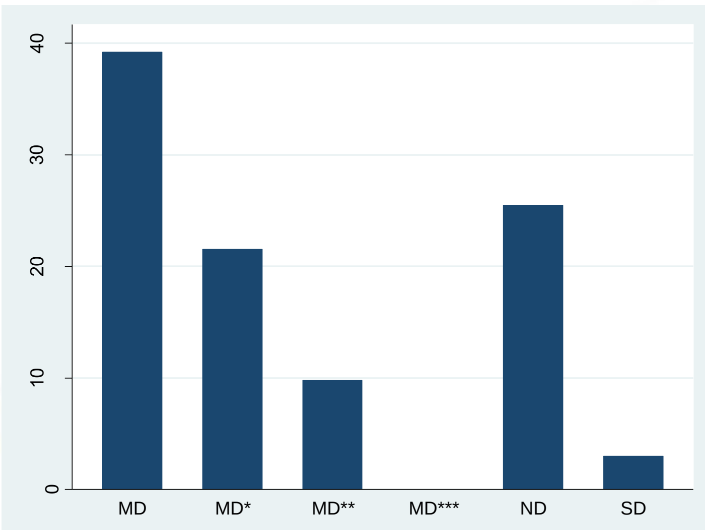
Arm Motor Score	No. of Participants	Leg Motor Score	No. of Participants
1	4 (3.92%)	1	1 (0.98%)
2	15 (14.71%)	2	8 (7.84%)
3	31 (30.39%)	3	28 (27.45%)
4	31 (30.39%)	4	30 (29.41%)
5	21 (20.59%)	5	35 (34.31%)

Figures 4.0 present the breakdown of the ordinal variable participation restriction. Over a third of participants felt they were minimally disadvantaged in terms of mobility whiles less than 1% felt they were most disadvantaged. Close to two thirds felt they experienced no disadvantage in terms physical independence in contrast to over 20% who felt minimally disadvantaged. Three out of every four participants had some level of work related disadvantage. Four out of every five participants felt they experienced no disadvantage in terms of social integration. Less than 7% of participants claimed they experienced any disadvantage in terms of orientation. About one out of four participants felt they were not disadvantaged in terms of economic self-sufficiency.

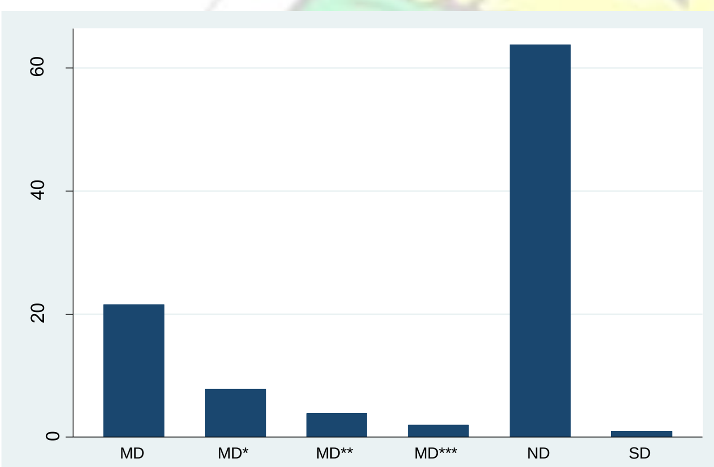
Figures 4.0 Components of Participation Restriction and its Ranking by Study Participants

KEYS: ND: No Disadvantage, MD: Minimal Disadvantage, MD*: Mild Disadvantage, MD: Moderate Disadvantage, SD: Severe Disadvantage, MD***: Most disadvantage**

Mobility



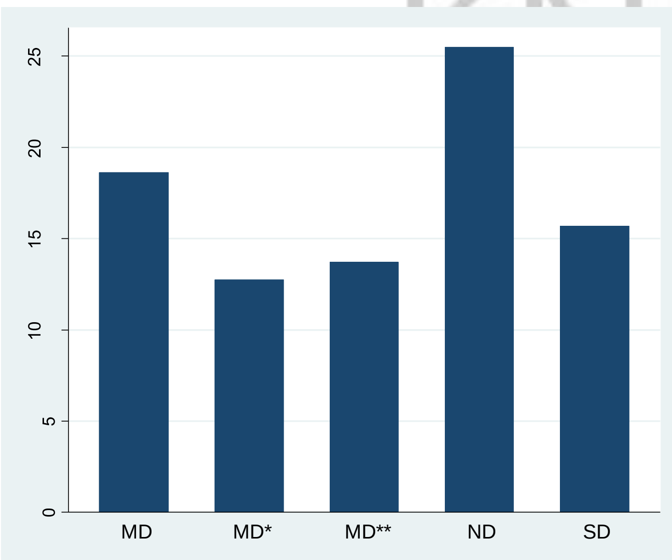
Physical independence



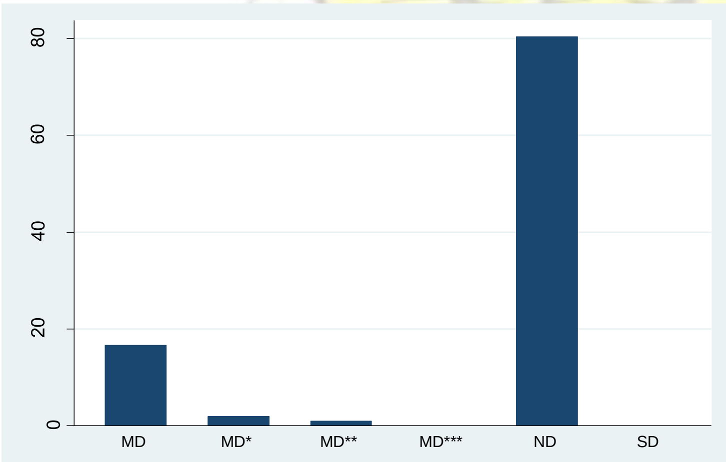
KEYS: ND: No Disadvantage, MD: Minimal Disadvantage, MD*: Mild Disadvantage,

