UNIVERSITY OF GHANA

DEPARTMENT OF PSYCHOLOGY

LEGON

NEUROPSYCHOLOGICAL DEFICITS IN CHILDREN WITH SEIZURE DISORDERS IN GHANA: A STUDY AT KORLE-BU TEACHING HOSPITAL

A THESIS SUBMITTED TO THE DEPARTMENT OF PSYCHOLOGY, UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN CLINICAL PSYCHOLOGY.

JUNE, 2015
DECLARATION

I hereby declare that this thesis is conducted by me under the supervision of Dr. Adote Anum and Dr. Benjamin Amponsah. This work has never been submitted to any other institution by anyone for any award. All references cited in this work have been duly acknowledged and I take full responsibility for any shortcomings in relation to this work.

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ABSTRACT

The aim of the study was to determine the cognitive and neuropsychological deficits associated with seizure disorders. The study also examined the effects of age at onset, socio-economic status, compliance with medication and sex of the patient. Seventy two patients visiting the neurological clinic at the Korle Bu Teaching Hospital and a healthy control group from West African Basic School were sampled for the study. Analysis was done using Pearson correlation and the ANOVA. Findings of the study indicated higher deficits in language skills, attention skills, executive functioning, anxiety and depression among seizure patients compared to healthy control group. There was no significant difference in memory and academic achievement among seizure patients and healthy control. Sex of seizure patients did not have any significant influence on language skills, attention skills, memory, executive functioning, academic achievement, depression and anxiety. Lower socioeconomic status was found to be associated with memory deficits and academic underachievement among seizure patients. Early age of diagnosis was found to be associated with higher deficits in language skills, attention skills and executive functioning. Finally, medication compliance was found to decrease deficits associated with academic performance, attention, language skills, memory skills, executive functions and anxiety among seizure patients. Findings suggest that though seizure is associated with higher neurocognitive deficits, socioeconomic factors improved the outcome of seizure patient's memory and academic achievement.
DEDICATION

This thesis is dedicated with gratitude and affection to my god father Alhaji Alhassan Ghansah for his dedication, motivation and support throughout this course. I also dedicate it to my kid (Ivan) for his love and support throughout the entire course.
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LIST OF ABBREVIATIONS

SES .......................................................... Socioeconomic Status
EF .......................................................... Executive Function
SD .......................................................... Seizure Disorder
SP .......................................................... Seizure Patients
CHAPTER ONE

INTRODUCTION

Background to the Study

Cognitive and brain related deficits are frequent in people with epilepsy or seizure disorders (Berg, Smith, Frobish, Levy, Testa, Becker-man & Shinnar, 2005). Epilepsy or seizure disorder is associated with varying brain damage or changes in brain neural network. The changes in brain neural networks affect behaviour causing cognitive and behavioural dysfunctions depending primarily on the location/sites or type of the seizure (Smith, Elliot & Lach, 2002). For instance, left temporal lobe seizures lead to verbal memory problems, while right temporal seizures do not (Rejno-Habte, Olsson & Jennische, 2009). The relation between seizures and these deficits may not necessarily be a direct causal relationship but possibly influenced by certain factors such as age at onset of disorder, socio-economic status, compliance with treatment and sex of the patients (Sharma, Singh, Goyal, Singla, & Kaur, 2011). There have been very few studies that evaluated all these factors in a single study. This study therefore assesses the deficits associated with seizure disorder and the factors that influence the deficits among these seizure patients.

Epilepsy is a neurological condition that affects the nervous system. It is a neurological condition involving the brain (damage to either part or both parts) that makes people more susceptible to having recurrent, unprovoked seizure (Elliott, 2005). Seizures involve a breakdown of the natural electrical activity in the brain (Dunn, Johnson, Perkins, Fastenau, Byars & Austin, 2010). Anything that interrupts the normal connections between nerve cells in the brain can cause a seizure. This includes high fever, low blood sugar, high blood sugar, alcohol or drug withdrawal, or a brain concussion (Seneviratne, Cook, & D'Souza, 2014). Under these circumstances, anyone
can have one or more seizures. However, when a person has two or more unprovoked seizures, he or she is considered to have epilepsy or seizure disorder (Fisher, van Emde Boas, Blume, Elger, Genton, Lee, & Engel, 2005).

