THE PREVALENCE OF COGNITIVE DYSFUNCTION FOLLOWING
TRAUMATIC BRAIN INJURY IN PATIENTS AT KENYATTA NATIONAL
HOSPITAL

A THESIS IN PART FULFILLMENT FOR THE AWARD OF THE DEGREE OF
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DECLARATION FORM

I SHEILA GACHANJA do declare that this dissertation is my own original work. It has not been presented to any other University or institution for the purpose of obtaining a degree or diploma.

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This Research Dissertation Is Dedicated to The Memory of My Late Grandmother:

SUSANNA MARY WANJIRUWAWERU,

A Woman of Great Character and Substance; Cucu, I Have Achieved What in Your Time You Couldn’t For Lack Of Resources & Not Incapacity, but You However Fought Hard For Me to Get the Education for Which I Now Enjoy, RIP.

&

To the walking wounded; those who grapple with the invisible cognitive deficits following traumatic brain injury.
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ABBREVIATIONS AND ACRONYMS

GCS – Glasgow Coma Scale

KNH – Kenyatta National Hospital

LOC – Loss of Consciousness

MMSE – Mini Mental Status Examination

MVA – Motor Vehicle Accident

PTA – Post Traumatic Amnesia

PTE – Post Traumatic Epilepsy

RBANS – The Repeatable Battery for the Assessment of Neuropsychological Status
(RBANS)

RTA – Road Traffic Accident

TBI – Traumatic Brain Injury
DEFINITION OF OPERATIONAL TERMS

Cognition was defined as the mental processes involved in acquiring, storing, retrieving, and using information and that include sensation, perception, memory, imagery, concept formation, reasoning, decision making, problem solving, and language.

TBI- A TBI occurs when a mechanical force is applied to the head and affects brain functioning. The mechanical force can consist of a blow to the head (such as from an assault, a fall, or when an individual strikes his/her head during a motor vehicle accident) or from a rapid acceleration-deceleration event (like a motor vehicle accident). It is possible for the brain to become injured even if the head has not directly struck or been struck by another object. When a force that results in head injury affects brain functioning, such as reducing the level of consciousness or confusion, the head injury is referred to as traumatic brain injury.

MEMORY: Memory refers to the process by which we use to acquire, store, retain and later retrieve information. The process of memory involves attention, encoding, storage and retrieval. The parts of the brain that are most associated with memory are the temporal lobes and a limbic structure called the hippocampus.

EXECUTIVESKILLS: Executive functions are high-level abilities that influence more basic abilities like attention, memory and motor skills. Executive functions of the brain encompasses a wide range of skills like planning, judgment, sequencing, rational thought, control and regulation of other abilities and behaviors, goal-directed behavior, initiation, inhibition. Executive functions allow one to anticipate outcomes and adapt to changing situations. The ability to form concepts and think abstractly is often considered components of executive function.

Language: A means of communicating thoughts and feelings, using a system of socially shared but arbitrary symbols (sounds, signs, or written symbols) arranged according to rules or grammar.

Attention: Attention is the ability to focus on certain aspects of the environment that are considered important or interesting and to flexibly manipulate this information.
ABSTRACT

Modern cognitive psychology has led us to understand and appreciate that all mental processes comprise of perceiving, thinking, recall, learning and language skills. These cognitive skills become impaired following a brain injury. Traumatic brain injury often impairs various parts of the brain and consequently alters the functioning of the brain. With the increase in modern technology and brain science many of the individuals who would have previously succumbed to their injuries often survive their head trauma only to be left with severe cognitive impairments. Road traffic accidents are the major cause of head injury with a rate of over half the overall incidence, while the rest are caused by sports and recreation falls, violence, and constructional accidents form the other bulk. The risk factors for sustaining a brain injury are being male, low socioeconomic status, unemployment low education levels and the use of alcohol. This research study is significant in that it will seek to determine the prevalence of cognitive dysfunction and thus come up with recommendations on how to handle this major health problem.

Objective

The purpose of the study was to find out the prevalence of cognitive dysfunction following traumatic brain injury in patients at the Kenyatta National Hospital.

Study Site

The study took place at Kenyatta National Hospital in the neurology, surgical clinics and the wards.

Study Design:

This was a cross sectional descriptive study that was conducted at the Kenyatta National Hospital. Data was collected using a structured demographic questionnaire, the Mini Mental Status Examination, the Trail Making Test and the Repeatable Battery for the Assessment of Neuropsychological Status. The researcher interviewed 75 study participants in this study.
Results

A total of 75 brain injury patients were recruited for the study. The actual study participants were 74. One study participant was excluded because their cognitive impairment was very severe as measured on the MMSE. The study comprised of 58 (78.4%) male study participants and 16 (22.6%) female study participants. The mean age of the study participants was 33.94 years. On the MMSE a majority of the respondent (67.7, 50) had no cognitive impairment, 31.1% (23) had moderate cognitive impairment while 1.4% (1) had severe cognitive impairment.

On the Trail Making Test (TMT) part A, 4.1% (3) had no cognitive impairment. A majority of the study participants 44 (59.5%) had mild cognitive impairment 36.5% (27) had moderate to severe levels of cognitive impairment.

On the TMT part B 8.1% (6) had no cognitive impairment. A majority of the study participants 31 (41.9%) had mild cognitive impairment, 22 (29.7%) had moderate impairment while 15 (20.3%) had severe impairment.

In the RBANS, 39 (51.4%) had severe cognitive impairment, 26.8% (19) of the study participants had moderate cognitive impairment. 13.4% (10) had mild cognitive impairment while the remaining 8.4% (6) scored in the average range of the standardized scores on the RBANS.

In this study there was significant cognitive impairment following TBI that was seen in the study participants. Cognitive impairment was significantly associated with age with a p = (0.037), gender with a p value of p=0.012, occupation p = 0.000, educational level 0.000, monthly income p= 0.016, and the cause of injury p = 0.006.

Conclusion

In conclusion there was significant cognitive impairment in the various areas of cognition to do with memory, attention, visual spatial abilities, constructional skills, language skills and executive skills in this study. Head injuries including those that are mild have a cumulative effect on the functioning of the brain. Their outcomes are far reaching beyond the physical scars or physical disability that is seen.

Recommendation:

There is need for clinical screening and neurocognitive rehabilitation for those who are found to be impaired in order to improve the quality of life for these patients. There is need to screen for cognitive impairment in primary health care and to refer patients for prompt psychological care to deal with the psychological issues and cognitive impairment following head injury.
CHAPTER ONE

1.1 INTRODUCTION

Modern cognitive psychology and brain science have led us to appreciate that all mental processes consist of perceiving, thinking, learning and remembering, and even the simplest of tasks requires the co-ordination of several regions of the brain.

TBI is a silent epidemic of modern times. TBI is defined as an acquired brain injury which occurs due to sudden trauma to the brain causing damage. TBI is mainly caused due to accelerating and decelerating forces within the brain or by a blunt object. According to Lezak, TBI occurs when a mechanical force is applied to the head and affects brain functioning. The mechanical force can consist of a blow to the head such as from an assault, a fall, or from a rapid acceleration-deceleration event as in the case of a like a motor vehicle accident. The notion that it is possible for the brain to become injured even if the head has not directly struck or been struck by another object has been a well-documented event. In the event of one sustaining a TBI, the effects are compounded by the loss of consciousness as well as post traumatic amnesia.

Historically, clinicians and investigators have classified traumatic brain injury as mild, moderate, and severe by using the scores of the Glasgow Coma Scale, a widely-used scoring system to assess coma and impaired consciousness. Patients with scores of 8 or less are classified as severe; scores of 9 to 12 are moderate; and scores of 13 to 15 are mild.

TBI is a global problem that affects a lot of people and whose costs are far reaching. The direct economic costs of global road crashes have been estimated at US$ 518 billion, with the costs in low-income countries – estimated at US$ 65 billion – exceeding the total annual amount received in development assistance to these countries. According to the CDC, over 5.3 million Americans live with impairments following a TBI. In America the cost of TBI is estimated to be about $60 billion annually. In India, 30,000 people die and about 120,000 are impaired every year due to TBI. The economic implication of TBI in India is estimated to be around Rs. 350 Crores.

Although the figures for the incidence of TBI are extremely large, they do however underestimate the true magnitude of TBI. Many of the individuals, who sustain a mild TBI, often are not detected, by the medical professionals and are often discharged with their impairments.
In Kenya, over 75% of road traffic casualties involve economically productive young adults with the average age of 30. Despite the large social and economic costs, there has been a relatively small amount of investment in road safety research and development, compared with other types of health loss.\(^6\)

Cognitive impairments which go unnoticed form a group of problems that prevent participation in expected and desirable societal roles like schooling, career work, parenting etcetera and often result in the greatest burden that is associated with TBI. In a study done by Rimel 1982 of 538 patients with TBI found that they were high rates of morbidity and unemployment in patients three months after the injury and the evidence that at the time of discharge, the cognitive deficits were not noticed.\(^4\) It is certain that in Kenya, and most of the rest of the world, that not enough consideration and time is spent on the retraining of the intellectual functions that are lost or impaired due to TBI.

**BACKGROUND OF THE STUDY**

**CAUSES OF TBI**

Half (50%) of all the TBI’s are due to transportation accidents involving all kinds of vehicles and pedestrians. They are the major cause of TBI to those who are below the age of 45. Approximately 20 percent of TBIs are due to violence, such as firearm assaults, fights, and child abuse, and about 3 percent are due to sports injuries. About 50% of all TBI incidents involve alcohol use\(^9\).

Motor vehicle accidents are the most common cause of head injury accounting for about 50% of all the injuries, they are followed by falls which account for 21%, violence accounts for about 12%, while injuries from sports and other recreation activities account for 10%. Closed head injuries in which the Dura matter is not penetrated account to about 90% of all TBI.\(^10\)

In Kenya most of the RTAs are caused by human error like over speeding, careless driving, drunk driving, and not observing the Highway Code, which accounts for 85% of the total causes, with mechanical problems accounting for 11% and the other 4% is accounted for by poor weather.\(^11\)
RISK FACTORS

Save for those over the 75 year age group, in which women outnumber the men, males, sustain injuries twice as frequently, as or more often than females. \(^2, 12, 13\) Lower socio economic status, unemployment, and lower education levels too appear as risk factors, increasing the likelihood of head injuries and consequently trauma. Injuries in these high risk populations seem to be mainly from assaults and falls.\(^2, 13, 14\) The researcher notes with keen concern the risk factors that have been identified as they could serve as a prototype for a developing country like Kenya. The risk factors are further compounded with the lack of safety infrastructure and the lack of compliance to the Highway Code. In Kenya the victims of RTA were identified to be mainly passengers who accounted for 41.1% of those who succumbed, pedestrians 36.1%, cyclists 12.4% and drivers 10.1%. \(^11\)

Alcohol and substance use has been implicated in the occurrence of TBI in a lot of studies on head injuries. In one study done, they found that in a series of patients, at least 29% had some prior Central Nervous System condition, including history of alcoholism (18%), and of head injury (8%). However, Kreutzer, and Rimel have reported that they found higher estimates of heavy drinkers. TBIs have also been reported to be common especially in the community psychiatric population. \(^16, 4\)

According to a prospective survey done on those who had mental illness and substance abuse, 72% had previously suffered TBI\(^17\). Substance abuse especially the use of alcohol predisposes one to drunk driving and thus MVA, head injury due to fights and brawls from a drunken spree. In a study done at a rehabilitation hospital in Pennsylvania, slightly more than 40% of those admitted for care of head injuries were suffering from alcohol abuse. \(^17\).