MD: Moderate Disadvantage, SD: Severe Disadvantage, MD***: Most disadvantage**

Occupation



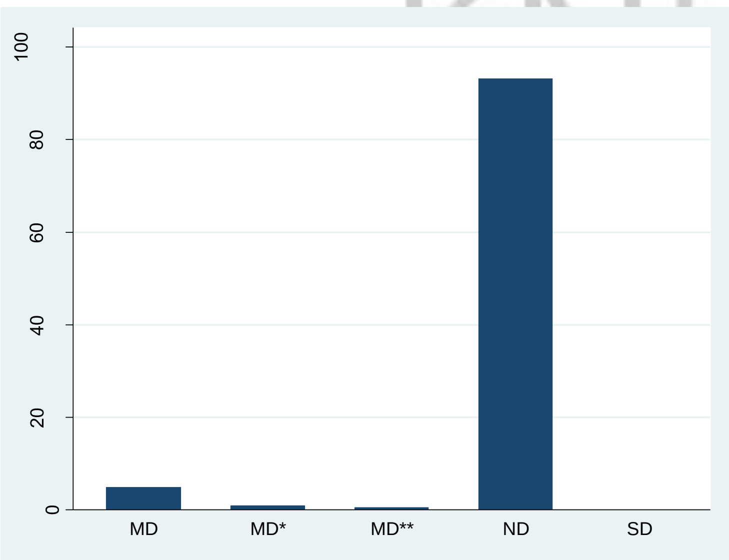
Social Integration



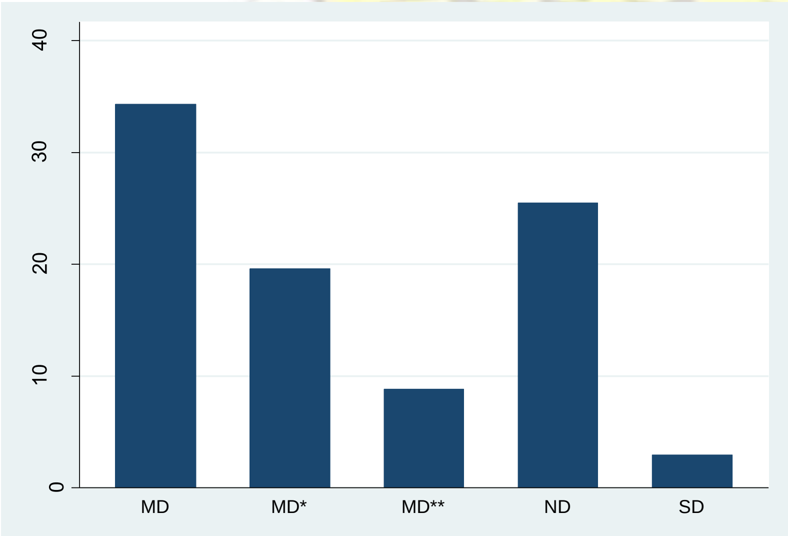
KEYS: ND: No Disadvantage, MD: Minimal Disadvantage, MD*: Mild Disadvantage,