In people with epilepsy, the electrical impulses that the brain nerve cells (neurons) use to communicate are occasionally disrupted. During this disruption, the neurons become overactive firing at an inordinate rate without the usual interruption (Narita, Hamano, Kuroda & Kawachi, 2006). The result of this disruption in the neurons' activity is a neurological disorder that can affect the body in a variety of ways, depending on the location of the seizure in the brain (Dunn, 2003). There are generally two categories of seizure disorders: focal and generalized seizure disorders. With focal seizures only a small area of the brain is involved and consciousness is preserved. However, the generalized seizure affects a larger portion of the brain and is associated with a loss of consciousness. Most studies (e.g., Dunn, 2003; Ho-Turner & Bennett 1999; Seneviratne, Cook & D'Souza, 2014; Sharma, Singh, Goyal, Singla & Kaur, 2011) have assessed neuropsychological deficits of epilepsy based on these two seizure categories, however there is another type of seizure disorders (idiopathic seizures) with no known cause which have been neglected by previous studies. These children with idiopathic seizure have a chemical predisposition towards recurrent seizures (MacAllister, Bender, Whitman, Welsh, Keller, Granader & Sherman, 2012). Anecdotal evidence from the neuro clinic data at the Korle Bu children's department indicates that this type (idiopathic seizure) is common in the Ghanaian culture compared to either focal or generalized disorders. In idiopathic epilepsy, one cannot identify any cause from investigation and imaging. It is therefore imperative to assess whether the cognitive and neuropsychological deficits found to be frequent in people with seizure disorders (focal and generalized) assessed by previous studies (e.g., Cornaggia, Beghi, Provenzi
& Beghi, 2006; Dunn, 2003; Seneviratne, Cook & D'Souza, 2014) are also frequent with these idiopathic seizure patients.

Dakwa and Mudyahoto (2013) reported that due to the brain injury caused by seizures, children with seizure disorders may develop long-term neuropsychological deficits. These deficits can happen in any area of thinking including attention, behavioural inhibition, language, memory, planning, and academic achievement. It is estimated that 30% of children with seizure disorders encounter severe cognitive and neuropsychological deficits such as learning difficulties, attention, language and memory disorders (Dakwa & Mudyahoto, 2013).

The study of the cognitive and neuropsychological deficits of seizure disorder has attracted a lot of attention by numerous researchers with some of these studies concluding that seizure disorder is associated with higher neuropsychological and behavioural deficits (Cornaggia, Beghi, Provenzi & Beghi, 2006; Dunn, 2003; Kim, Kim, Byeon, Eun, Rhie, Seo, & Eun, 2012; Lendt, Helmstaedter, Kuczyat, Schramm, & Elger, 2000; Pataaraia, Billingsley-Marshall, & Castillo, 2005). However, few of these studies (e.g., Dunn, 2003; Kim, et al., 2012; Lendt, et al., 2000) have assessed the factors that predispose the seizure patients to experience such deficits. Findings have not also been consistent especially with regard to the cognitive deficits associated with epileptic children (Dunn, Johnson, Perkins, Fastenau, Byars & Austin, 2010). Whilst some studies (e.g., Aldenkamp, Alpherts, Dekkerr, & Overweg, 1990; McNelis, Dunn, Johnson, Austin & Perkins, 2007) have indicated no significant difference in memory and academic achievement between epileptic children and healthy control group, other studies (e.g., Aldenkamp, Weber, Overweg-Plandsoen, Reijs & van Mil, 2005; Dakwa & Mudyahoto 2013; Hoie, Mykletun, Sommerfelt, Bjornaes, Skeidsvol & Waaler, 2005) have found higher academic
performance and memory abilities among healthy control group compared to seizure patients. These inconsistencies highlight a glaring gap on the study of neuropsychological deficits associated with seizure disorders and the factors that expose seizure patients to experience higher deficits.

**The nature and pattern of Deficits Associated with Epilepsy (Seizure Patients)**

Uncontrolled seizures are usually associated with neuropsychological deficits in memory, attention and concentration, executive functioning and language (Smith, Elliot & Lach, 2002; Williams, 2002). When children have seizures they are shown to be at-risk for a variety of neuropsychological deficits, including deficits in overall intellectual functioning, memory, attention, and executive functioning (Koleoso, & Uwadiae, 2013; MacAllister, Bender, Whitman, Welsh, Keller, Granader & Sherman, 2012; Oguz, Kurul, & Dirik, 2002; Piccinelli, Beghi, Borgatti, Ferri, Giordano, Romeo, Termine, Viri, Zucca, & Balottin, 2009; Rejno-Habte, Olsson, & Jennische, 2009; Westerveld, 2010).