Studies implicate alcohol in one third to half of all deaths related to trauma in recurrent head injuries has been found to be a common occurrence in patients with a history of alcoholism and in contact sports patients. \(^5\) Acknowledging the fact that alcohol use and abuse has been a major enigma in Kenyan society, the translation of these would imply that the Kenyan community is by and large at a greater risk of sustaining a TBI in one’s lifetime. This is saddening noting that even in cases of mild traumatic brain injury, cognitive, behavioral and personality changes are bound to affect an individual sometimes even maiming them for life.
While motor vehicle accidents and falls are the leading cause of head injury, assaults whether by blows to the head or by penetrating objects like weapons, machetes, etcetera, sports and other recreational activities, and work related injuries account for from about 25% to 40% of reported injuries.  

According to Lezak, in one study on 2,310 patients with neurologic trauma, 11% comprised of motor cyclists who were found to more likely sustain focal and severe injuries, require craniotomies and have poor outcomes than other neuro-trauma patients. Motor cycle accidents also account for the most frequent civilian cause of TBI.

According to the 2009 World Health Organization (WHO) global status report, Kenya recorded 3,760 traffic deaths, the highest in East Africa region. At least 90% of the global fatalities from traffic accidents occur in low and middle income countries even though, only 46% of global vehicles are in these countries. Kenya has among the worst statistics globally. By 2015, the World Health Organization predicts the increase of road deaths will rise from 1.2 to 1.8 million, and by 2.4 million by the year 2030.

The researcher notes with deep concern the implication of this study to the situation here in Kenya, in which the use of motor cycles has increased in virtually all places in the country. The motorcycles are used greatly within major and small towns in urban centers and within the rural areas for transportation purposes in times where access to the interior parts of the country where the road networks are in bad condition or they do not exist, or as an adjunct in urban areas where they are faster, cheaper and offer door to door services as compared to other means of road transportation. This increased use of the bodabodas as they are popularly referred to, has also gone with increased road accidents and falls. The investigator will seek to know what their impact is as pertains to head injuries and what happens to the survivors of TBI.  Globally, the incidence of TBI is increasing largely due to the increase in motor vehicle use in low and middle income countries. 

In a developing country like Kenya, automobile use has increased faster than safety infrastructure could be established. In the report, Kenya had 12,470 reported non-fatal accidents in the year 2007. The high incidence of RTA in Kenya, could also possibly translate to higher rates of TBI in the country. According to the WHO report, the patients who were admitted to the surgical wards following head injuries were between 45% -60%.
The increase in biking and motorcycling has focused attention on injuries sustained during these activities. Most of these injuries are traumatic brain injuries (TBI), caused by the lack of helmets for head protection. Fatal crashes from cycling are mostly likely to result in TBI. Serious head injuries have been found to be more prevalent in adults although a fair amount of children are injured while cycling.

1.2 PROBLEM STATEMENT

TBI is a silent plague of modern times. It is the most common cause of death and disability among young people below the age of 45 and accounts for a considerable amount of life years of disability. TBI severely disables about 150-200 persons per one million annually. According to the World Health Organization, the burden of TBI is greatest in Low- and Middle-Income Countries (LAMIC), where 85% of the world's population live. Despite this, very little is known about patient outcomes after TBI in LAMIC. The Global status report found that low- and middle-income countries have higher road traffic fatality rates (21.5 and 19.5 per 100,000 population, respectively) than high-income countries (10.3 per 100,000). Over 90% of the world’s fatalities on the roads occur in low-income and middle-income countries, which have only 48% of the world’s registered vehicles.

Most of the brain injuries in this group of people come from accidents like the RTA and from falls and risk taking behavior. The cost of TBI to a country is far reaching; a lot of money is spent in the treatment of the survivors and also by the insurance companies. Overall TBI has an economic impact on the family which loses income due to low rates of return to work for survivors and to the country due to the loss of able bodied persons who form the working population in the country.

In developing countries like Kenya, the rate of infrastructure has developed faster than the rate of safety measures could be put in place. It has been estimated that there are over 1.18 million road traffic injury related deaths annually globally, with 74% occurring in developing countries.

In Kenya, there has been an alarming rise in RTA with a consequence in the rise of morbidity and mortality rates. TBI is one of the commonest outcomes of RTA while other traumas are mainly physiological. Brain injury in turn causes deficits in cognition with skills like memory, thinking, attention and concentration, executive skills, language and communication...
skills being greatly affected to varying degrees. In Kenya the rise in the rate of substance abuse especially the use of alcohol has led to the increase in the risk of RTAs. According to the Kenya Police statistics, over 3,000 people perish each year, with over 30,000 people getting injured. 11

These rates are alarming owing to the fact that the survivors of road accidents have been noted to succumb to their fatal injuries days later or to live with considerable disability. In addition to RTAs, alcohol and other substances of abuse increase the risk of fights and blows to the head, and consequently raising the possibility of TBI.

Head injuries present an immense problem to medical services within a country. While Kenya has increased the number of professionals dealing with brain injury patients, like neurologists, neurosurgeons, and other mental health workers like psychiatrists and psychologists, few in the field if any are involved in the rehabilitation of patients suffering from cognitive deficits following brain injury. This creates an immense problem to the country and to the individuals who need rehabilitation and their families who have no idea on what to do. The role of the researcher was to quantify the cognitive outcomes of TBI, and thus highlight the problem of TBI and consequently the need to train more health workers to deal with this health riddle. The younger age groups tend to be overrepresented in those who sustain a brain damage because life expectancy is often near normal 3 for this age group.

In Kenya the role of rehabilitation is critical in order to maximize quality of life by reducing cognitive disability and by improving quality of life. These younger age groups of able bodied persons usually form the working class of a nation and therefore the economic backbone of the country, cognitive disability would mean loss of incomes, and disruption of socio lives. It is unfortunate that the necessary rehabilitative services are nonexistent in a country that would be in dire need for the services.

TBI presents a major worldwide social, economic, and health problem. It also plays a leading role in disability due to trauma. In Africa, like the rest of the world TBI is a leading cause of death and disability in persons under the age of forty five. The rate among young males (ages 15 to 44 years) tended to be at increased risk of being injured or killed on roads. Unfortunately this would include the most economically active group; making road traffic crashes a contributor to increased economic vulnerability at individual and household levels, and entrenched poverty in communities.
1.3 RESEARCH OBJECTIVES

1. To determine the prevalence rate of cognitive dysfunction following a TBI among patients at the KNH.

2. To identify the effects of TBI on cognitive abilities like attention, memory, thinking, constructional abilities, executive skills and language and communication.

3. To determine the association between cognitive impairment and socio-demographic factors like age, gender, level of education, religion, cause of TBI and socio economic status.

1.4 JUSTIFICATION OF THE STUDY

After the initial care during the hospitalization period, patients are typically discharged to their homes and back to their occupations with minimal plan to deal with their inevitable cognitive impairments and other behavioral challenges following TBI. While it is banal that many of the health workers dealing with brain injury patients realize that the outcomes of it are usually multi modal. In Kenya, the screening of patient’s neurobehavioral status following a head injury is uncommon. Cognitive rehabilitation for those needing it is also not available and patients have to wade through their difficulties sometimes with loss of previously held roles and status due to impairment. It is therefore significant to have a study done on the cognitive impairments and their impact so that policies can be put up to curb the problem and increase the quality of life for those who have had a traumatic brain injury.

According to the emerging database, there is sufficient evidence that traditional rehabilitation which focuses on physiotherapy does not render any attention to the cognitive deficits following brain injury. The physical treatment given coupled with occupational therapy are often inadequate and render the patients to be physically fit but to be cognitively disabled giving rise to the term the walking wounded. When the patients return to their occupations they are accosted by their new impairments and the painful realization that they are not as they used to be. A status that further complicates their psychological well-being giving raises to mood disorders, apathy, and personality change and personality disorders.
It is with this in mind that the researcher wants to investigate the magnitude of the problem and then make recommendations on the way forward.

This study then is justifiable to be carried out to bring out the magnitude of cognitive disability and other related issues for the well-being of the country and in particular those that are affected either directly or indirectly.

This research study will validate the need for psychological assessment, diagnosis and cognitive retraining for those found to be suffering from (psychological) cognitive deficits following brain injury. It will sensitize the policy makers on the cognitive deficits that occur following a brain injury and their far reaching consequences on the economy and society at large.

Data from this study will validate the need for training health professionals especially neuropsychologists, who at the moment are nonexistent in the country. The study will facilitate the patients with knowledge of their cognitive impairments and what they can do to improve their abilities. The findings derived from the study will enable other institutions dealing with brain injury to develop programs that address the aftermath of brain injury. Other researchers may also use this study a springboard for further research.
CHAPTER TWO

REVIEW OF RELATED LITERATURE

INTRODUCTION:

This chapter covered literature on TBI, how it is measured, the epidemiology of TBI, causes of TBI, the risk factors involved in sustaining a brain injury and the outcomes of TBI, under the headings of memory, attention, executive function, construction ability, language, communication, and the long term complications of TBI.

2.1 INCIDENCE /EPIDEMIOLOGY OF TRAUMATIC BRAIN INJURY

TBI is a silent epidemic of modern times; it is also a leading cause of morbidity and mortality. In persons under 45 years of age, TBI is the leading cause of death and disability. In the United States the yearly incidence of TBI is estimated at 180-250 per 100,000 people which is approximately 2 million people per year. Of these patients about 500,000 may require hospitalization, with about 80,000 who will suffer from some level of chronic disability. In the United States of America, approximately 230,000 survive after TBI. 9 Motor vehicle accidents are the most common cause of head injury in the United States, accounting for more than 50%, followed by falls (21%), violence (12%), and injuries from sports or recreational activities (10%). Health costs from TBI in the USA are estimated to be $48 billion annually. 22 In France, the yearly incidence for TBI was 281 per 100,000, 322 per 100,000 in Australia, 430 per 100,000 in England, and in South Africa the rate was 361 per 100,000. 22 In India 30,000 people die and 125,000 persons are disabled each year due to TBI. 8 In Kenya, according to the Kenya Police statistics, over 3,000 people perish each year, with over 30,000 people getting injured. 11

According to the World Health Report on Road safety 2007, all road users were at risk of getting involved in a RTA, irrespective of the mode of transport. The risk was found to be particularly high in vulnerable populations like for pedestrians, or those travelling on two- or three-wheeled vehicles. Other categories of road users who were at high risk of injuries and fatalities included those using public transport, and passengers on pick-up trucks who are sometimes perched on top of goods and merchandise. A few countries were found to have only pedestrians dominating the death rates: Democratic Republic of Congo (59%), Ethiopia (54.8%), Kenya (47%), Malawi (45%), Mozambique (68.1%), and Zambia (49.8%). 20
According to Lezak,\textsuperscript{2} it is also the most common cause of brain damage. Modern medical techniques for the management of acute brain conditions are saving more accident victims who ten or twenty years ago would have succumbed to the metabolic, hemodynamic and other secondary complications that follow severe head trauma.\textsuperscript{2,23}

\section*{2.2 Etiology of Psychiatric Disability After TBI}

Morbidity following TBI is affected by various Psychological and etiological factors which contribute to the severity of psychological and psychiatric illnesses. There is a link between the psychogenic and physical factors that influence the outcome of a head injury.\textsuperscript{24}

\subsection*{2.2.1 Mental Constitution}

The mental constitution refers to the pre-morbid psychiatric status of the person who has been injured. It is difficult to ascertain the pre-morbid mental ability and personality through the use of psychological assessments. However, Lishman asserts that it is a well-documented phenomenon that a history of behavioral problems, psychosis, deviations from the norm, and being intellectually challenged in relatives has a far reaching consequence in the person in question. Studies show that the development of psychiatric morbidity following head injury is seen to rely heavily on the pre-morbid mental status.\textsuperscript{24}

The researcher reaffirms that the presence of psychological stressors as well as substance abuse has an effect on the severity on the cognitive abilities following TBI.