MD: Moderate Disadvantage, SD: Severe Disadvantage, MD***: Most disadvantage**

Orientation



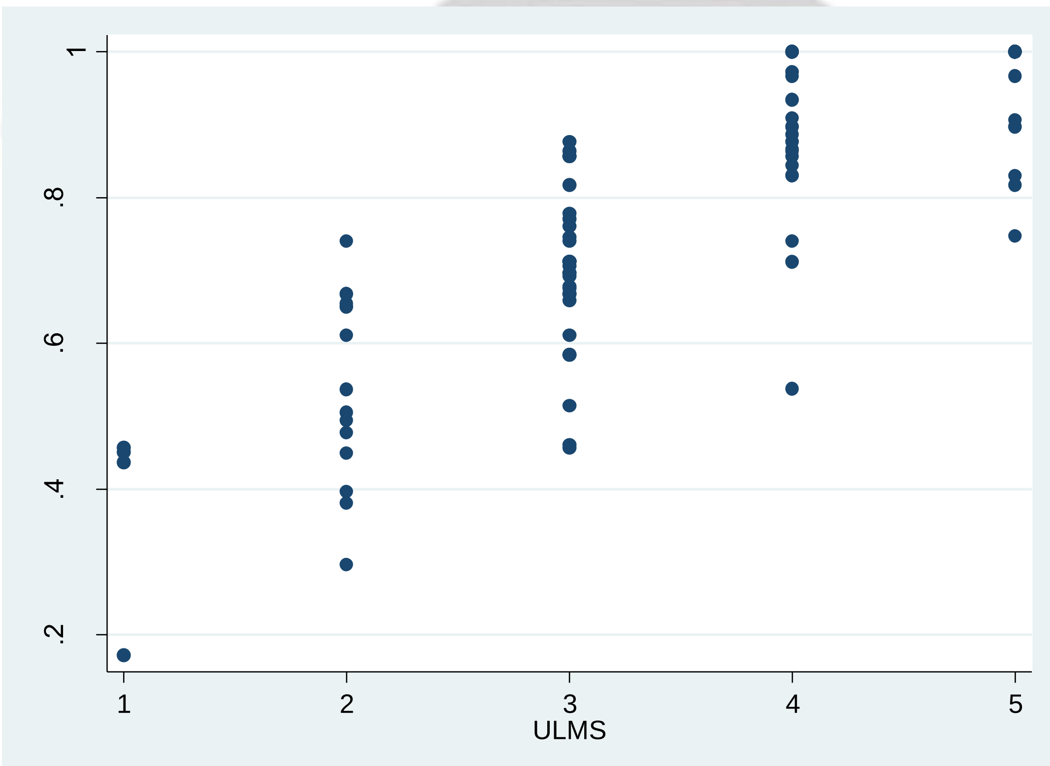
Economic self sufficiency



4.3 Correlation between Arm Motor Impairment and Participation Restriction

Figure 5.0 below presents the visual correlation between arm motor impairment and participation restriction. The scatter plot largely indicates a linear relationship between the two aforementioned variables. Lower upper limb motor scores are associated with lower levels of participation and vice-versa, an indication of a positive association and monotonicity.

Figure 5.0: A scatter graph depicting LHSS scores versus ULMS scores of study participants



Key: LHSS: London Handicap Scale Score (Participation restriction)

ULMS: Upper Limb Motor Score (Motor impairment)

Table 3.0 below presents the spearman rank correlation test on upper limb motor impairment and participation restriction. The correlation co-efficient reveals a strong positive correlation between the two aforementioned variables.

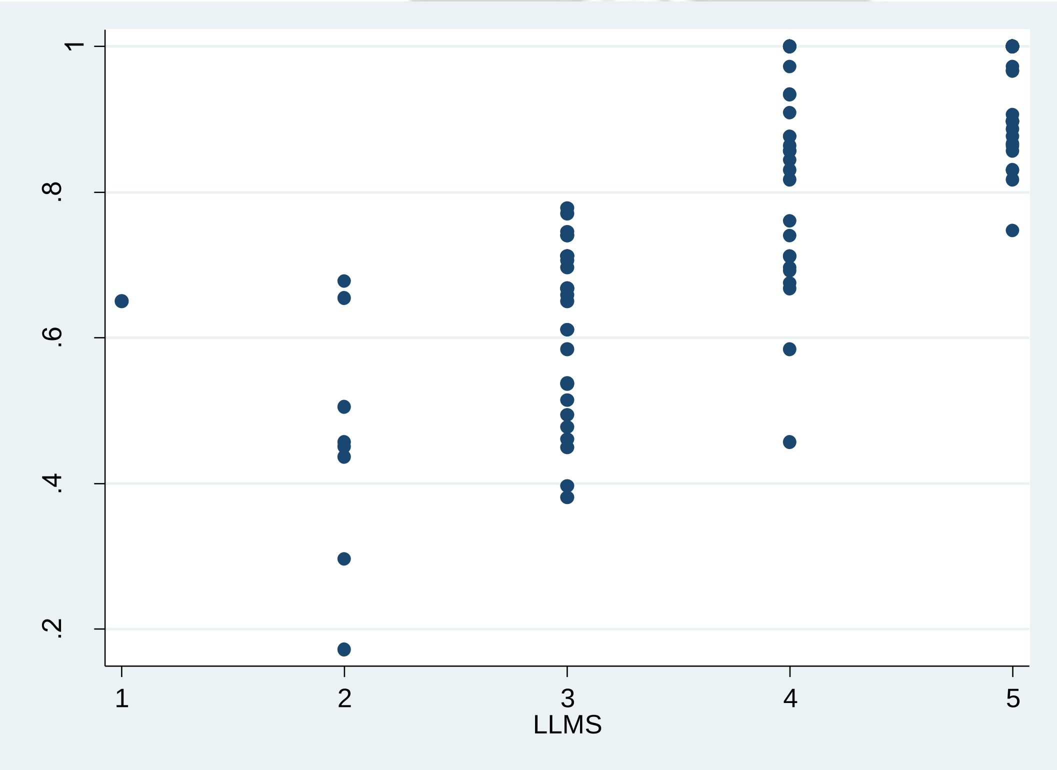
Table 3.0 Spearman Rank Correlation Analysis of Arm Motor Impairment and Participation Restriction

Number of observations	102
Spearman's r_s	0.8343
P-value	0.0000

4.4 Correlation between Leg Motor Impairment and Participation Restriction

Figure 6.0 presents the visual correlation between leg motor impairment and participation restriction. The scatter plot largely indicates a linear relationship between the two aforementioned variables. Higher LLMS are associated with higher levels of participation and vice-versa, an indication of a positive association and monotonicity.