According to Camfield and Camfield (2007), seizure disorders are associated with difficulties in memory processes. Memory deals with the processes involved in encoding, storing and retrieving information (Beardsworth & Zaidel, 1994). Memory phenomena have been categorized as explicit or implicit. Explicit memories for experience involve the hippocampus-medial temporal lobe system and implicit memories for learning involve the cerebellum, amygdala, and other systems (Brown, Malec, McClelland, Diehl, Englander, & Cifu, 2005). Damage to the brain responsible for memory activities can cause memory problems (Fastenau, 2013).
Memory is also affected by numerous factors including how alert one is when information is presented, and the physical and mental context in which information is learned and later remembered (Thompson, Santos, Oakes & Radtke, 1996). For example, lack of sleep will undermine your memory, as well as factors like fatigue, anxiety, and stress (Gonzalez, Anderson, Wood, Mitchell & Harvey, 2007). Since seizure is associated with lack of sleep, fatigue, anxiety and stress, it tends to negatively affect memory as well (Sharma, Singh, Goyal, Singla, & Kaur, 2011). Brain cells either excite or inhibit (stop) other brain cells from sending messages. Usually there is a balance of cells that excite and those that can stop these messages (Millis, & Ricker, 1994). However, when a seizure occurs, there may be too much or too little activity, causing an imbalance between exciting and inhibiting activity (Draper, & Ponsford, 2008). This can affect the extent to which information can be encoded and retrieved. Also, during seizures, there are damages to neural connections between memory systems which disrupt the encoding and storage of information and subsequently affect recall of the information (Camfield & Camfield, 2007). After a seizure, the patient may also feel confused, fatigued, have headache, and/or process information slower than usual. This affects their ability to also retrieve the information already encoded (Fleming, Riley, Gill, Gullo, Strong, & Shum, 2008).

Repeated seizures affect attention, particularly in children (Hermann, Jones, Dabbs, Allen, Sheth, Fine, McMillan, & Seidenberg, 2007). Attention refers to the focusing of mental effort to actively process specific information present in our environment (Revlin, 2013). Difficulties in attention are noticed easily among growing children in school because of an inability to focus on tasks and to learn (Dibajnia, Moghadasin & Zahirrodin, 2015). It is important in processing information by helping the brain attend to relevant stimuli. Based on this, when individuals have difficulty with attention their performance on a number of cognitive activities such as learning,
problem solving, and academic achievement are also affected (Forceville, 1992; Hernandez, Sauerwein, Jambaque, De Guise, Lussier, Lortie, Dulac & Lassonde, 2002; Riva, Saletti, Nichelli, & Bulgheroni, 2002). Seizures that disrupt sleep in children lead to fatigue and therefore impair attention and concentration (Forceville, 1992).

Yet another cognitive ability affected by seizure disorders is executive function (MacAllister, Bender, Whitman, Welsh, Keller, Granader & Sherman, 2012). Executive functions (EF) are a set of cognitive skills that enable the individual performance of voluntary actions to orient goals (Saboya, Franco & Mattos, 2002). It encompasses control processes in planning, working memory, inhibition, mental flexibility, as well as the initiation and monitoring of action (Chan, Shum, Touloupoulou, & Chen, 2008; Stuss & Alexander, 2000; Zamarian, Trinka, Bonatti, Kuchukhidze, Bodner, Benke, Koppelstaetter & Delazer, 2011). Executive functions are responsible for focusing, guiding, directing, managing and integrating cognitive functions, and emotions (Zamarian et. al., 2011). Executive function helps connect past experiences with present actions necessary to attain solution to a new problem (Saboya, Franco & Mattos, 2002). The ability to connect past experiences with present actions is inhibited when there is damage to the frontal lobes of the brain. Seizures make it impossible for the brain to develop connection between the past experiences and the present actions which affect executive function processes such as planning, strategy application, self-regulation, inhibition, goal-directed behavior, initiation, and insight (Stuss & Levine, 2002).

Seizure disorder can also affect the processing of language (Duke, Tesfaye, Berl, Walker, Ritzl, Fasano, Conry, Pearl, Sato, Theodore & Gaillard, 2012). Aphasia is a language impairment caused by a permanent or transient injury to the Wernicke's area and the Broca's areas of the
left temporal lobe and left frontal lobe respectively. These areas are critical for language comprehension and production in a previously normal language user (Deonna & Roulet-Perez, 2005). The deficit may range from very limited problems in exact word finding to more pervasive deficits impacting on all language modalities. The effect of seizure on language manifests itself during speech production or verbal comprehension (Deonna & Roulet-Perez, 2005). Word finding difficulties are the most frequent complaints of patients with seizures originating from the language-dominant cerebral hemisphere (Hamberge et al., 2007). When epilepsy develops in early childhood, the patterns of language areas in the brain may be out of the ordinary and developmental difficulties may emerge, in which the child has difficulty in acquiring communication skills.

Children who suffer seizure disorders have also been reported to have academic underachievement (Williams, 2002). The relationship between epilepsy and academic difficulties is indirectly caused by decreased alertness having a general impact on learning (Sturniolo & Galletti, 1994). Increased seizure frequency is also associated with inattentiveness predisposing the seizure patient to cognitive dysfunction. The more frequent the seizures, the more the inattentive the patient may be and thus leading to higher cognitive impairment (Smith, Elliot & Lach, 2002; Williams, 2002). The issue of high absenteeism from school due to illness, hospitalization, and stigma also affect academic activity and performance of seizure patients.