\subsection*{2.2.2 Repeated Head Trauma}

Repeated head injuries are likely to have a far reaching and greater effect on ones cognition. A second head trauma even when mild tends to leave a victim with more cognitive deficits than if it was only a single infarct.\textsuperscript{2} While it is noteworthy that a single head injury usually doubles the risk of sustaining another head injury in the future. While two such injuries raise the risk eight times over.\textsuperscript{25}

The effects of repeated head injury have been well demonstrated by the effect of contact sports like boxing and soccer where in later years dementia pugilistica tends to develop in this population. Boxing has shown a cumulative effect on repeated trauma to the brain in which fighters have shown Parkinsonism and motor symptoms. Other cognitive impairments
exhibited by boxers’ include memory problems, disorientation and confusion which are also discussed elsewhere in this study.

2.2.3 AGE

Most literature on brain and head injuries suggest that age appears to have an effect on the severity of cognitive impairments in adults. Two aspects which affect the severity of trauma Post Traumatic Amnesia and the duration of a coma, compound impairment with advancement in age. As earlier noted the longer the PTA and the loss of consciousness, the greater is the morbidity and mortality rate. 26

Lishman, alludes that the severity of the impairment with increasing age could be due to the possible increase in cerebral vascular Disease, the diminishing reserve of neurons, and the general loss of resilience and adaptability in older adults. 24

Results from one study of patients with severe head injury and above the age of 65, showed that they were twice as likely to die (77%) from their injuries than younger patients (39%) with the similar severity. The elderly with moderately severe injuries were more than twice as likely to remain severely affected or be in a vegetative state (35%) compared to (14%). The rate of return to work for those aged 50 and above was less than 30% whereas more than 70% of those aged below 20 years were able to do so. Anxiety and fears which he attributed to increased problems in occupational and financial adjustment were more common with the increase in age at the time of injury. 24

2.2.4 LOCATION OF BRAIN DAMAGE

While assessing the severity of brain damage and the location it is important to note that problems do arise in the attempt to give precise localizations of lesions following TBI. Correlations that have been investigated between the location of the lesion and the mental morbidity exhibited. In this regard, the investigator acknowledges that literature suggests that precision on closed head may be difficult to ascertain than in penetrating head injuries. In CHI focal deficits are overlaid by generalized effects of brain damage. Notable impairments like dysphasia and the frontal lobe syndrome have been noted in the cognitive and behavioral spheres respectively. 24
With convexity lesions, patients showed no personality changes but had apathy and lack of motivation. Lack of productive thinking, indifference, and poor decision making ability is shown as well. Patients orbital showed changes in personality and had higher incidence of psychiatric morbidity. The patients intellectual impairments may be sometime be hard to capture during formal intelligence testing. However the patients showed lack of perseverance, dis-inhibition and aggression, failure to maintain satisfactory relationships, change of sexual behavior like hyper sexuality.

Further, it has been documented that patients with lesions of the mid brain, hypothalamus, and the orbital frontal cortex had sluggishness and apathy along with mood lability and irritability coupled with the disturbance of the essential drives and instincts controlled by the hypothalamus like sleep, appetite and sex. Patients with left parietal-temporal lesions showed significant losses of general intelligence.

### 2.2.5 PARIETAL LOBE

Lesions in the parietal lobe may cause a variety of neuropsychological disturbances. Lesions in the non-dominant parietal lobe bring about visual spatial difficulties with neglect of contralateral space, constructional and dressing apraxias. Lesions in the dominant lobe may be associated with receptive dysphasia, limb apraxia, body image disorders, right-left disorientation, dyscalculia, finger agnosia, and agraphia in various combinations. In the non-dominant parietal lesions unawareness of the neurological lesion may be present a condition referred to as anosagosia.  

### 2.2.6 TEMPORAL LOBE

Damage to the temporal-limbic area of the brain is often characterized by a myriad of complex neuropsychological syndromes. Personality change resembling that of the frontal lobe is common but is accompanied by specific neuropsychological pattern. This may be due to the fronto-temporal connections and associations. Temporal lobe lesions involving the hippocampus usually produce memory deficits. With the left hippocampal damage, the patient will display impaired verbal deficits while the right hemisphere patients have impaired spatial or non-verbal aspects of memory. Behaviorally, the left sided lesions of the
medial temporal lobe produces psychotic symptoms while in the right temporal the problems are mainly affective.\textsuperscript{28}

2.2.7 THE OCCIPITAL LOBE

The occipital lobe are located at the back of the head and are important for perceiving and interpreting visual information like object recognition and identifying color. Infarct on the occipital lobes may in turn cause disturbances in visual processing. Injury may be accompanied by migraines occipital seizures. Lesions of the visual association areas may produce visual hallucinations including the occurrence of diplopia and continuously seeing the image after the stimulus is removed. Lesions that affect the temporal or parietal lobe may also produce visual disorientation thus producing difficulty in localizing the stimulus. Prosopagnosia is not uncommon in patients with occipital lobe damage. Blindness following occipital damage is possible even where there is no physical damage to the individual. Anton’s syndrome- denial of blindness after brain damage may also occur.\textsuperscript{24, 26}

2.2.8 CIRCUMSTANCES, SETTING AND REPERCUSSIONS OF INJURY

The circumstances and or setting in which the head injury occurred was an important consideration while judging the outcomes of a TBI. In instances such as if the patient was to blame for the injury; for example if they were under the influence of drugs, were driving recklessly or over speeding when the accident occurred. Emotional circumstances such as survivor guilt when other passenger the patient was driving perish, may further complicate the intellectual impairments following brain damage. Another consideration is settings in which patients have been exposed to extreme danger and near death as they evoke fear, anxiety and the possibility of having post-traumatic stress disorders and neuro-cognitive disorders. The healing process is another consideration, whereby, the meaning attributed to the impairments incurred can have emotional weight and therefore elongate the time taken to heal both physically and emotionally. This is a phenomena experienced by physicians in cases where the psychological damage does not match the physical damage.\textsuperscript{24}
2.2.9 ENVIRONMENTAL FACTORS

The environmental factors following TBI are significant in that they can be used to predict a prognostic prediction. The setting that the patient is exposed to during the recuperation period like the social support accorded, presence or absence of rehabilitative support have a significant repercussion on how recovery occurs. Injuries requiring adjustment and greater demand on the patient are crucial to the cognitive and psychological deficits. Environmental circumstances for instance if they were the primary caregiver and have no resources for the medical and rehabilitation services needed for recovery. Social factors like solitude and where there is great personality change thus family members may also be harsh and have not yet come to grips with the consequences of the injury, may also impact on the psychological wellbeing of the patient. 24

2.3 OUTCOMES OF TBI

It is unfortunate that the problems associated with Common disabilities following brain injury include problems with cognitive abilities, neurobehavioral problems and psychiatric morbidities. Cognitive deficits can be divided into four phases according to how they occur. 29, 30

According to the first is a period of Loss Of Consciousness (LOC) or coma, occurring soon after the injury, the second phase is characterized by a mixture of cognitive and behavioral problems like in the case of the post concussive syndrome, the third phase is usually the period between six months to twelve months where there is usually a rapid period of recovery of cognitive functioning, followed by plateauing of recovery over 12-24 months subsequent to the injury. The fourth phase is characterized by permanent cognitive sequelae, and includes deficits in thinking, memory, reasoning, planning, organizing, mental flexibility, problem solving, making judgments, language and communication difficulties, sensory processing difficulties, and attention deficits. . 29, 30

According to a study done by Fahyin 24, of the 22 patients with severe head injuries, years later, 17 patients had some form of psychiatric sequelae, and psychiatric disturbance which was a prominent cause of incapacity to work. The psychiatric sequelae recorded included: affective outbursts, chronic irritability, epileptiform and hallucinatory episodes and paranoid developments, impairment of cognitive process was also noted.
Neurobehavioral problems following TBI include irritability, restlessness, dis-inhibition, inappropriate sexual behavior, impulsivity, egocentrism, mental health problems like anxiety, depression, post-traumatic stress disorder, somatization, personality changes, aggression, apathy, alcohol and substance abuse, sleep problems, acting out and social inappropriateness. Despite the common occurrence of these symptoms following TBI, there are relatively few studies that provide clear guidance regarding their impact and management. 

In a study done by De Guise E, consisting of three hundred and forty-eight (348) TBI patients, using the Galveston Orientation Amnesia Test score, Glasgow Coma Scale score, results of cerebral imaging, Neurobehavioral Rating Scale score, the Functional Independence Measure cognitive score and the Glasgow Outcome Scale score. Found that most patients presented with frontal (57.6%) and temporal (40%) lesions. Sixty-two percent had post-traumatic amnesia of less than 24 hours. 70% presented with mild TBI, 14% with moderate and 15% with severe TBI. The cognitive deficits most frequently observed on the Neurobehavioral Rating Scale were in the areas of attention, memory and mental flexibility as well as slowness and mental fatigability. Most patients had good cognitive outcome on the Functional Independence Measure and scores of 2 and 3 were frequent on the Glasgow Outcome Scale. 45% percent of the patients returned home after discharge, 51.7% were referred to in or outpatient rehabilitation and 3.2% were transferred to long-term care facilities.

It should be noted that the psychological problems and cognitive deficits arising from a TBI may arise at different stages of recovery. Certain types of symptoms or deficits have been explained by the areas that are commonly damaged in TBI such as the frontal lobes, temporal lobes or the cerebellum. The survivors of TBI are often left with significant cognitive, behavioral and communicative disabilities. TBI also predisposes one to the life time risk of disorders such as Alzheimer’s disease, epilepsy, Parkinson’s disease among others that was tackled later in this paper.

Although the largest group of TBI survivors are young adults in their prime working years, many survivors, particularly those with a severe TBI, do not return to work. Estimates vary widely, ranging from a low of 12.5% to as high as 80% who do not return to work. The ability to return to work is highly correlated to the post-acute functional limitations of the survivor. In a national survey in Canada, 66% of TBI survivors living in the community
reported an ongoing need for assistance with some activities of daily living, 75% were not working, and 90% reported limitations or dissatisfaction with social integration.  

2.3.1 MEMORY IMPAIRMENTS FOLLOWING TBI

Central to all cognitive functions and to probably what is typically human is the ability to have memory and the capacity for learning. While mild to moderate memory loss leads to the patient being disorientated and confused, severely impaired memory often detaches the individual from emotionally and meaningful contact with the social world. It renders the individual to be passive, heavily dependent and to lack the capacity for new learning.  

Impairments in memory are often very frequent following brain injury. The period of Post Traumatic Amnesia (PTA), is often used to gauge the severity of an injury and can also be used to predict the outcome of the prognosis. PTA is a common phenomenon after TBI; they are usually two kinds of distinct PTA. Anterograde amnesia which is the loss of memory for events after the onset of trauma and Retrograde amnesia is the loss of memory for information and events before the onset of trauma. Multiple studies have used the presence of Anterograde and retrograde amnesia as a diagnostic requirement. The longer the PTA the poorer is the outcome in most of the studies. 