Figure 6.0: A scatter graph depicting LHSS scores versus LLMS scores of study participants



Key: LHSS: London Handicap Scale Score (Participation restriction)

LLMS: Lower Limb Motor Score (Motor impairment)

Table 4.0 below represents the spearman rank correlation test on upper limb motor impairment and participation restriction. The correlation co-efficient reveals a strong positive correlation between the two aforementioned variables.

Table 4.0 Spearman Rank Correlation Analysis of Leg Motor Impairment and Participation Restriction

Number of observations	102
Spearman's r_s	0.8013
P-value	0.000

4.5 Comparison of Correlation of Arm Motor Impairment and Participation Restriction against Leg Motor Impairment and Participation Restriction

Both arm motor impairment and leg motor impairment show a strong positive association with participation restriction albeit differences in numerical strength. The spearman correlation coefficient of arm motor impairment and participation restriction yields 0.8343 whiles that between leg motor impairment and participation restriction yields 0.8013. Thus, arm motor impairment is more strongly related to participation compared to leg motor impairment.

4.6 Test of Hypotheses

1. H_O: There is no significant correlation between arm motor impairment and participation restriction.

Using the spearman rank correlation test between the two variables in Table 3.0 at a significance level of 0.05,

$P = 0.000$

Since $P < 0.05$, H_o is rejected.

2. H_O: There is no significant correlation between leg motor impairment and participation restriction.

Using the spearman rank correlation test between the two variables in Table 4.0 at a significance level of 0.05,

$P = 0.000$

Since $P < 0.05$, H_o is rejected.

CHAPTER FIVE

5.0 DISCUSSION

5.1 1ntroduction to Discussion

This chapter narrates the implications of the study findings as well as the possible explanations behind them in strict accordance with the study objectives. It covers the areas of demographic profile and stroke characteristics of participants, arm and leg motor scores, components of participation restriction and its ranking, correlation between arm motor impairment and participation restriction, correlation between leg motor impairment and participation restriction as well as a comparison of the aforementioned correlations.

5.2 Demographic profile and Stroke Characteristics of Study Participants

The mean age of post-stroke study participants was 62.08 (± 11.76) with an average of 13.40 (± 8.20) months between the onset of stroke and time of research. Taking cognizance of the standard deviation associated with the mean age, the reported mean age of study participants largely fits into the age range (55 and 85) at which incidence of stroke is highest as espoused by Roth (2002). The mean age reported in this study compares favorably with that of Agyemang et al (2012) who reported a mean age of 63.7 years in a 2 year retrospective study of stroke patients at the Komfo Anokye Teaching Hospital. In terms of the incidence of stroke between the two genders, men had roughly 35% higher incidence than females. This higher incidence of stroke in men is however anticipated by Roth (2002) who postulated incidence of stroke is 30-80% higher in men compared to women.

The 80.39% incidence of ischemic stroke as against 10.78% of hemorrhagic stroke is largely consistent with incidence rates reported by Donnan et al (2008) and Andersen et al (2009) who reported 87% and 90% respectively for the incidence rate of ischemic stroke. The 9 cases of stroke that defied classification as either ischemic or hemorrhagic are likely due to a lack of conclusive evidence from brain imaging techniques or in some rare cases study participants not undergoing brain imaging at all.

Left hemiplegic stroke was more prevalent among participants (58.82%) as against right hemiplegia (41.18%). This trend is largely inconsistent with that reiterated by Hedna et al (2013) who had majority of ischemic stroke patients exhibiting right half hemiplegia. A mean of 6.18 months of rehabilitation implies most participants had achieved or were close to achieving their respective maximum functional and motor recovery levels as envisaged by Verheyden et al (2008).

5.21 Arm and leg Motor Scores of Study Participants

A score of 5 on the manual muscle test (MMT) denotes normal upper limb (arm) or lower limb (leg) power. Thus participants with motor scores of 5 for arm (20.59%) and leg (34.31%) are theoretically expected to have little or no difficulties in terms of activities of daily living that involve that particular limb□be it feeding with reference to the arm or walking with reference to the leg. With respect to participating in society participants with motor scores of 5 for both arm and leg are likely to go back to their jobs without requiring any large scale job modification or having to adjust to the job due to impairments. They are equally likely to have little to no challenges in terms of mobility, physical independence and economic self-sufficiency.

This is not to suggest such participants are immune to significant challenges in terms of participation. With stroke being a condition that primarily has to do with injury to the brain, cognitive challenges (including the severer dementia) are likely to persist as espoused by Zhou et al (2005). Such cognitive challenges could give rise to challenges with orientation (awareness of environment) and social integration. Further to this the concept of participation restriction has social and attitudinal dimensions. The social dimension embodies laws and social norms. The attitudinal component includes stigmatization and its concomitant variants. Thus a post-stroke patient who achieves the maximum upper limb and lower limb motor scores post-rehabilitation is not exempt from experiencing some level of participation restriction. Generally the lower the motor score for both the upper limb and lower limb the lower the anticipated participation in society.

5.22 Components of Participation Restriction and its Ranking by Study Participants

The specific components of participation restriction applied in the study were mobility, physical independence, occupation, social integration, orientation and economic self-sufficiency. Mobility had the basic definition of "getting around" and basically involves walking. Up to 74% of participants had some level of disadvantage associated with mobility. This finding is crucial due to the fact that mobility has obvious implications on other domains of participation restriction. Specifically it has a direct impact on physical independence, occupation and economic selfsufficiency. Harwood et al (1994) equally found mobility to be highly restricted in post-stroke patients.