Apart from significant cognitive and neuropsychological deficits associated with children suffering from seizure disorder, certain behavioural and emotional problems are also known to be outcomes of seizure disorders (Kanner & Palac, 2000). These behavioural and emotional
problems are not necessarily or entirely associated with brain changes (Dunn, 2003). Some specific behavioural and emotional problems associated with seizure disorders include depression and anxiety (Austin, Risinger & Beckett, 1992; Dunn, 2003).

Seizure disorder-related depression can occur before, during, or after seizures, but is most often associated with periods between seizures (Oguz et al., 2002). Symptoms of depression most often seen in children with epilepsy are sleeping disturbances, fatigue or restlessness, lack of enthusiasm, and frequent emotional outbursts. The cause of depression in people with epilepsy is thought to result from both internal and external factors (Austin, Perkins, Johnson, Fastenau, Byars, deGrauw & Dunn, 2011). Internal factors are as a result of problems in the structure or function of the brain, whereas external factors are not biologically based and instead result, for example, from the reactions of others to an individual's epilepsy or from a child's own response to feelings of anxiety or depression. The disapproval from family members and peers are external factors which result in higher level of depression among seizure patients. The irritability, withdrawal, and thoughts of death are more consistent with depression (Dunn, 2003). High level of anxiety is also associated with seizure (Adewuya & Ola, 2005). Anxiety disorders associated with epilepsy may take the form of chronic, generalized worrying, acute, overwhelming panic attacks, or obsessive-compulsive tendencies (Austin et al., 2011). The disorders often arise in response to the unpredictability and lack of control associated with seizures. For some people with epilepsy, anxiety may cause them to overestimate the threat posed by future seizures, or underestimate their ability to cope. Such thoughts can cause physical symptoms that heighten the feeling of a lack of control resulting in higher level of anxiety (Reilly, Agnew, Brian, & Neville, 2011).
Factors that Predispose Seizure Patients to Experience High Neurocognitive Deficits

There are reports of mediating or attenuating circumstances or factors that minimize the severe consequences of seizures disorders (Narita, Hamano, Kuroda & Kawachi, 2006; Nolan, Redoblado, Lah & Sabaz, 2003). Some factors have the potential to influence neuropsychological and behavioural deficits of these seizure patients. The most commonly reported factors are the age at onset of the seizure disorder, sex of the individual, compliance with medication, and socioeconomic status (Anderson, Spencer-Smith, Coleman, Anderson, Williams, Greenham, Leventer & Jacobs, 2010; Griffin & Tranel, 2007; Pataraia, Billingsley-Marshall & Castillo, 2005).

Effective treatment of epilepsy depends on medication compliance across a lifetime (Fountain, 2000). For individuals with epilepsy, adherence to medication is crucial in preventing or minimizing seizures and their cumulative impact on everyday life. Failure to comply with medication may lead to toxicity which will serve as a significant limiting factor in treatment maintenance (Donovan & Blake, 1992). In Ghana, people look for alternative explanations and cure to seizures (Dakwa & Mudyahoto, 2013). The traditional belief as to the causes of diseases such as epilepsy in Ghana affects the extent to which epileptic patients comply with medication (Dakwa & Mudyahoto, 2013). Patients who believe seizure is caused by spiritual factors other than a defect in the brain will fail to comply with medications provided by the medical practitioner (Bootsma, Ricker, Hekster, Hulsman, Lambrechts, Majoie, Schellekens, de Krom & Aldenkamp, 2009).

Another factor that influences the rate of deficits among seizure patients is low socioeconomic status (Eddy, Rickards & Cavanna, 2011). In Ghana, there may be multiplicity of treatment
options which may be determined by the level of socio-economic status. Some people may not comply with medication due to poor socio-economic status which makes it difficult for some patients to be able to afford medications regularly (Fountain, 2000). Determinants of socio-economic status such as education and income affect belief system and affordability. People might not follow through with treatment because they could not afford medication (Rodenburg, Meijer, Dekovi & Aldenkamp, 2006). Some patients may also not be able to attend hospitals regularly because of poor socio-economic status (Devinsky, Faught, Wilder, Kanner, Kamin, Kramer & Rosenberg, 1995). Poor socio-economic status also contributes to poor education which is associated with knowledge of etiology of disorder and higher stigma. In some cases of childhood seizures, a special diet that is rich in fat and low in sugar are prescribed to help to reduce the frequency of seizures (Rodenburg, Meijer, Dekovi & Aldenkamp, 2006). This type of treatment should be done under the supervision of a healthcare provider to make sure the child gets proper nutrition. Some patients may not obtain this diet or the supervision because of low socioeconomic status (Fountain, 2000).

Age at onset of the disorder has also been found to increase the likelihood of neuropsychological deficits among seizure patients. Vingerhoets (2006) found that the younger a child is when the seizures begin; the more widespread the area of the brain is affected, leading to deficits in varied abilities.