In very severe and extreme cases of memory impairments, where the temporal lobes and the hippocampus are severely damaged the patient may only be aware of what is immediate. According to Lezak, in the extreme cases disorders of memory often does condemn the patient to immediate memory only. Problems in memory usually elicit difficulties in the acquisition and retrieval of materials. Recall tends to be confounded by difficulty in discriminating between intrusions, whether they are purely associative or of similar material. Impairments with short term memory often manifests with the individual misplacing objects, forgetting day to day activities, the loss of the ability for new learning e.g. lists of items, etcetera

Studies have also shown that persons who were alcoholics or were drunk during the time of injury tended to have more memory impairments than persons with the similar injuries but have had no history of alcohol abuse.
In one study done by McKinlay, et al., which constituted of Fifty-five cases of (46 male) aged 16-60 years (mean 35.7, SD 14-3) with severe blunt head injury and a PTA of at least two days found memory problems in the group. The memory items investigated included disorientation, omissions, repetitions and other indications of memory lapses. Overall, memory difficulties were reported in 73% of cases at 3 months, 59% at 6 months and 69% at 12 months. Impairments in memory like many other cognitive skills are and may be affected due to other impairments. Patients with memory deficits could have attention problems, lack of the ability to concentrate, confusional states and impairments in the capacity of encoding.

This study screened TBI patients at KNH to gauge the extent of memory impairment and its impact on other cognitive skills, and their day to day life including their return to work after TBI. The RBANS battery uses the following subtest to measure memory function: list learning recall, story recall, recognition memory and figure recall all of which are computed to form a delayed memory recall score.

2.3.2 FRONTAL LOBE SYNDROMES/ DYSEXECUTIVE SYNDROME:

The executive functions enable a person to lead a purposeful, independent and have a goal oriented behavior. The frontal lobes’ prefrontal cortex forms an important element of the frontal-sub-cortical circuits sub-serving the executive functions. Executive dysfunction is among the most common and disabling aspects of cognitive impairment following traumatic brain injury (TBI), and may include deficits in reasoning, planning, concept formation, and mental flexibility, aspects of attention and awareness, and purposeful behavior.

Dysexecutive difficulties result not only from prefrontal lesions but also from lesions elsewhere in these circuits. The Dys-executive syndrome is characterized by: Lack of initiative, limited ability to organize own behavior, difficulties in judgment and monitoring of behavior, limited ability in inhibiting strong response tendencies (disinhibition), inadequate formation of hypotheses and plans, limited mental flexibility, shifting-problems, disturbed judgment of social situations symptoms of behavioral dyscontrol such as impulsivity and aggression, lack of motivation, apathy, lack of initiation behavior, disorganization, attention and memory deficits, and mood dys-regulation (e.g., moodiness, irritability, "mood swings").
2.3.3 IMPAIRMENTS IN ATTENTION

Attention refers to the process by which organisms select a subset of available information upon which to focus for enhanced processing and integration. Attention is usually considered to have at least three aspects: orienting, filtering, and searching. Attention deficits are common sequelae in injuries of all severity.  

The deficits are in the areas of selective attention or an inability to withstand distraction, visual scanning or complex attention, and inability to divide attention between two tasks. Persons with attention deficits become easily distracted, have trouble keeping track of what is being said or done, experience information overload, have difficulty doing more than one task at a time and can be slower at taking in and making sense of information. While it is possible for a patient to have above average performance yet, had attention and concentration difficulties, the overall cognitive productivity will be greatly affected. And the person is also more easily fatigued.

According to Sohlberg and Mateer\textsuperscript{38}, attention can be classified into five categories which are focused attention which is the ability to respond discretely to specific visual, auditory or tactile stimuli. Sustained attention also referred to as vigilance is the ability to maintain a consistent behavioral response during continuous and repetitive activity for instance reading. While selective attention is the ability to maintain a behavioral or cognitive set, in the face of distracting or competing stimuli, for instance maintaining conversation in a crowded environment. Alternating attention is the ability of mental flexibility that permits a person to shift their focus of attention and move between tasks having different cognitive requirements. While lastly is divided attention which is considered as the highest level of attention and it refers to the ability to respond simultaneously to multiple tasks or multiple task demands.\textsuperscript{38}

Deficits in attention are very common in TBI albeit not universal for all the patients. Studies have shown that attention deficits are more common especially in patients whose injuries occurred due to deceleration, as in road traffic accidents or rail road accidents.  

Patients with attention deficits are affected in one or more aspects of attention as discussed earlier. Slowed information processing shows up more generally in attention deficits, including poor concentration heightened distractibility, difficulty doing more than one thing at a time, and complaints of impaired short term memory.
2.3.4 LANGUAGE DISORDERS FOLLOWING TBI:

Following a TBI, especially one involving the language dominant hemisphere, the processes of language are more often than not disrupted. Difficulties in language following TBI may vary greatly depending on the nature, localization and severity of the brain injury. Depending on the localization of the brain infarct, language impairment of varying degrees are common disabilities following TBI.

Following brain injury, many patients experience changes in the speed and ease of verbal production. Some patients with frontal lobe lesions experience problems with expressing their speech due to damage in the Broca’s area called Broca’s aphasia while others who have sustained injury in the dominant Temporal Lobe’s Wernicke area, have Wernicke Aphasia in which the patient will have problems comprehending speech. Conduction aphasia is characterized by fluent but paraphasic verbal output, normal comprehension but impaired repetition. Conduction aphasia is also referred to as literal and is characterized by phonemic (sound) distortion of the word e.g. “spikologist” for psychologist this type of paraphasia is contrasted from verbal paraphrasia which is indicated by the incorrect substitution of a lexical item e.g. referring to a “screwdriver” as a hammer. Other common forms of aphasia following TBI are anomic aphasia which is characterized by naming difficulties. Another difficulty is called Dysarthria is a motor speech disorder caused by the muscular impairment. The lack of coordination, weakness, or slowness of muscles involved in the process of speaking.

Language deficits often lead to miscommunication frustration and confusion both for the patient and those interacting with them. Many patients experience moderate to severe language and communication problems that may clear up or become subtle overtime, however, most of the language problems persist over long periods of time.

In a study done by McKinlay, which constituted of Fifty-five cases of (46 male) aged 16-60 years (mean 35.7, SD 14.3) with severe blunt head injury and a PTA of at least two days found that patients who had dysarthria and dysphasia. The most frequent problems were difficulty in expression (for example word finding or fluency) reported in 47%, 44% and 44% of cases at 3, 6 and 12 months respectively, and dysarthria in 33%, 26% and 29% of cases.
In some cases the difficulties were minor and although noted by relatives were not always apparent to the psychologist who assessed the patient. Receptive difficulties were less common (no more than 15% of cases at any follow-up).

2.3.5 CONSTRUCTIONAL DIFFICULTIES

A complex series of events has to take place for this to occur. The visual motor skills comprises of hand eye coordination, visual perception and visual motor integration. Constructional apraxia is a form of apraxia characterized by the inability to copy drawings or to manipulate objects to form patterns or designs. It is caused by a right hemisphere lesion. The deficit is tested by asking the patient to copy two-dimensional geometric patterns, such as circles, squares, diamonds, and hexagons, and to copy three-dimensional structures constructed of 1-inch building blocks. 39

According to Russel et al. 40

“Severe deficits in constructional skills such as drawing, copying and building three Dimension structures are a common outcome of TBI. Persons with constructional apraxia may have no difficulty while making purposeful motor movements but are unable to copy or make drawings accurately. The deficits seen in copying and drawing are diverse across patient groups, with striking differences in performance between focal lesion patients with right as opposed to left hemisphere damage. Drawings of patients with right-hemisphere constructional apraxia lack accurate spatial relationships between the components of objects and have an incoherent, disjointed quality. On the other hand patients with damage to the left hemisphere produce qualitatively different drawing performance with an oversimplification of figures and a perseveration on items suggestive of planning deficits for a recent review of constructional deficits.” 40

Various literatures suggest that persons who have had a brain injury continue to struggle with the residual impairments of higher cerebral functioning years after their trauma.

For many of the patients who suffer from a TBI, the damage incurred may lead to lifelong disability. This status is made worse by the lack of cognitive rehabilitation services for the patients who need it. The term disability in the case of TBI refers to physical, emotional,
ment and the lifelong dependability on other persons for the day to day livelihood. The use and dependability on alcohol and other psychoactive substances usually render a patient to a lower quality of life than the one they had before the injury. Personality change which is a common phenomenon following TBI may also disable the patient. Even for patients who seem to have recovered fully from their physical disabilities may still be prone to other lifelong and debilitating symptoms like Alzheimer’s disease and dementia.

The patient’s psychosocial life is also greatly impaired following TBI. Despite the advances in early diagnosis and treatment of moderate to severe TBI, the fact remains that traumatic brain injury will be a life-changing experience for many patients. Helping the patient, family members, and caregivers cope with these long-term consequences is an important part of TBI rehabilitation. Neuropsychological rehabilitation was started with this in mind. Neuropsychological rehabilitation focuses on the remediation of higher cerebral impairments their management and dealing with other psychological disorders following TBI. It is unfortunate and extremely sad to note that most of Africa has no rehabilitation units dealing with the devastating effects of brain injury. Many if not all the patients who would be eligible for cognitive retraining never get this service. They are forced to wade through the murky waters of cognitive disability, unemployment due to low rates of return to work and interruption to social life. The researcher through this paper hoped to ignite the education system to include the training of neuropsychologists and other health care workers to deal with the problem which is affecting many able bodied Kenyans who are rendered disable due to their head traumas.

Even when the physicians and other health care providers are aware of the patients’ cognitive difficulties, little is done on improving the patients’ cognitive status. While the researcher acknowledges the impact and input of the psychiatrists in the management of psychological disorders like confusion, anxiety, depression, personality disorders, mood lability among other psychological impairments little is done to help the patients who are severely impaired to improve.

2.4LONG TERM COMPLICATIONS OF TBI

It is unfortunate that TBI not only causes widespread disability, but it also predisposes one to the other neurological illnesses. Head injuries including those that are mild have a cumulative
effect. Their outcomes are far reaching beyond the physical scars or physical disability. Studies have shown that TBI does predispose on to cognitive deterioration and reduced competency over the course of one’s lifetime. The long term effects following TBI include Parkinson disease, Alzheimer’s disease, Dementia pugilistica, post traumatic dementia, epilepsy, and substance abuse especially the use of alcohol.

2.5 POST TRAUMATIC EPILEPSY

Post traumatic epilepsy is a common phenomenon. It is defined as unprovoked epileptic seizure occurring at least seven days after the TBI. The social implications of post traumatic epilepsy are enormous. The development of epilepsy in TBI patients also implies the likelihood of other psychological morbidity due to seizure activity. According to Chen, et al., Uncontrolled epilepsy renders the patient to be denied a driver’s license and causes one have complexities in gaining employment or maintaining one due to the risks involved. They found that the young who are between the ages of 20-40 are most likely to die due to epileptic seizures.41

In a research study on The Vietnam Head Injury survivors, done by Raymont V, et al.43, they found that there was high prevalence (45%-53%) of posttraumatic epilepsy (PTE) in the longitudinal cohort study. In phase three of their study, a span of 30-35 years post injury, the prevalence of PTE 119 participants was (43.7%) representing 87 patients this was consistent with the phase two results of 43% prevalence rates.43

2.6 PARKINSON’S DISEASE AND OTHER MOTOR IMPAIRMENTS

Parkinson’s disease is a movement disorder characterized mainly by rigidity, bradykinesia, postural instability, and tremor. It is triggered by the lack of the dopamine neurotransmitter in the brain. Studies have reported a positive correlation between Parkinsonism and previous brain injury.

In a case control study done by J. H. Bower, D. M. Maraganore, B. J. Peterson, S. K. McDonnell, J. E. Ahlskog, and W. A. Rocca, (2002), found that the overall frequency of head trauma was significantly higher in cases than in controls (odds ratio [OR] = 4.3; 95% CI = 1.2 to 15.2). Compared with participants who had never experienced a head injury, mild head injury with no memory loss were found to have no increased risk; however, participants who experienced a mild head trauma with loss of consciousness or a more severe trauma had an
OR of 11.0 (95% CI = 1.4 to 85.2). Although not significant, head trauma resulting in hospitalization was more frequent in cases than in control participants (OR = 8.0; 95% CI = 1.0 to 64.0).