Participants who experienced no disadvantage with regard to the mobility domain likely had sufficient power to overcome any barriers associated with that domain. These mostly physical barriers include the absence of ramps, hand rails and accessible transportation system. On the flipside the "no disadvantage" ranking could be attributed to the metropolis having sufficient facilitators to forestall any disadvantages associated with mobility post-stroke (or disability in general). A cursory assessment of facilitators/barriers within the metropolis indicates the former interpretation holds sway compared to the latter. On the other hand the nearly 5% of participants who perceived themselves as "severely disadvantaged" were likely unable to overcome the physical barriers to mobility due to the absence of facilitators that would enhance mobility of post-stroke patients. Other physical, social and attitudinal factors are likely responsible for the choices between the two extreme levels of "no disadvantage" and "severe disadvantage".

Physical independence had the basic definition of "looking after yourself". It entails whether participants are able to go about their daily activities independently or whether they require assistance from other persons. Over 60% of participants felt no disadvantage on this criterion unlike D'Alisa et al (2005) who reported this domain to be highly restricted.

Post-stroke participants who experienced no disadvantage likely had sufficient upper and lower limb strength post stroke to overcome any barriers associated with those activities. On the flip side the presence of facilitators could enhance activities of physical independence despite limb motor impairments. These facilitators could include proper signage, vestibules and curb ramps. The over 20% of participants who felt minimally disadvantaged are likely to have experienced more barriers (or less facilitators) or had lower upper limb and lower limb motor power to begin with.

Occupation had the basic definition of "work" and it's near uniform distribution across the five levels of disadvantage reflects the pervasive nature of work related participation restriction post stroke. Sturm et al (2002) and Harwood et al (1994) reported similar findings. Over a quarter of participants felt they had no disadvantage concerning work post-stroke. This could be attributed to them having an optimal motor function such that they slotted back into work without any difficulties. A second proposition could be the availability of facilitators that compensated for any motor impairment these post-stroke participants might have. Variations in the above two propositions are likely responsible for the other levels of disadvantages selected by other participants.

Social integration had the basic definition of "Getting on with people" and involves the interactions of post-stroke patients with persons within their communities. These interactions may range from persons encountered as the participant seeks a specific service to mere friends. Over 80% of participants felt they had no disadvantage in these interactions. This implies there were likely no barriers to effective social integration. The most likely barrier to social integration of post-stroke patients is stigmatization and it's subsequent "labeling". Thus the 20% of participants who experienced some level of disadvantage pertaining to social integration likely experienced some level of stigma.

Orientation had the basic definition of "awareness of environment" and relates how easily participants are able to familiarize and understand the external environment post stroke. Well over 90% of participants felt no disadvantage with this parameter, the highest in all the six parameters. This trend is similar to that of Sturm et al (2002) who found participation to be highest in the orientation domain but contrast sharply with Lo et al (2008) who reported significant challenges with orientation among post-stroke patients. Barriers such as the absence of proper signage on roads and community buildings could be responsible for different levels of disadvantages experienced by some participants on this parameter.

Economic self-sufficiency had the basic definition of "affording the things you need" and connotes the impact of post-stroke impairments and disabilities on the income of participants. The vast majority of participants besides a paltry 35% felt they experienced some level of disadvantage pertaining to earnings. This trend could be attributed to a lack of optimal motor strength that makes it difficult for these participants to fulfill those obligations that would earn them money. The facilitator-barrier factor cannot be ruled out either. The absence of facilitators or presence of barriers could obstruct these participants from executing their economic activities thereby negatively impacting their earnings.

5.3 Correlation between Arm Motor Impairment and Participation Restriction

The spearman rank correlation of 0.8343 is an indication of strong positive relationship between the two aforementioned variables. This trend largely agrees with Hamzat and Peters (2009) who deduced a positive relationship between motor function and participation.

It holds that the severer the arm motor impairment the higher the level of participation restriction experienced by the post-stroke participant and vice-versa. This conforms to the anticipated principle that post-stroke patients with severer motor impairments are likely to succumb to the numerous societal barriers that they encounter especially those barriers related to mobility, physical independence, occupation and economic self-sufficiency as these barriers by their physical nature require sufficient motor power to deal with. Further to this participants with severer arm motor impairment are equally at a disadvantage with regards to social integration and orientation the other two parameters that complete the six level participation restriction.

A participant with a severer arm motor impairment is likely to be restricted to his home environment due to difficulties in executing activities associated with the arm. Thus social interaction is likely restricted to his/her immediate family and integration with larger society is virtually non-existent, further contributing to participation restriction. Again severer arm motor impairments are likely to be obvious to other members of larger society □ leading to a "discredited" form of stigmatization that subsequently hampers social integration. Last but not the least a severer arm motor impairment is likely an indication of a severer injury in the brain. This direct injury to the brain (ischemic or hemorrhagic) could likely lead to difficulties in orientation as experienced by participants.