Sex of the individual has been found to be inconsistent predictor of psychological problems in children with seizure disorder. According to Oostrom (2000), the independent risk factors (socio-economic status, age at onset and type of medication) contribute with different prominence to neuropsychological deficits in boys and girls in the epilepsy population. As emphasized by Oostrom (2000), having seizure disorder is a much stronger risk factor of developing
neuropsychological problems in girls, whereas boys with epilepsy are affected by low socioeconomic status as having epilepsy. This means that the neuropsychological deficits associated with seizure among males and females may depend on independent factors such as socio-economic status, age at onset etc. and need to be verified.

The present study thus explored the deficits among epileptic (seizure) patients and the mediating or attenuating factors that may account for high deficits among such children.

**Statement of the Problem**

One of the most common neurological disorders in childhood is epilepsy (Fastenau, Shen, Dunn, Perkins, Hermann & Austin, 2004). Prevalence estimates suggest that approximately 5% of children will have at least one seizure in their lifetime with approximately 25% of these children subsequently meeting formal diagnostic criteria for epilepsy (Sharma, Singh, Goyal, Singla & Kaur, 2011). These children have also been found to be at-risk for a variety of deficits including deficits in overall intellectual abilities, memory abilities, attention, language skills and emotional response.

The prevalence of the deficits associated with the seizure disorder has attracted a lot of attention with large body of studies conducted on the neuropsychological deficits associated with seizure disorder. Notable among these deficits assessed include attention, memory, and academic performance (Dunn, Johnson, Perkins, Fastenau, Byars, & Austin, 2010; Elliot, 2005; Reilly & Neville, 2011; Vingerhoets, 2006). Though numerous studies have been carried out on how seizure disorders is linked to neuropsychological and behavioural deficits in the European countries, very little has been done to examine the risk factors that may account for the high deficits among the seizure patients especially in Ghana. In Ghana, because of the low socio-
economic status and the belief as to the cause of the disorder, people do not seek adequate care to help control the seizures (Dakwa & Mudyahoto, 2013). It is therefore important to study into these factors that exposes patients to severe neuropsychological deficits.

Epilepsy has also always been poorly understood by some societies and has frequently been associated with numerous myths and beliefs as a result of deficient or incorrect information about it (Austin, Dunn, Johnson & Perkins, 2004). Cultural beliefs and misconceptions about epilepsy influence the care-seeking behaviour of people with epilepsy. Despite the advance in orthodox treatment, a sizable proportion of epileptic population in Africa still resort to complementary and alternative medicine for treatment due to the cultural beliefs and misconceptions (Dakwa & Mudyahoto, 2013). Children with epilepsy are even socially discriminated against on the ground of widespread negative public misconceptions and beliefs (Martiniuk, Speechley, Secco, & Campbell, 2007). This phenomenon thus highlights the importance of improvement in knowledge towards epilepsy among patients, their families or caregivers as well as the public in attempt to ensure that conventional treatment and health-related quality of life is not compromised.

According to Ortinski and Meador (2004), the knowledge level of the general public is not adequate because researchers have not analyzed all the factors that put epileptic children at risk of developing neuropsychological deficits. Whiles some studies have linked variables such as sex, age of onset and socio-economic status to neuropsychological deficits among epileptic children (Bourgeois, 2002; Jackson, Dabbs, Walker, Jones, Hsu, Stafstrom, Seidenberg & Hermann, 2013; Ortinski & Meador, 2004), other studies that take into account type of medication and medication compliance as risk factors to the development of severe
neuropsychological deficits among epileptic children is underrepresented, particularly within the context of Ghana. Thus the present study quantitatively explored the neuropsychological deficits among epileptic children and the factors that may account for high neuropsychological deficits among epileptic children.

**Aims and Objectives**

The main aim of the study is to assess the neuropsychological deficits associated with seizure disorder and to provide a better explanation of the predictive factors that may expose seizure patients to severe neuropsychological deficits in Ghana. Given the above mentioned context which the present study is predicated, the following specific objectives were pursued:

1. To examine neuropsychological deficits in selected cognitive abilities (language skills, attention skills, memory skills, executive functions), and behavioural and emotional responses and academic achievement of people with seizure disorders.
2. To examine the relation between neuropsychological deficits of seizure patients and demographic factors such as age, socio-economic status, sex and compliance with medication and the age at onset.

**Relevance of the Study**

This study aimed at investigating the neuropsychological deficits associated with seizure disorders and the predictive factors that expose them to higher deficits. Seizure disorder is not new in the African continent but researchers have not concentrated much on this disorder in the African continent and Ghana to be specific. The knowledge level of some researchers and the general public on seizure disorders is also low. By assessing the neuropsychological deficits and the predictive factors that exposes one to experience high neuropsychological deficits, the study
will generate knowledge about seizure disorders and help enlighten the general public as to the
deficits associated with the disorder.