2.7 DEMENTIA PUGILISTICA:

Dementia pugilistica is also referred to as chronic encephalopathy, is a consequence of head trauma from boxing, repetitive blows to the head over a long period of time. This repeated head trauma predisposes one to dementia and Parkinsonism and is characterized by memory problems and other cognitive deficits. Dementia pugilistica can also result from a single severe TBI that had resulted into a coma.\textsuperscript{2,31}
RESEARCH SCOPE:

General objective
The purpose of this study was to find out the cognitive outcomes following a traumatic brain injury in patients at the KNH.

OBJECTIVES OF THE STUDY

4. To determine the prevalence rate of cognitive dysfunction following a TBI among patients at the KNH.
5. To identify the effects of TBI on cognitive abilities like attention, memory, thinking, constructional abilities, executive skills and language and communication.
6. To determine the association between cognitive impairment and socio-demographic factors like age, gender, level of education, religion and occupation.

RESEARCH QUESTIONS

1. What is the prevalence of cognitive dysfunction following TBI in patients in KNH?
2. What are the effects of TBI on memory, attention, thinking, constructional abilities, executive skills and language and communication?
3. What is the association between cognitive impairment and socio-demographic factors like age, gender, level of education and occupation?

ASSUMPTIONS OF THE STUDY

The following are the assumptions of this study:

1. There is cognitive impairment among TBI patients at Kenyatta National Hospital.
2. That the cognitive impairments impact negatively on the patient’s psychosocial life.
3. The patients were willing to give authentic and uninfluenced answers.
4. That RBANS is a good measure for neuropsychological status following TBI.
CHAPTER THREE

METHODOLOGY:

3.1 STUDY DESIGN:

The study was a cross sectional descriptive study. Data was collected using a structured demographic questionnaire, the MMSE, the trail making test and the RBANS were used to measure cognitive impairment following brain injury. The mini mental status exam was also used to screen out those who were too severely impaired to participate in the study, the trail making test was used to screen for executive skills, while the RBANS was used to screen for cognitive deficits that follow brain injury like memory, language skills, visual spatial skills constructional ability and attention skills.

3.2 STUDY AREA/SITE

The study took place at Kenyatta National Hospital in the neurology, and surgical clinics and the wards. KNH is the oldest hospital; it is situated in Nairobi the capital city of Kenya. It is currently the largest referral and Teaching Hospital in the country, and also provides a medical research environment. It was built in 1901 and has been around for over 100 years.

The study area was chosen and judged as suitable because as a referral hospital, it is bound to receive patients from all over the country and even outside the country. 50% of Traumatic brain injury is caused by road traffic accidents, while the other 50% of TBI injuries come from falls, violence and recreational activities. From this cadre of patients, a substantial amount would end up in KNH either brought in as emergency cases or referred for specialized care due to severity of the injury. The researcher would assume that patients suffering from brain injury would exhibit cognitive dysfunction.

This then made KNH the most suited to carry out this study in, as the population was deemed as diverse and further make generalizations of these study findings more suitable.

3.3 STUDY POPULATION:

The target population for this study was patients who had suffered a TBI. The study population is drawn from patients who attend the neurology and surgical clinics and the wards for the same, where it was most likely to encounter patients who had suffered from a
brain injury. The study populations attend KNH clinics or are within the hospital for treatment and follow up. Files for the patients who are attending the clinic on a particular day, were checked with the help of nursing personnel who usually triage and prepare the patients to be seen by the doctors, to verify those that have suffered a brain injury.

Those that will have met the inclusion criteria will then be recruited for the study following the ethics and research committee of university of Nairobi and KNH guidelines. The purpose of the study was explained to the study participants after which those who consent to sign the consent form were given the socio demographic questionnaire to fill. The trail making test will then be administered following the mini mental status examination, then the repeatable battery for neuropsychological status was administered to those who will have attained a score of 18 and above on the MMSE. The study participants were selected from the age of 20 years and above. This is consistent with the norms used in the Repeatable Battery for Neuropsychological Status research instrument. The pre coded questionnaires were clinician administered and the researcher will adhere to confidentiality by ensuring that they are stored away in safe custody. The study participants will comprise both male and female.

**INCLUSION CRITERIA**

- Study participants must have had a traumatic brain injury.
- Study participants must give consent.
- All study participants must be aged between 20-89 years at the time of testing. As the norms for RBANS are only for this age group.

**EXCLUSION CRITERIA**

- Study participants who refuse to sign the consent form.
- Study participants below the age of 20 years.
- Study participants who will present with other overt mental disorders.
3.4.1 Sample size determination

The following formula by Yamane and Taro\(^4\) was used to determine the sample size:

\[
n = \frac{N}{1 + N (e)^2}
\]

Where;

- \(n\) is the desired sample size.
- \(N\) is the target population.

While \(e\) is the precision level of ±10% at 95% confidence interval\(^4\)

Data was collected from the neurological clinics at KNH where there is an average of 75 patients who attend the clinic every week. For a period of one month, the target population size will make up 300 patients. Using the formula above the sample size was as follows

\[
n = \frac{300}{1 + 300(0.1)^2} = 75
\]

From the formula the desired sample was 75 study participants. This was the sample that is going to be under study.

3.4.2 SAMPLING METHOD:

Purposive sampling was used where those study participants who meet the set inclusion criteria were recruited for the study, until the desired sample size of 75 study participants is reached.

3.5 DATA COLLECTION INSTRUMENTS:

For this study, three psychometric instruments and the social demographic questionnaire were used, the mini mental status examination (MMSE), the trail making test (TMT) which is a good measure for executive skills and the RBANS which will measure immediate memory, delayed memory, attention, verbal comprehension, delayed memory, recognition memory, visual perception and constructional abilities, in its 12 subsets.
3.5.1 THE MINI MENTAL STATUS EXAMINATION (MMSE):

The mini-mental state examination (MMSE) or Folstein test is a brief 30-point questionnaire test that is used to screen for cognitive impairment. The MMSE was originally designed to screen for dementia. However, it has recently been used within the clinical setup to screen for the severity of cognitive impairment following brain injury. It is also used to document progress in response to treatment. The MMSE is a clinician administered tool. The MMSE test will also be used to filter out those patients who have severe cognitive impairment and cannot withstand testing on the RBANS. This is consistent with the fact that they will already be biased for further screening with the RBANS due to the severity of cognitive impairment. Orientation includes questions about time, day, date and location. Registration which is a short-term memory task, the subject is given three unrelated words and their task is to repeat them after the examiner. Attention and Calculation where the subject counts backwards by seven from 100 an alternative to the task is to spell the word WORLD backwards. Recall the subject is asked to recall three objects named in Registration section. Language the subject names simple objects, repeats a sentence, and follows a command. While lastly, in the MMSE is the visual-spatial task where the subject is asked to copy overlapping pentagons.

3.5.2 TRAIL MAKING TEST A AND B

The Trail-making test is a neuropsychological test of visual attention, speed and mental flexibility. The trail making test is clinician administered. The test includes section A and B. in section A the subject would be required to connect dots of 25 consecutive targets on a sheet of paper in ascending order. In section B, the test will require the participants to alternate between numbers and letters (1, A, 2, B, etc.). The standard administration procedure includes practice exercises for part A and B. with a cut off practice time of 20 seconds for part A and 30 seconds for part B. The test takes about 5-10 minutes to administer. The goal of the subject is to finish the test as quickly as possible, and the time taken to complete the test is used as the primary performance metric. Section B of the test is a good measure for frontal lobe abilities and impairments thus its significance in this study. An oral TMT can also be used as an alternative for special populations for whom the drawing might be inappropriate. Scoring is expressed in terms of time taken to complete the test in seconds. The TMT completion time increases with increasing severity of head injury.
The TMT test was initially used for assessing general intelligence and was part of the Army Individual Test of General Ability, but has since become a common diagnostic tool in clinical settings as well, as poor performance is known to be associated with many types of brain impairment; in particular frontal lobe lesions. According to Reitan,\textsuperscript{46}, he observed that “… those persons with brain damage tend to perform significantly more poorly on the TMT than do control participants without the morbidity.” The TMT was a clinician administered tool.

3.5.3 THE REPEATABLE BATTERY FOR THE ASSESSMENT OF NEUROPSYCHOLOGICAL STATUS (RBANS):

RBANS is a brief, individually and clinician administered test that helps determine the neuropsychological status of adults ages 20 through 89 who have neurologic injury or disease such as dementia, head injury, and stroke. The RBANS measures immediate and delayed memory, attention, language, and visual spatial skills. RBANS examines multiple areas of cognitive functioning and profiles impairment across domains using 12 subtests. These subtests include: List Learning, Story Memory, Figure Copy, Line Orientation, Digit Span, Coding, Picture Naming, Semantic Fluency, List Recall, List Recognition, Story Recall and Figure Recall. The repeatable battery for the assessment of neuropsychological status (RBANS) was initially designed as a screening tool for the assessment of dementia \textsuperscript{49}. Since its origin, however, it has been used in the screening of various neuropsychological disorders and impairments of note is, Parkinson’s disease \textsuperscript{47}, in the differentiation of Alzheimer’s dementia from vascular dementia \textsuperscript{48}, multiple sclerosis and cerebrovascular disorders \textsuperscript{50,51} and Huntington’s disease \textsuperscript{52}.

According to MacKay et al.\textsuperscript{53} the RBANS earned its popularity for use with these other populations due to its many advantages including its short administration time, co-normed index scores, inclusion of a summary score, and alternate forms. Recent research has shifted its focus towards the use of RBANS with those patients who have sustained a TBI.

In one study done by Smigielski et al. \textsuperscript{54} it compared RBANS scores in patients with traumatic brain injury to other established neuropsychological measures. They concluded that the RBANS demonstrated satisfactory concurrent validity with these measures, and appeared to be sensitive to the impairments demonstrated by patients with moderate-severe TBI. They suggest that the RBANS may be a useful tool in the early psychometric evaluation of TBI. \textsuperscript{54}
In another study done by MacKay et.al \(^{53}\) on the reliability and validity of the RBANS in a traumatic brain injured sample, found that the RBANS was an important clinical utility in the screening of disorders among the neurological populations. The study extended the current literature regarding the utility of the RBANS in a Moderate – Severe TBI.

The RBANS has also been found to be more sensitive to TBI-related deficits as well as a tool that is for differentiating individuals with and without brain injury than other cognitive screening tools like the Mini Mental Status Examination (MMSE) and Neurocognitive Status Examination (COGNISTAT) \(^{53, 55, 56}\).

In their conclusion, Mackay et al. \(^{53}\) demonstrated that the RBANS was a clinically valid and reliable tool for use in patients who have suffered a moderate to severe brain injury.

The subtest raw scores are converted to age based index scores by means of tables included in the stimulus booklet. \((\text{Mean}=100 \text{ Standard Deviation}=15)\) range is from 40-160. The scaled scores are interpreted as follows: 69 and below = Extremely Low, 70-79= Borderline, 80-89 = low average, 90-109 average, 110-119 = above average, 120-129 = superior and Above 130 = very superior. \(^{48}\)

It is with this in mind that the researcher zeroed in on the use of the RBANS over other screening instruments for the proposed research study. The RBANS was the principal tool that was used to measure cognitive outcomes following brain injury.

**3.5.4 SOCIO DEMOGRAPHIC QUESTIONNAIRE**

A socio demographic questionnaire designed by the researcher was used to gather information on the study participants, and on how they got the traumatic brain injury. These will include; age, religion, marital status, education, occupation economic status, number of children and costs of medical treatment.