5.4 Correlation between Leg Motor Impairment and Participation Restriction

The spearman's rank correlation co-efficient of 0.8013 is an indication of a strong positive association between leg motor impairment and participation restriction. It connotes that the severer the leg motor impairment the higher the level of participation restriction. This trend, once again fits the anticipated principle that the severer a limb impairment the higher the level of participation restriction due to the fact that participation in society require optimal motor function. Leg motor impairment is likely to have a negative impact on mobility, physical independence, occupation and economic self-sufficiency □ as these components of participation share a common activity□ walking. Apparently the lower limb (leg) is primarily responsible for walking and any form of impairment that impacts it has an adverse effect on this activity. This problem is further compounded by the fact that impaired walking by post-stroke patients leads to compensatory mechanisms in other body systems. This results in fatigability and further restricts participation in society.

Difficulty in walking (an activity limitation) equally has negative impact on social integration as it serves to limit encounters with members and facilities of the larger community. Other factors that limit social integration include stigmatization and other attitudinal barriers □ more so for post-stroke participants with obvious leg impairments (severer leg motor impairment). A severer leg motor impairment is likely indicative of a severer initial injury in the brain, hence the likelihood of difficulties with awareness of the external environment (orientation).

5.5 Comparison of Correlation of Arm Motor Impairment and Participation Restriction against Leg Motor Impairment and Participation Restriction

The spearman rank correlation coefficient between arm motor impairment and participation restriction yielded 0.8343 while that between leg motor impairment and the latter yielded 0.8013. This could be interpreted as arm motor scores having a stronger relationship with participation (not participation restriction). This is because the London Handicap Scale (LHS) measures participation restriction in a negative sense which implies the higher the overall score on the LHS the lower the participation restriction and vice-versa. From this it follows that higher figures of arm motor scores correspond to higher levels of participation compared to that of leg motor scores. Thus leg motor impairment relates more to participation restriction compared to arm motor impairment. To the best of my knowledge hardly any previous studies link limb motor impairment to participation restriction. Desrosiers et al (2003) found leg impairment and disability to be more related to handicap situations (based on assessment of Life Habits) compared to arm impairment and disability.

The implication of this deduction is that for post-stroke patients within the Tamale Metropolis, residual post-rehabilitation leg motor impairment is likely to limit their participation in society compared to arm motor impairment. Specifically mobility, physical independence, occupation, social integration, orientation and economic self-sufficiency as a unit is hindered more by leg motor impairment than arm motor impairment.

A particular activity limitation that could account for the more debilitating effect of leg motor impairment on participation is likely difficulty in walking. Walking □ an activity that is so vital that it's limiting effect is felt at home and subsequently accentuated at the societal level. Further to this, difficulty in walking implies higher energy levels are required to undertake activities of daily living as espoused by Staines et al (2009). Higher energy demands imply fewer activities of daily living and subsequently physical deconditioning thrives. Thus a vicious cycle sets in that could account for the more debilitating effect of leg motor impairment on participation compared to arm motor impairment.

On the contrary arm motor impairment is unlikely to have such far reaching consequences although the implication of each participant's arm motor impairment is unique. The upper limb □ a relatively smaller limb compared to the lower limb has little impact on mobility. Further to this the unaffected upper limb in post-stroke patients has the potential to adequately compensate for the affected upper limb in some activities. Thus the overall effect of arm motor impairment on participation could be mitigated to a greater extent compared to leg motor impairment.

CHAPTER SIX

CONCLUSION, RECOMMENDATIONS AND LIMITATIONS OF STUDY

The specific objectives of the research were to establish the correlation between arm motor impairment and participation restriction, establish the correlation between leg motor impairment and participation restriction as well as deduce whether arm or leg motor impairment is more to participation restriction in post-stroke participants who had undergone at least 3 months of rehabilitation within the Tamale metropolis.

Generally, higher arm (upper limb) motor scores corresponded to higher levels of participation in post-stroke participants and vice-versa. Higher leg (lower limb) motor scores equally corresponded to higher levels of participation and vice-versa.

Both arm motor impairment and leg motor impairment had a strong positive correlation with participation restriction. However leg motor impairment had a stronger correlation (related more) with participation restriction compared to arm motor impairment. Specifically, leg motor impairment had a stronger relationship with difficulties in mobility, physical independence, occupation, social integration, orientation and economic self-sufficiency.

In light of these it is recommended that;

Rehabilitation experts (clinicians and non-clinicians) ought to draw a link between stroke related impairments and the social implication (participation restriction) of those same impairments in order to make informed decisions. This implies the assessment of recovery in post-stroke patients should not be solely based on the presence or absence of impairments but should include the challenges (physical, social and attitudinal barriers) these individuals are likely to encounter within society. Further to this, disability practitioners need to focus on interventions that are aimed at reducing the impact of barriers (physical, social and attitudinal) as these barriers are likely to engage the attention of post-stroke patients compared to the underlying impairment.

With respect to policy in procuring assistive devices, the study clearly demonstrates that both arm and leg assistive devices would be useful in reducing participation restriction in the Tamale Metropolitan Area. In terms of a choice between the two aforementioned devices, leg assistive devices would be more useful in improving participation of post-stroke patients within the metropolis.

Further research should be conducted to link the three components of disability; impairments, activity limitation and participation restriction so as to draw a complete picture of disability for post-stroke patients.

A major limitation of the study is the fact that motor impairment was assessed solely on the ability to perform voluntary movement (muscle power). Motor impairment does not preclude sensory disturbances and motor coordination difficulties which have the potential to influence participation restriction. Further to this, the exclusion of post-stroke patients unable to communicate implies the external validity of the research is limited.