The knowledge that this study will generate may lead to an improvement in health-related quality
of life not only for patients but the families and caregivers of the seizure patients. Secondly, the
knowledge could provide better insight into the nature of the disorder as well as its future course.
This will go a long way to inform educationist, counselors, the clergy, educational institutions,
cooperate organization, parents and the society as a whole in gaining knowledge to help them in
their counseling process and also help detect the onset of the disorder earlier to institute
mechanisms that could curtail or minimize the deficits associated with it. Furthermore, the study
will enormously contribute toward the treatment regime of seizure patients by extending our
understanding of the dynamics of the disorder and the predictive factors that expose victims to
the higher neuropsychological deficits associated with seizure disorders.

Lastly, the study will help address the paucity of literature, stimulate concerns and promote a
platform for addressing the neuropsychological deficits associated with epilepsy and the
predictive factors that predisposes patients to more deficits through the presentation of detailed
investigations of epileptic patients in the Ghanaian context.
CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter presents a review of some theoretical underpinnings of the deficits in selected cognitive abilities in children with seizure disorders in Ghana and the predictive factors which expose seizure patients to severe deficits. There is also a review of related studies in relation to the neuropsychological and other deficits in children with seizure disorders. Rationale for the present study is also presented here. There is also a presentation of predictions in the form of hypotheses which are followed by a conceptual model that graphically demonstrate the relationships predicted. Operational definitions of terms used in the study conclude the chapter.

Theoretical Framework

The use of theory serves as a guide for finding answers to research questions as well as providing broad explanations for research findings. There exist several theories that explain the neuropsychological deficits in children with seizure disorders and the factors which expose seizure patients to severe neuropsychological deficits. The predictions made in the present study were therefore based on certain specific theories such as Luria's Theory of Executive Function (Luria, 1974), Functional Plasticity Theory (Kolb, 1995) Versus Theory of Vulnerability (Giza, Prins, Hovda, Herschman & Feldman, 2002) and the Risk and Protective Factor Model (Hawkins, Catalano & Miller, 1992). It is within the framework of these theories that the findings obtained are explained.
**Luria's Theory of Executive Function**

According to Luria theory of executive function (Luria, 1974), the human brain consists of three basic functional units that are interactively linked and the participation of these three functional units is necessary for any type of mental activity. The three units are responsible for regulating cortical tone, for detecting, processing, and storing information from the environment and for regulating mental activity and behaviour. Luria (1974) proposed that each of these units is "hierarchical in structure and consists of at least three cortical zones built one above the other" (p. 43). These three basic functional units are the primary functional unit, the secondary functional unit and the tertiary functional unit.

The primary functional unit is located in the brain stem and is responsible for receiving impulses from or sending impulses to the periphery. This helps in regulating and maintaining arousal of the cortex. The secondary functional unit which involves the temporal, parietal and occipital lobes is termed as the projection-association area and is responsible for encoding, processing, and storage of information for projection to efferent pathways. The third (tertiary) functional unit located in the frontal lobes is also termed as zones of overlapping area. This functional unit is responsible for programming, regulating, and verifying human behaviour. It is also responsible for complex forms of mental activity which requires the integrated participation of many cortical structures.

According to Luria theory of executive function (Luria, 1974), each form of conscious activity is always a complex functional system and takes place through the combined working of all three functional units. Each functional unit makes its own contribution to regulate all our behaviours. In order to undertake any behaviour such as voluntary movement, the first unit through its
systems provides the muscle tone, the systems of the second unit provide afferent feedback as to the status of the movement and the third unit regulates the movement by synthesizing, coordinating and adjusting the movement toward the goal. When this complex functional system is damaged by injury to any of the functional unit or all of the functional units, it disrupts the cohesion of the system resulting in the inability to verify or regulate behavioural outcomes. Consequently, it can lead to the replacement of these complex programmes by more basic behaviour or stereotypical behaviour that is either illogical, irrelevant, or inappropriate.

This theory has found evidence by previous researchers (e.g... Chan & Chen, 2004) leading to the development of various executive function tests such as the Reciprocal Motor Programme Test which has been shown to have similar sensitivity to the Wisconsin Card Sorting Test in patients with frontal lobe lesions (Mirsky, 2003). The theory has also found support in the study by Chan and Chen (2004) where damage to the functional unit of the brain was found to affect motor coordination, sensory integration and disinhibition. In relation to the present study, since seizure is associated with varying brain damage or changes in brain neural networks, it will disrupt the cohesion of the functional brain system resulting in cognitive and behavioural dysfunctions in area of thinking including language, memory, attention, planning, reading, spelling, math and behavioral inhibition.

**Functional Plasticity Theory (Kolb, 1995) Versus Theory of Vulnerability (Giza, Prins, Hovda, Herschman & Feldman, 2002)**

In view of the impact of an early brain damage on cerebral and cognitive development, two opposing theories which are contradictory in their predictions have been proposed. These
theories are the Functional Plasticity Theory (Kennard, 1936; Kolb, 1995) and the Vulnerability Theory (Giza, Prins, Hovda, Herschman & Feldman, 2002).