**3.6 ETHICAL CONSIDERATION:**

The proposal was developed with the academic assistance of the university supervisors. The proposal was presented to the Kenyatta National Hospital Ethics and Research Committee for approval. Before commencing the study approval was sought from the Department of Psychiatry, the Research and Ethics committee of KNH, and the Ministry of Education Science and Technology.
The researcher will endeavor to ensure that ethics, confidentiality and volunteerism were adhered to in this study, in accordance to the KNH and university of Nairobi ethics and research committee requirements. All the respondents were informed about the research study and the purpose for the research study. The study population was required to sign a consent form before they participate in the study and participation was on volunteer basis. The respondents will remain anonymous and no name was required. Permission to undertake this study was sought from the ethics and research committee at Kenyatta National Hospital.

3.7 RESEARCH RISKS
The researcher acknowledges that there was a risk of distressing the participants during the interview and the gathering of data. The respondents found to be needing counseling were referred to the right clinic for further medical care and support.

3.8 DATA ANALYSIS
Data was coded, entered and managed in a pre-designed Microsoft Access database. Data entry was done continuously in the course of data collection. Data cleaning was done at the end of every week and any errors encountered were resolved immediately; by checking the questionnaires of the study participant. In cases where the errors could not be resolved, the researcher will replace the questionnaire by interviewing another patient. After the data was thoroughly cleaned, data analysis was conducted using SPSS version 20.0

Data was illustrated using tables, graphs and pie charts. Some of the tables that the researcher may use for analysis are a table on cognitive dysfunction in relation to socio demographic factors, a table showing comparisons of cognitive impairment as compared to the different tools used in this study, the risk factors associated with sustaining a traumatic brain injury and consequently cognitive dysfunction was determined by analyzing the associations between socio-demographic factors and cognitive dysfunctions.

Descriptive statistics was employed to describe the groups formed by the data. Descriptive statistics enable the researcher to compare information across different age groups at the same time. The participants for study are comparable in terms of other background variables and the distinct phenomena under study.

The mini mental status exam questionnaire will give data on the level of cognitive impairment, the trail making test will give measures on executive dysfunction, while the
Repeatable Battery of Neuropsychological Status will give data on cognitive dysfunction related to language, memory, visual-spatial abilities, constructional skills, and attention. This will ensure that the objectives for this study are met.

### 3.9 RESEARCH PROCEDURE

The research study was carried out on patients who have suffered a traumatic brain injury and were attending Kenyatta National Hospital. The study participants were informed about the study, its purpose and its objectives and the benefits that will possibly emanate from this study in the future. The study participants were then recruited in the clinics as they attended them for treatment. All medical ethical procedures were adhered to by coding of the questionnaires and study instruments, no name was required in the study to maintain confidentiality, and data was collected from those participants who gave consent and from those whose relatives will give assent if the study participant is not in a position to do so. The study participant was guided to fill in the social demographic questionnaire followed by the Trail Making Test, then The Mini Mental Status Examination. Those study participants who scored 18 and above on the MMSE, then proceeded to fill in the repeatable battery for Neuropsychological Status. All the questionnaires were clinician administered and therefore they were administered by the researcher. The filled questionnaires were then kept under lock and key. Data from the filled questionnaires was scored and entered using Microsoft excel before been analyzed by the statistician using Statistical Package for the Social Sciences version 20.0. Data was presented using tables, pie charts, and graphs.
CHAPTER FOUR: RESEARCH RESULTS

Introduction

This chapter presents the results of the research study on the prevalence of cognitive impairment following traumatic brain injury. Data was presented in tables, pie charts and graphs.

4.1 Socio-Demographic characteristics

A total of 75 brain injury patients were recruited for the study. The actual study participants were 74. One study participant was excluded because their cognitive impairment was very severe as measured on the MMSE. The study comprised of 58 (78.4%) male study participants and 16 (22.6%) female study participants. The mean age of the study participants was 33.94 years. A majority of the study participants were aged 50 years and below 70 (94.1%) as illustrated in table 1. The other socio demographic characteristics and their frequencies have been tabulated in table 1 below.

SOCIO DEMOGRAPHIC CHARACTERISTICS AMONG TBI STUDY PARTICIPANTS IN KNH: Table: 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-28 years</td>
<td>13</td>
<td>17.5</td>
</tr>
<tr>
<td>29 - 39 years</td>
<td>29</td>
<td>39.2</td>
</tr>
<tr>
<td>40 - 50 years</td>
<td>29</td>
<td>39.2</td>
</tr>
<tr>
<td>51 years and above</td>
<td>3</td>
<td>4.1</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>58</td>
<td>78.4</td>
</tr>
<tr>
<td>Female</td>
<td>16</td>
<td>21.6</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>46</td>
<td>62.2</td>
</tr>
<tr>
<td>Single</td>
<td>22</td>
<td>29.6</td>
</tr>
<tr>
<td>Divorced</td>
<td>5</td>
<td>6.8</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td><strong>Religious Affiliation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catholic</td>
<td>28</td>
<td>37.8</td>
</tr>
<tr>
<td>Protestant</td>
<td>42</td>
<td>56.7</td>
</tr>
<tr>
<td>Muslim</td>
<td>1</td>
<td>1.4</td>
</tr>
</tbody>
</table>
4.2 Socio-economic characteristics of TBI study participants at KNH.

The monthly income for the study participants were Ksh. 20,000/= and below 42 (56.7%), those who earned above twenty thousand but below Ksh 40,000/= were 21 (28.4%), while those that earned above Ksh. 40,000/= were 11 (14.9%). The study participants’ occupation prior to the head injury was highly skilled 3(4.1%), skilled 22 (29.7%), semi-skilled 36 (48.6%), and manual laborers 12 (16.2%). The occupational status for the study participants at the time of interview was full time employed 26 (35.1%), part time employed 24 (32.4%)
those that were unemployed were 21 (28.4%) retired were 1 (1.4%) and other were 2 (2.7%) as shown in table 2 below.

**Socio Economic Characteristics Table: 2**

<table>
<thead>
<tr>
<th>Monthly income</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>20,000 and below</td>
<td>42</td>
</tr>
<tr>
<td>20,001 - 40,000</td>
<td>21</td>
</tr>
<tr>
<td>40,001 - 70,000</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Occupational status</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time employed</td>
<td>26</td>
</tr>
<tr>
<td>Part-time employed</td>
<td>24</td>
</tr>
<tr>
<td>Unemployed</td>
<td>21</td>
</tr>
<tr>
<td>Retired</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expenditure since onset of injury</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100,000 and below</td>
<td>15</td>
</tr>
<tr>
<td>100,001 - 200,000</td>
<td>35</td>
</tr>
<tr>
<td>200,001 - 300,000</td>
<td>17</td>
</tr>
<tr>
<td>300,001 - 400,000</td>
<td>5</td>
</tr>
<tr>
<td>400,001 and above</td>
<td>1</td>
</tr>
<tr>
<td>Don't Know</td>
<td>1</td>
</tr>
</tbody>
</table>

Length of Time since Onset of Brain Injury in TBI study participants at KNH.

Most of the study participants had acquired the brain injury within one year’s time as shown in figure 1.
Causes of Head Injury among TBI study participants at KNH.

The major cause of the head injury was motor vehicle accident 30 (40.5%), violence 20 (27.0%), motorcycle accident 11(14.9) falls accounted for 9 (12.1 %), and sports and recreation accidents 4 (5.4%) as shown in figure 2.
4.3 THE PREVALENCE OF COGNITIVE DYSFUNCTION FOLLOWING TBI

4.3.1 Measuring Cognitive Dysfunction using the Mini-Mental State Examination (MMSE)

The study found that majority of the respondent (67.7, 50) scored 24-30 (uncertain cognitive impairment) with a significant number of study participants (31.1%, 23) scoring 18-23 (mild/moderate). A sample of only 1.4% (1) study participants was found to score 0-17 (severe cognitive impairment) as shown in table 3 below.

**Frequency of cognitive impairment (MMSE) among patients at the KNH:**

**Table 3**

<table>
<thead>
<tr>
<th>Cognitive impairment (MMSE)</th>
<th>Frequency</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe cognitive impairment</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Moderate cognitive impairment</td>
<td>24</td>
<td>32.0</td>
</tr>
<tr>
<td>Uncertain / No cognitive impairment</td>
<td>50</td>
<td>66.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>75</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

4.4. Measuring Cognitive Dysfunction using Trail Making Test (TMT)

Data revealed that 4.1% (3) study participants used less than < 29 seconds to finish the trail indicating no cognitive impairment. The majority of the study participants 44 (59.5%) scored 29 - 78 in the Trail Making Test Part A indicating mild cognitive impairment. However, a significant number of the study participants (36.5%, 27) were found to exhibit moderate to severe levels of cognitive impairment. (Table 4)
### Frequency of cognitive impairment (TMT Part A) among patients at KNH: Table 4

<table>
<thead>
<tr>
<th>Cognitive impairment (TMT Part A)</th>
<th>Frequency</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 29 seconds no cognitive impairment</td>
<td>3</td>
<td>4.1</td>
</tr>
<tr>
<td>29 - 78 seconds mild cognitive impairment</td>
<td>44</td>
<td>59.5</td>
</tr>
<tr>
<td>&gt; 78 seconds moderate to severe cognitive impairment</td>
<td>27</td>
<td>36.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>74</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

### 4.5 Frequency of Cognitive Impairment (TMT Part B)

Table 4 shows that a sample of only 8.1% (6) study participants had no cognitive impairment on the Trail Making Test Part B. A majority of the study participants 31 (41.9%) had mild cognitive impairment. A significant number of the study participants 22 (29.7%) had moderate impairment while 15 (20.3%) had severe impairment on the TMT part B.

### Frequency of cognitive impairment (TMT Part B) among patients at KNH: Table 5

<table>
<thead>
<tr>
<th>Cognitive impairment (TMT Part B)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 75 seconds –no cognitive impairment</td>
<td>6</td>
<td>8.1</td>
</tr>
<tr>
<td>75 – 180- seconds mild cognitive impairment</td>
<td>31</td>
<td>41.9</td>
</tr>
<tr>
<td>181 - 273 - seconds moderate cognitive impairment</td>
<td>22</td>
<td>29.7</td>
</tr>
<tr>
<td>&gt; 273 seconds- (severe cognitive impairment)</td>
<td>15</td>
<td>20.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>74</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
4.6 Measuring Cognitive Dysfunction using Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)

In the RBANS, data from the total scale index score found that, majority of the study participants’ 39 (51.4%) had severe cognitive impairment as measured on the RBANS. 26.8% (19) of the study participants had moderate cognitive impairment. 13.4% (10) had mild cognitive impairment while the remaining 8.4% (6) scored in the average range of the standardized scores on the RBANS as shown in table 6.
Frequency of cognitive impairment (RBANS) among patients at the KNH: Table 6

<table>
<thead>
<tr>
<th>Cognitive impairment (RBANS)</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely low</td>
<td>39</td>
<td>51.4</td>
</tr>
<tr>
<td>Borderline</td>
<td>19</td>
<td>26.8</td>
</tr>
<tr>
<td>Low average</td>
<td>10</td>
<td>13.4</td>
</tr>
<tr>
<td>Average</td>
<td>6</td>
<td>8.4</td>
</tr>
<tr>
<td>Total</td>
<td>74</td>
<td>100.0</td>
</tr>
</tbody>
</table>

4.7 The Effects of TBI on Memory, Attention, Visual spatial abilities, construction Skills and Language.

4.7.1 Immediate Memory

Immediate memory was assessed using the RBANS tasks of list learning and short story memory recall. Data revealed that most of the study participants (33.8%, 25) had severe immediate memory impairment. 11(14.9%) of the study participants had moderate cognitive impairment, 18 (24.3%) had mild cognitive impairment while 20 (27%) were on the average level of cognitive functioning.