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APPENDIX I Arm and Leg Motor Impairment after Stroke Rehabilitation: Relation to Participation Restriction Data Collection Sheet

Date: ____ /___ , 2015

Participant's ID number:________

Assessor's Name:________________________________

Upper limb motor score of participant on MMT: ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Lower limb motor score of participant on MMT: ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Demographic Profile and Stroke Characteristics

Age_____ (yrs) Sex_____ Occupation__

1. Type of stroke: Ischemic ☐ Hemorrhagic ☐ Unknown ☐
2. Side of hemiplegia: Right ☐ Left ☐ Bilateral ☐
3. Natural dominant half: Right ☐ Left ☐
4. Number of months since first stroke episode
5. Number of months spent undergoing physical/medical rehabilitation__________ **Participation Restriction Using LHS**

Parameter	**Finding (Please tick one)**	**Value**
Mobility:	No disadvantage	0.071
Are you able to walk in and outside the home?	Minimal disadvantage	0.038
	Mild disadvantage	0.000
	Moderate disadvantage	-0.036
	Severe disadvantage	-0.072
	Most disadvantaged	-0.108

Parameter	Finding (Please tick one)	Value
Physical independence:	No disadvantage	0.102
Does your condition affect your ability to wash yourself, dress yourself or go shopping?	Minimal disadvantage	0.011
	Mild disadvantage	-0.021
	Moderate disadvantage	-0.053
	Severe disadvantage	-0.057
	Most disadvantaged	-0.061
Occupation:	No disadvantage	0.099
How has your condition impacted your job?	Minimal disadvantage	-0.004
	Mild disadvantage	-0.014
	Moderate disadvantage	-0.024
	Severe disadvantage	-0.035
	Most disadvantaged	-0.060
Social integration:	No disadvantage	0.063
Does your condition stop you getting on with family and friends?	Minimal disadvantage	0.035
	Mild disadvantage	0.007
	Moderate disadvantage	-0.022
	Severe disadvantage	-0.029
	Most disadvantaged	-0.041
Orientation:	No disadvantage	0.109
Has your condition made it more difficult to understand the world around you?	Minimal disadvantage	-0.008
	Mild disadvantage	-0.038
	Moderate disadvantage	-0.051
	Severe disadvantage	-0.063
	Most disadvantaged	-0.075
Economic self-sufficiency:	No disadvantage	0.100
Has your condition reduced the amount of money you make in a month?	Minimal disadvantage	0.067
	Mild disadvantage	0.033
	Moderate disadvantage	-0.023
	Severe disadvantage	-0.067
	Most disadvantaged	-0.111
	Grand Total	

APPENDIX II

Data Collected

Age	Sex	TS	HS	DH	MSFS	MPMR	ULS	LLS	LHSS	ID
56	F	I	R	R	11	6	3	4	0.76	10
72	M	I	L	R	14	12	4	4	1	22
45	M	I	R	R	7	5	4	3	0.538	4
73	M	I	L	R	36	30	2	3	0.477	15
53	F	I	R	R	13	4	3	3	0.745	225
78	M	I	L	R	14	8	3	4	0.712	76
68	M	U	R	R	24	16	4	4	1	13
59	F	I	L	R	8	5	4	5	1	19
66	M	I	R	R	4	3	2	3	0.65	302
76	M	U	L	R	6	5	5	5	1	28
48	F	I	L	R	19	6	1	2	0.172	101
51	M	I	R	R	7	6	3	4	0.856	203
64	M	H	R	R	14	10	3	3	0.712	214
73	M	I	L	R	12	8	4	4	1	109
55	M	I	L	R	5	3	2	3	0.611	295
59	F	I	L	R	4	3	3	3	0.712	206
67	M	I	R	R	11	5	4	5	0.856	101
81	M	I	R	R	7	5	5	5	1	28
69	M	I	L	R	4	5	2	2	0.655	31
50	F	I	R	R	12	8	3	4	0.817	45
64	F	I	R	R	6	3	3	4	0.864	38
67	M	I	L	R	6	4	5	5	0.747	22
74	M	I	R	R	8	5	4	3	0.74	27
72	M	I	L	R	12	8	3	4	0.668	98
49	M	I	L	R	14	9	4	4	0.876	80
52	M	I	R	R	18	12	3	4	0.696	28
49	M	I	L	R	6	4	5	5	0.967	72
56	F	I	L	R	8	5	3	4	0.74	45
46	F	I	L	R	9	5	4	4	0.831	63
51	F	I	R	R	12	6	3	3	0.46	75
71	M	I	L	L	9	5	4	5	0.967	81