The functional plasticity theory posits that early brain damage as opposed to late brain damage is the most biologically manageable and that early brain damage has less impact on the neuropsychological function of patients. The theory suggests that the young brain is flexible and therefore capable of recovery after brain damage (Kennard, 1936; Kolb, 1995). According to this theory, there is less functional specialization in early life. Because of this, functions that would depend on a damaged area would simply reorganize to functionally cope with the damage (Sheppard & Lippe, 2012). This theory therefore emphasizes that children who will get seizure at a tender age will be able to reorganize to functionally cope with the damage and thus leading to less functional deficits. This theory was supported by Dennis (2009) using the Kennard principles which emphasized that there is a negative linear relation between age at brain injury and functional outcome. In effect, other things being equal, the younger the brain incurs an injury, the better the outcome.

The vulnerability theory on the other hand posits that the young brain is the most fragile and therefore vulnerable to early damage (Giza, Prins, Hovda, Herschman & Feldman, 2002). It argues that because the brain at a tender age will not have achieved functional specialization, it will attempt to recover threatened functions, but will do so unreasonably creating faulty connections in early life (Sheppard & Lippe, 2012). The theory again emphasized that a crowding effect will take place when there is early damage to the brain such that healthy tissue will take over the damaged tissue in an attempt to recover the cognitive function at hand which will limit the tissue's quantitative and qualitative resources (Satz, Strauss, Hunter & Wada,
1994). In effect, the vulnerability theory argues that early brain damage has the most detrimental impact on cerebral and cognitive development and leads to higher functional deficits. Evidence of the vulnerability hypotheses was first demonstrated in the context of hemispheric dominance following left hemisphere damage in early life such that an insult to the left hemisphere prior to one year of age resulted in the proper development of language but faulty development of nonverbal skills; owing to brain plasticity, the emerging language functions took over neurons dedicated to nonverbal skills which was not the case when the damage occurred after one year of age (Satz, Strauss, Hunter & Wada, 1994).

Though studies have supported the opposing predictions of both theories on early brain damage and its impact on functional deficits, the vulnerability theory has been mostly supported (Anderson & Moore, 1995; Anderson, Bond, Catroppa, Grimwood, Keir & Nolan, 1997; Bittigau, Sifringer, Felderhoff-Mueser & Ikonomidou, 2004). Narita, Hamano, Kuroda and Kawachi (2006) also supported the vulnerability hypothesis by indicating that children who suffer from epilepsy before the age of one year had higher neuropsychological and cognitive deficits than children who suffered from epilepsy after the age of one year.

**Risk and Protective Factor Model (Hawkins, Catalano & Miller, 1992)**

Risk factors are either background characteristics or life events that may have a negative impact on child development and behavioural outcomes. Risk factors are associated with the increased likelihood of a behaviour that usually has negative consequences. Protective factors on the other hand are characteristics and events that positively influence individuals and help limit the impact of risk factors. Protective factors therefore reduce the impact of risk behaviour, help individuals not to engage in potentially harmful behaviour, and promote an alternative pathway (Spooner,
Hall & Lynskey, 2001). Essentially, risk factors are the weaknesses and protective factors are the strengths of any given family.

According to the Risk and Protective Factor Model, there are some factors which when present helps to reduce the behavioural deficits associated with seizures. The Risk and Protective Factor Model view lack of low socio-economic status and lack of compliance with medication as the causes of negative behavioural deficits in people with epileptic disorders (Marsh, 1990). A study by Clare, Hugh and Andrea (2011) found compliance with medication as protective factor to combating the neuropsychological deficits associated with seizure disorders. Piccinelli, Beghi, Borgatti, Ferri, Giordano, Romeo, Termine, Viri, Zucca and Balottin (2010) also supported the risk and protective factor model by indicating that low socio-economic status is a detrimental factor that is negatively correlated to intelligence, memory and attention among seizure patients.

**Review of Related Studies**

This section review empirical studies that help in explaining the predicted relationships of the variables considered in the study. The study begins with a review of studies on seizure disorder in Ghana. It also reviews the neuropsychological and other deficits associated with seizure patients. It further assesses whether the deficits associated with seizure disorders will be predicted by factors such as age at onset, socio-economic status, compliance with medication and sex of the seizure patient.
Studies on Seizure Patients in Ghana

There is paucity of studies on seizure disorder in Ghana. The few studies on seizure patients in Ghana have been narrowed emphasizing on perception, misconceptions and ways of coping the frequency of seizure disorders in Ghana.