Frequency for immediate memory index score: table 7

<table>
<thead>
<tr>
<th>Valid</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe short term memory impairment</td>
<td>25</td>
<td>33.8</td>
</tr>
<tr>
<td>Moderate STM impairment</td>
<td>11</td>
<td>14.9</td>
</tr>
<tr>
<td>Mild memory impairment</td>
<td>18</td>
<td>24.0</td>
</tr>
<tr>
<td>Average</td>
<td>20</td>
<td>27.0</td>
</tr>
<tr>
<td>Total</td>
<td>74</td>
<td>100.0</td>
</tr>
</tbody>
</table>
4.7.2 Visuo-spatial/Constructional skills

Visual spatial and construction skills were assessed using the line orientation and figure copy subtests in the RBANS. Table 7 shows that most of the study participants (36.5%, 27) had no cognitive impairment in Visuo-spatial/constructional abilities. 27% (20) study participants had mild cognitive impairment in relation to those skills. A sample of 18.9% (14) study participants had moderate cognitive impairment while 17.6% (13) had severe impairment on Visuo-spatial/constructional abilities.

Frequency for visual spatial and constructional skills: TABLE 8

<table>
<thead>
<tr>
<th>Valid</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe impairment on visual spatial skills</td>
<td>13</td>
<td>17.6</td>
</tr>
<tr>
<td>Moderate</td>
<td>14</td>
<td>18.9</td>
</tr>
<tr>
<td>Mild</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td>Average</td>
<td>27</td>
<td>36.5</td>
</tr>
<tr>
<td>Total</td>
<td>74</td>
<td>100.0</td>
</tr>
</tbody>
</table>

4.7.3 Language impairment following TBI

Language skills were tested using the semantic fluency and picture naming subtests on the RBANS. Data revealed that a majority of the study participants 48.6% (36) had severe language impairments, followed by 20.3% (15) who had moderate language impairments then 5.4% (4) who had mild language impairments and (25.7%, 19) study participants who were on the average range.
### 4.7.4 Attention

Attention skills were tested using digit span and coding subtests on the RBANS. Data showed that attention skills were severely impacted. A majority of the study participants (78.4%, 58) had severe attention impairment, 16.2 (12) study participants had moderate impairment while the rest 5.4% (4) had mild attention impairment.

**Frequency for attention index score: Table 9**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe impairment in attention</td>
<td>58</td>
<td>78.4</td>
</tr>
<tr>
<td>Moderate</td>
<td>12</td>
<td>16.2</td>
</tr>
<tr>
<td>Mild</td>
<td>4</td>
<td>5.4</td>
</tr>
<tr>
<td>Average</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>74</td>
<td>100.0</td>
</tr>
</tbody>
</table>
4.7.5 Delayed Memory

Data reveals that majority of the study participants (52.7%, 39) had severe delayed memory impairment. 12.2% (9) had moderate memory impairment, 20.3% (15) study participants had mild delayed memory impairment. While the remaining 14.9% (11) study participants had average levels of functioning.

Frequency for delayed memory index score figure 7
### Frequency table showing the distribution of impairment by Age: Table 10

<table>
<thead>
<tr>
<th>Age</th>
<th>Count</th>
<th>RBANS Total Scale</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>69 and below</td>
<td>70 - 79</td>
</tr>
<tr>
<td>18-28 years</td>
<td>8</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>61.5%</td>
<td>23.1%</td>
<td>15.4%</td>
</tr>
<tr>
<td>29 - 39 years</td>
<td>17</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>58.6%</td>
<td>34.5%</td>
<td>6.9%</td>
</tr>
<tr>
<td>40 - 50 years</td>
<td>16</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>55.2%</td>
<td>13.8%</td>
<td>20.7%</td>
</tr>
<tr>
<td>51 years and above</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>66.7%</td>
<td>33.3%</td>
<td>0.0%</td>
</tr>
<tr>
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4.8 Correlations of Cognitive Impairment and Socio-Demographic Factors

This study found that age was correlated to cognitive impairment using MMSE\( (p = 0.037)\), significant at the 0.05 level\( (\text{Table 7})\).

This study found that gender was associated with cognitive impairment using RBANS test\( (p = 0.012)\), significant at the 0.05 level\( (\text{Table 7})\).

This study found that occupation status was significantly associated to cognitive impairment using RBANS test\( (p = 0.000)\). The correlation is significant at the 0.01 level means that occupation had a very strong correlation with cognitive impairment \( (\text{Table 7})\).

This study found that educational level was statistically significant in relation to cognitive impairment using MMSE and RBANS tests \( (p = 0.024 \text{ and } p = 0.000)\), respectively. The RBANS correlation\( (p = 0.000)\) is significant at the 0.01 level means that educational level had a very strong correlation with cognitive impairment \( (\text{Table 7})\).

This study found that religion was statistically significant when related to cognitive impairment using RBANS test\( (p = 0.016)\), significant at the 0.05 level\( (\text{Table 7})\).

This study found that monthly income was statistically significant when associated to cognitive impairment using RBANS test\( (p = 0.010)\). The correlation is significant at the 0.01 level means that monthly income had a very strong correlation with cognitive impairment \( (\text{Table 7})\).

This study found that expenditure since onset of injury was statistically significant in relation to cognitive impairment using Trail Making Test B \( (p = 0.003)\). The correlation is significant at the 0.01 level means that expenditure since onset of injury had a very strong correlation with cognitive impairment \( (\text{Table 7})\).

This study found that cause of injury was significantly linked to cognitive impairment using RBANS test\( (p = 0.006)\). The correlation is significant at the 0.01 level means that cause of injury has a very strong correlation with cognitive impairment.
Correlations between cognitive impairment and socio-demographic factors using the Pearson’s chi-square test. Table 11

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*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).
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In Fisher’s exact test for correlations, gender (F=0.000), occupation (F=0.003), educational level (F=0.000), monthly income (F=0.002), were significantly correlated with cognitive impairment.
CHAPTER FIVE:

DISCUSSION

In the current study the distribution of male study participants to that of female participants was in the ratio of 3.5:1. Men were 3.5 times more likely to have a brain injury than were women in the study. This was comparable with most studies \(^1\), \(^2\), \(^3\) where men outnumbered women to have a head injury than women with a ratio of 2:1. In this study the ratio for men to women was higher than the expected, and was consistent with a study done by Mckinlay, ET al.\(^7\) it constituted of 55 cases of 46 male and 9 females with a ratio of 4.5:1 respectively. In another study by Fuji & Iqbal\(^5\) the study was composed of 49 males and 11 females. The proportion of males to females’ in their study was significantly different from the expected (2:1) base rate for TBI, the ratio was 5:1.

TBI is the leading cause of death and disability for those below the age of 45 years. In the study, those between 29 years and 50 years of age formed 78.4% of the study participants; this distribution shows that the able bodied persons were over represented in the study. The mean age for the participants in this study was 33.97, this is comparable with most literature\(^2\), \(^6\), \(^12\), \(^17\), \(^19\) that suggests TBI is common among the young people between the ages of 15-45.

The distribution for the cause of head injury in this study was mainly from RTA and from violence. The cause of head injury was also impacted by the use of motorcycles. This was consistent with a study done by Lezak\(^2\) that found TBI due to motorcycle accidents was 11%, violence was 20 (27.0%), falls were 8 (10.8%) while sports and recreation accidents were 3 (4.1%). It was also comparable with a study done by the National Institute of Health in which, half (50%) of all the TBIs’ were due to transportation accidents involving all kinds of vehicles and pedestrians. Approximately 20 percent of TBIs were due to violence, such as firearm assaults, fights, and child abuse, and about 3 percent are due to sports injuries. In this study the cause of the injury was associated with cognitive dysfunction on the RBANS. The increase of motor vehicles on the Kenyan roads has also caused an increased influx on the accidents on the roads; this would in turn be assumed by the researcher that there would be an increased likelihood to the number of TBIs among the Kenyan population and consequently an increase in cognitive impairment following head injury.
The MMSE is a tool that measures cognitive impairment due to dementia. It has however been used as a good measure for baseline cognitive impairment following head injury. In this study, the researcher found that majority of the study participants (67.6%, 50) scored 24-30 indicating uncertain / No cognitive impairment. This was a high number of persons for whom the tool was not able to capture their cognitive impairment as compared to the other tools and especially so for the RBANS. The MMSE was correlated with educational level showing that the higher the number of years in education one had, the better their score indicating lower cognitive impairment. The lack of a relationship on cognitive impairment with the other tests points to the MMSE not being able to effectively screen for cognitive impairment in TBI patients.

The trail making test is good in giving a baseline score on cognitive impairment, in this study it was found to be good in measuring aspects of cognition that had to do with, visual spatial speed and attention. The trail making test was used to measure for impairment especially that targeting the frontal lobes. The longer a respondent took to complete the test the more severe was the cognitive impairment. In this study, 27(36.5%) of the study participants were found to be deficient having indicating more severe levels of impairment in executive skills.

The Trail making test part B was used as a good measure for frontal lobe impairment. It assessed skills in visual reasoning, planning, concept formation, and mental flexibility, aspects of attention and awareness, and purposeful behavior impairment. Severe cognitive impairment was found in 15 (20.3%) for those who took greater than 273 seconds to complete the test. Moderate impairment was found in 22 (29.7%) who took greater than 181 seconds but less than 273 seconds to complete the test. Trail making test part B is more complex and calls for a greater coordination between the mental processes and the motor coordination.

In this study cognitive impairment, on the TMT part B was associated with expenditure since the onset of TBI. Frontal lobe impairments are not uncommon due to RTA especially because of the accelerating and decelerating of forces causing the brain to be jammed into the hard bony structures of the skull.
COGNITIVE DYSFUNCTION USING THE RBANS

In this study the RBANS was the main neuropsychological tool that was used to screen for cognitive impairment following TBI, it did show higher levels of cognitive dysfunction following TBI than the other two instruments. Cognitive dysfunction on the RBANS was correlated with, gender, occupation, cause of head injury and education level. According to studies done on the standardization of psychometric tests educational levels are a major predictor of performance on the tests. This was also demonstrated in the case of the MMSE, and the Trail Making Test part B.

In the RBANS, levels of cognitive impairment from the total scale index score was that a majority of the study participants 39 (51.4%) had severe cognitive impairment.

Those who were described in the RBANS as having severe cognitive impairment had a percentile rank of less than 2% on the bell curve which is exceptionally low for this population while those with moderate cognitive impairment were between the 3\(^{\text{rd}}\) and 9\(^{\text{th}}\) percentile rank, study participants who were described as having mild cognitive impairment had a percentile rank of between 10\%-25\% while those in the average range had a percentile rank of between 26\% - 75\%. Any score above that is on the high average and has a percentile rank of > 75\% on the bell curve.