78	F	H	L	R	36	5	4	4	0.934	92
69	M	I	L	R	48	7	3	4	0.876	79
78	M	U	R	R	8	3	5	5	1	201
67	M	U	L	R	28	5	4	4	1	110
56	M	I	L	R	18	8	3	3	0.706	15
79	M	I	L	R	5	4	2	3	0.668	207
75	F	I	R	R	13	8	4	4	0.909	56
78	F	I	L	R	16	7	3	3	0.712	75
67	M	I	L	R	6	4	4	5	0.897	83
69	M	I	L	R	24	5	4	4	0.972	96
72	F	I	R	R	41	7	5	5	0.83	9
82	M	I	L	R	12	6	4	5	0.867	34
49	F	I	L	R	11	4	5	5	1	45
61	M	I	R	R	8	7	2	3	0.38	79
71	F	H	L	R	14	10	2	2	0.505	56
65	M	I	R	R	15	3	5	5	1	19
42	M	I	R	R	14	5	3	4	0.675	49
67	F	I	L	R	10	5	1	2	0.457	84
51	M	H	L	R	5	4	3	3	0.584	70
59	F	I	L	R	14	5	3	3	0.771	58
50	M	I	R	R	13	7	4	4	0.844	93
45	M	I	R	R	12	5	4	5	1	13
64	M	I	L	R	13	6	5	5	1	217
67	F	I	L	R	15	7	5	5	1	106
71	M	H	L	R	14	6	3	2	0.678	235
45	M	I	L	R	15	6	4	4	0.712	82
76	F	I	L	R	12	8	5	5	0.817	53
68	M	H	R	R	8	7	3	3	0.611	9
74	M	I	R	R	36	5	3	4	0.856	266
64	M	I	R	R	13	6	5	5	0.897	194
55	M	I	R	R	8	5	2	3	0.668	258
59	F	H	L	R	30	4	4	4	1	28
73	M	U	L	R	32	10	2	3	0.537	29
75	F	H	R	R	8	5	4	5	1	12
39	F	I	R	R	12	8	5	5	1	283
76	M	U	L	R	16	5	3	3	0.514	33
55	M	I	L	R	13	8	5	5	0.897	98
67	M	I	L	R	5	3	4	5	0.972	49

76	**M**	**I**	**L**	**L**	**10**	**4**	**3**	**4**	**0.457**	**66**
47	**M**	**I**	**R**	**R**	**17**	**6**	**5**	**5**	**1**	**38**
60	**F**	**I**	**L**	**R**	**12**	**6**	**2**	**3**	**0.494**	**101**
71	**F**	**I**	**R**	**R**	**7**	**4**	**2**	**2**	**0.296**	**155**
76	**M**	**I**	**L**	**R**	**9**	**6**	**4**	**4**	**0.711**	**277**
55	**M**	**I**	**R**	**R**	**19**	**7**	**5**	**5**	**0.906**	**148**
66	**M**	**I**	**L**	**R**	**13**	**7**	**4**	**5**	**1**	**139**
44	**F**	**I**	**R**	**R**	**12**	**9**	**2**	**3**	**0.449**	**88**
81	**M**	**I**	**R**	**R**	**8**	**5**	**4**	**5**	**0.876**	**120**
79	**M**	**I**	**R**	**R**	**5**	**4**	**3**	**4**	**0.584**	**91**
76	**M**	**I**	**R**	**R**	**22**	**8**	**3**	**3**	**0.696**	**126**
81	**M**	**I**	**L**	**R**	**8**	**5**	**4**	**5**	**0.887**	**139**
56	**F**	**I**	**L**	**R**	**15**	**8**	**5**	**5**	**1**	**181**
64	**M**	**I**	**L**	**R**	**22**	**9**	**2**	**3**	**0.74**	**148**
49	**F**	**U**	**L**	**R**	**19**	**7**	**3**	**3**	**0.778**	**243**
55	**M**	**I**	**R**	**R**	**8**	**4**	**4**	**5**	**0.831**	**5**
56	**M**	**H**	**L**	**R**	**24**	**12**	**5**	**5**	**1**	**201**
58	**M**	**I**	**L**	**R**	**8**	**4**	**4**	**5**	**0.864**	**244**
78	**M**	**I**	**L**	**R**	**12**	**6**	**1**	**2**	**0.437**	**138**
75	**M**	**I**	**L**	**R**	**7**	**4**	**3**	**3**	**0.658**	**26**
66	**M**	**I**	**R**	**R**	**13**	**6**	**3**	**4**	**0.692**	**76**
45	**M**	**I**	**R**	**R**	**16**	**4**	**1**	**2**	**0.451**	**149**
50	**F**	**I**	**L**	**R**	**8**	**3**	**5**	**4**	**1**	**194**
42	**F**	**I**	**R**	**R**	**13**	**6**	**4**	**5**	**0.897**	**228**
43	**M**	**H**	**L**	**R**	**7**	**3**	**5**	**5**	**1**	**178**
46	**F**	**U**	**R**	**R**	**18**	**5**	**2**	**3**	**0.396**	**195**
50	**M**	**I**	**R**	**R**	**5**	**3**	**3**	**3**	**0.712**	**92**
55	**M**	**I**	**L**	**R**	**8**	**3**	**4**	**4**	**0.934**	**145**
59	**F**	**U**	**L**	**R**	**9**	**6**	**5**	**5**	**1**	**133**
63	**F**	**I**	**L**	**R**	**10**	**5**	**3**	**4**	**0.856**	**68**
45	**M**	**I**	**R**	**R**	**13**	**4**	**2**	**1**	**0.65**	**89**
46	**M**	**H**	**L**	**R**	**15**	**7**	**3**	**3**	**0.668**	**186**
47	**M**	**I**	**L**	**R**	**14**	**8**	**4**	**5**	**1**	**172**

Keys: TS □Type of Stroke

HS □ Hemiplegic Side

DH □ Dominant Half

MSFS Months since First Stroke

MPMRMonths on Physical/Medical Rehabilitation

ULS Upper Limb Score

LLS Lower limb Score

LHSS London Handicap Scale Score