On the RBANS, the greatest impairment was seen on attention skills which were measured using digit span and coding. Language skills which involved naming of items presented in pictorial forms and semantic fluency a task that involved retrieving of names was also a predictor of poor cognitive outcomes following TBI. The delayed memory task which involves, list recall, list recognition, story recall and figure recall was also a predictor of greater cognitive impairment with a higher number of study participants having memory impairment than on other indices like visual spatial and constructional skills. In a study done by De Guise E ET al.\(^\text{32}\), using the Neurobehavioral Rating Scale observed that attention; memory and mental flexibility as well as slowness and mental fatigability were the major cognitive deficits in the 348 study participants that they interviewed.
MEMORY

In one study done by McKinlay, et al,\textsuperscript{37} which constituted of Fifty-five cases of (46 male) aged 16-60 years (mean 35.7, SD 14-3) with severe blunt head injury and a PTA of at least two days found memory problems in the group. The memory items investigated included disorientation, omissions, repetitions and other indications of memory lapses. Overall, memory difficulties were reported in 73% of cases at 3 months, 59% at 6 months and 69% at 12 months. Impairments in memory like many other cognitive skills are and may be affected due to other impairments. Patients with memory deficits could have attention problems; lack of the ability to concentrate, confusional states and impairments in the capacity of encoding.\textsuperscript{37} In this study immediate memory was assessed based on the task of list learning and short story recall. In this study memory impairments were common with 48% having severe to moderately severe impairment and are consistent with literature on TBI which suggests that memory loss is the most likely outcome following TBI.

In the delayed memory index, a greater level of memory impairment was observed with a majority of the study participants scoring 52.7% (39), on the moderate to severe range. Here the study participants were unable to recall the list of words and the short story that had been used to test for immediate memory as well as the figure that they had been asked to copy earlier on. Problems associated with memory are also documented in literature with the occurrence of both retrograde amnesia and anterograde amnesia been common.

ATTENTION DEFICIT

Deficits in attention are very common in TBI albeit not universal for all the patients. Studies have shown that attention deficits are more common especially in patients whose injuries occurred due to deceleration, as in road traffic accidents or rail road accidents.\textsuperscript{2}

Under the RBANS, attention skills were assessed using digit span and coding. Impairments in attention were seen in the majority of the patients, 78.4% (58) indicating severe impairment in the attention indices. This study indicated severe cognitive impairment for most of the study participants in relation to attention. This finding on the RBANS was consistent with the findings on the TMT part A and part B.
VISUAL SPATIAL AND CONSTRUCTIONAL DEFICITS

The visual motor skills comprises of hand eye coordination, visual perception and visual motor integration. In this study the visual spatial index showed the least cognitive impairment as measured by the RBANS. 36.5% (27) were in the average range indicating normal levels of cognitive functioning, 27% (20) had mild impairment, 18.9 (14) had moderate levels of impairment while 17.6% (13) had severe impairment in visual spatial and constructional abilities. In a study done by Russel, it suggested severe visual spatial impairments following TBI, this study was in contrast with the findings of that study and other literature that suggest severe visual spatial and constructional skills following head injury. Most of the study participants did not show severe cognitive impairment and were instead in the normal to mild range of cognitive impairment.

LANGUAGE

In this study language problems were assessed using the semantic fluency and the picture naming subtests of the RBANS and the results indicated impairment in various aspects of language like word retrieval. Data revealed that the majority of the study participants’ language skills were particularly impaired 48.6% (36). The researcher noted that the identification of a Cannon in the test was failed by most of the participants who either had never seen it or those that that had seen the cannon had no idea what it was called. This for the researcher seemed like a cultural bias of the African people versus westernized countries and Europeans with the same kind of impairment.

Language impairment in this study was consistent with most of the literature that documents language difficulties following head injuries with either Broca’s aphasia or Wernicke’s aphasia. A study done by McKinlay, of 55 patients, found that following head injury patients had dysarthria and dysphasia. The most frequent problems were difficulty in expression reported in 47%, 44% and 44% of cases at 3, 6 and 12 months respectively, and dysarthria in 33%, 26% and 29% of cases.
Conclusion

TBI presented a major social, economic, and health problem. In the study the majority of the respondents were at their prime in life; as the young between the ages of 29-50 years old were over represented in the study. The disability is a major contributor to loss of income and industry for this age group, and this has an impact on the economy of the country as a whole.

In conclusion there was significant cognitive impairment in the various areas of cognition to do with memory, attention, visual spatial abilities, constructional skills, language skills and executive skills in this study. Head injuries including those that are mild have a cumulative effect. Their outcomes are far reaching beyond the physical scars or physical disability.

There is need for clinical screening and neurocognitive rehabilitation for those who are impaired in order to improve the quality of life for these patients. Their rehabilitation should be multimodal so that it deals with the physical, psychological and psychiatric disabilities that occur following trauma and more so the invisible ones like cognitive dysfunction.

From this study the major cause of head injury was RTA and violence, there is need to put in place preventive measures such as the use of safety belts and the use of helmets, education on road safety and the adherence to the Highway Code. There is need to reduce the occurrence of TBI, due to violence through community policing projects and conflict resolution management.
RECOMMENDATIONS
The study recommends that cognitive dysfunction following TBI should be addressed in a more comprehensive way in order to take care of the deficits and disabilities that occur.

The study findings call for an integration of neuropsychological testing within the clinical setting to detect cognitive impairment and the referral of patients who need help.

The study recommends that there is need for further research on the other psychiatric morbidity following TBI.

It is recommended that there is need to analyze the appropriateness of the tools in reference to the Kenyan populace in terms of the cultural and social norms.

It is recommended that prevention measures should be put in place to help reduce the occurrence of Traumatic Brain injury. Safety educational programs and the enforcement of the Highway Code should be emphasized in Kenya as a way of mitigating the effects of TBI.

STUDY LIMITATIONS
1. The study was limited to those patients who were 20 years and above, due to standardization of the RBANS which does not have data on persons below that age. Cognitive dysfunction was not assessed for persons below this age.
2. The study was limited to patients at the KNH, Nairobi and so the outcomes may not be comprehensively applied to different locations.
3. The study was limited in the use of western based norms on the tests which may bias the African populace.
FLOW CHART ILLUSTRATING METHODOLOGY:

Identification and selection of research study cases at the neurology Clinic at KNH using inclusion criteria.

Decline to sign

Explain and obtain consent.

Thank and exclude.

Administer the social demographic questionnaire and the Trail making test.

Administer Mini Mental Status Exam.

Score of >18

Score of <18

Administer the RBANS and the Trail Making Test part A & B

Analysis of obtained data using SPSS

Mild cognitive impairment

Moderate cognitive impairment

Severe cognitive impairment
REFERENCES


## APPENDICES

### Appendix 1

#### Timeline

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<td>Presentation Of Results</td>
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### Budget:

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<td>Data collection tool (RBANS)</td>
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<td>Typing, printing and photocopy</td>
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<td><strong>Total costs</strong></td>
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Appendix 2

Diagram illustrating conceptual framework:

- **Background variables**
  - Gender
  - Age
  - Marital status
  - Occupation
  - Religion
  - Education level

- **Control**
  - Ages between 20-89.

- **Independent Variables**
  - **Causes of TBI**
    - Road traffic accidents
    - Recreational activities
    - Sports
    - Falls, constructional accidents
    - Violence e.g. fights, gunshot wounds, assaults
  - **Predisposing factors**
    - Gender
    - Social economic status
    - Alcohol & substance abuse
    - Previous head injury
    - Location of infarct

- **Dependent Variables**
  - **Outcomes**
    - Cognitive impairment
    - Memory impairment
    - Dys-executive syndrome
    - Post concussion syndrome
    - Attention & concentration difficulties
    - Language and communication difficulties
    - Sensory and motor skills impairment.
    - **Psychiatric morbidity**
      - Depression
      - Anxiety
      - Post traumatic stress disorder
      - Psychosis
      - Early dementia
      - Personality change
      - Epilepsy
Appendix 3

INFORMED CONSENT EXPLANATION

My name is Sheila Gachanja, a clinical psychology student in the department of psychiatry in the University of Nairobi.

**Study title:** The Prevalence of Cognitive Dysfunction Following Traumatic Brain Injury in Patients at Kenyatta National Hospital.

**Institution:** Department of Psychiatry, Faculty of Medicine, College of Health Sciences, University of Nairobi.

**Purpose:** the purpose of this study is to determine the prevalence of cognitive dysfunction following traumatic brain injury in patients at the Kenyatta National hospital.

**Supervisors:** Dr. Caleb Othieno and Dr. Mary Kuria from the Department of Psychiatry, Faculty of Medicine, College of Health Sciences, University of Nairobi.

The objectives of the study are:

1. To determine the cognitive impairment following brain injury,
2. To determine the effects of brain injury on memory, attention, concentration, language, constructional ability, and mental flexibility.

**Benefits of this study** there will be no direct benefit for participation in this study. However the benefit is to gather information that will enable better screening of deficits and intervention of people with cognitive impairment in Kenya following head injury through rehabilitation.

**Risk of the study** the risk is that due to individuals’ varying appraisal of similar circumstances, some subjects may find certain questions distressing or difficult. Those subjects found to need further medical intervention, will be referred to the appropriate clinic in KNH.

**Voluntarism:** your agreement to enroll in the study is voluntary and you may withdrawal from the study at any time. There will be no penalty or loss of benefit in which you are otherwise entitled due to refusal to participate in the study.

**Confidentiality:** All the information obtained from this study will be regarded with outmost confidentiality and your name will not be recorded anywhere in the study or in the resulting publications.
After you read the explanation please feel free to ask any questions that will allow you to understand clearly the nature of the study. Thank you for participating in this research study.

CONTACTS:
Researcher: Sheila Gachanja - Telephone no: 0720-224-872

Supervisors: Dr. Mary Wangari Kuria- Telephone no: 0733610978
            Prof. Caleb Othieno- Telephone no: 0724879111

Prof. Guantai-Telephone no: 2726300-9 the chairperson of the Kenyatta National Hospital Ethics Committee.
CONSENT FORM

I the undersigned do hereby volunteer to participate in this research study. The nature and purpose have been fully explained to me fully by Sheila Gachanja. I do understand that all the information gathered will be treated with utmost confidentiality and will be used for this study only. I have been given the opportunity to ask questions regarding the study and I have understood. I understand that I can withdraw from the study and that I will not lose any benefits or my rights that I am otherwise entitled.

Code: ________________________________

Signed ________________________________ Date ________________________________

Signed ________________________________ Date ________________________________

Witness
SOCIO-DEMOGRAPHIC QUESTIONNAIRE:

Date of testing: ____________________.

Study No: ____________________________

Institution/ clinic ____________________________________________

IP/OP No: __________________________

Home address: ____________________________________________

Province: __________________________ District _______________________

1) What is your date of birth? Year___________ Month_______ Day________

2) That makes you ___________ years old.

3) Gender (please tick one)

   a) Male □

   b) Female □

4) Marital status please (tick one)

   a) Married

   b) Single

   c) Divorced

   d) Other (please specify) ________________________________

5) Occupation

   a) Highly skilled

   b) Skilled

   c) Semi skilled

   d) Manual
6) What is your current occupational status?
   a) Full time employed
   b) Part time
   c) Unemployed
   d) Retired
   e) Other (please specify) ________________________

7) Education level (please tick one)
   a) Primary level and below
   b) O- Level/ Secondary level
   c) Tertiary (college and above) Level

8) Religion (please tick one)
   a) Catholic
   b) protestant
   c) Muslim
   d) Other (please specify) ___________________________.

9) How long has it been since your injury?
   a) ________________________________(months, years etc )

10) How much money do you earn per month?
    a) ________________________________Ksh

11) How much money have you spent since your injury?
    a) ________________________________Ksh
12) What caused your brain injury?
   a) Road traffic accident
      i) Vehicles
      ii) Motorcycles/Boda bodas
   b) Sports accident
   c) Fall
   d) Violence (Fight, gunshot)

13) Have you ever had seizures after the injury?
   a) Yes
   b) No

14) If you said yes to Q.13 above how long after your injury did the seizure start?
   a) Between one month and six months
   b) Between six months to one year
   c) Between one year to two years

15) How often have you had seizure activity since your injury?
   a) ________________________________