For example, Dugbartey and Barimah (2013) conducted a study aimed at investigating the psychosocial beliefs and knowledge about epilepsy among university students in Ghana. Data was collected from a voluntarily participating sample of 173 healthy Ghanaian university students without a history of seizure disorder or epilepsy using the Antonak and Rankin’s (1982) Scale of Attitudes Toward Persons with Epilepsy (ATPE-Form S). Findings of the study using the Pearson product-moment correlation analyses revealed a moderate relationship between the participants’ knowledge about, and attitudes toward, persons with epilepsy. Results indicated a growing trend toward relatively favorable attitudes toward individuals with the disorder.

Some studies have also assessed the causes of convulsion among patients. Ankrah, Adiku, Badoe, Sagoe, Kafintu-Kwashie and Seshie (2014) also investigated the association between HHV-6 infection and the convulsions prevailing at the Child Health Department of the Korle-Bu Teaching Hospital. Children admitted into the Department of Child Health with episode of convulsions were recruited after informed consent had been sought from subjects. Cerebrospinal fluid (CSF) and Plasma were obtained from patients. Findings indicated that viral infections may be the probable cause of the observed convulsions but not malaria or bacterial infections. None of the samples from the patients had evidence of HHV-6.

Studies have also concentrated on ways of managing seizure disorder. Owusu-Ofori, Agbenyega, Ansong and Scheld (2004) conducted a study aimed to determining the positive yield of lumbar
punctures in a setting where routine lumbar puncture is routinely carried out and to determine if any other parameter could help differentiate bacterial meningitis from the various other diagnoses of children who presented with a febrile seizure. The study was carried out among children aged three months to 15 years of age, hospitalized at the Komfo Anokye Teaching Hospital in Kumasi. Findings of the study indicated that there was a 10.2% (n = 19) positive yield for bacterial meningitis with a case fatality rate of 36.8% (n = 7). Cerebral malaria, which is not easily distinguishable from bacterial meningitis, accounted for 16.1% (n = 30) of the children. Twenty percent of bacterial meningitis patients had a positive blood smear for malaria. The indication for doing a lumbar puncture was similar in both cerebral malaria and bacterial meningitis patients. Signs of meningism were not the primary reason for carrying out a lumbar puncture, even in the group of children who had bacterial meningitis. The researchers concluded that performing routine lumbar punctures may have a role to play in the management of children with febrile seizures.

Cao, Badoe, Zhu, Zhao, Hu and Liao (2015) also conducted a study aimed at assessing the impact of ketogenic diet therapy for children with intractable epilepsy in Ghana with regard to its low cost and simple procedure. The study was individual case study using a 10-month-old girl with epilepsy with unknown etiology. The seizures of the patients could not be controlled by more than 3 antiepileptic drugs and her development delayed severely due to frequent seizures. The authors successfully applied ketogenic diet for the participants. The results indicated that the seizures of the patient were completely controlled after 2 weeks’ therapy. The mental condition of the participant was also improved after that.
Deficits Associated with Seizure Disorder

Children with epilepsy may experience significant challenges in the areas of attention and concentration, memory, executive function, and academic achievement (Smith, Elliot & Lach 2002; Williams, 2002). Different researchers have concentrated on different cognitive and neuropsychological deficits. Some of these studies (e.g., Elliott, 2005; Oostrom, Van Teeseling, Smeets-Schouten, Peters & Jennekens-Schinkel, 2005) focus on only one deficit whilst others (e.g., Gulgonen, Demirbilek, Korkmaz, Dervent, & Townes, 2000; Jackson, Dabbs, Natalie, Jones, Hsu, Stafstrom, Seidenberg & Hermann, 2013) focus on many deficits. The cognitive and neuropsychological deficits assessed in this study include memory skills, language skills, attention skills, executive functions and behavioural and emotional responses and academic performance.

Impact of Seizure Disorders on Memory and Academic Performance

The overall intellectual ability in children with epilepsy though is comparable to the normal childhood population; some of these children with seizure disorders are greatly behind normal children on academic achievement (Elliott, 2005). The presence of memory difficulties in people with epilepsy is well recognized by researchers and has been found to be a basic cause of low academic performance among epileptic children. On the basis of this, some previous researchers have assessed memory and academic performance as unitary though others have assessed them differently.

Though most researchers advocate that seizure disorders interject memory and negatively affect academic performance, there is some evidence that some epileptic patients are normal in academic performance (e.g., Sillanpa, Suominen, Rautava & Aromaa, 2011). Oostrom, Van
Teeseling, Smeets-Schouten, Peters and Jennekens-Schinkel (2005) indicated that no epilepsy-related variables had clinically meaningful effects on cognition or behavior. Reilly and Neville (2011) also adopted the meta-analytical design to examine academic performance of seizure patients. The evidence found did not indicate significant difference in academic underachievement (achievement below that expected on basis of IQ scores) between seizure patients and the healthy general population. They concluded that differences do not exist in overall achievement among seizure patients and healthy control group. Similarly, Vingerhoets (2006) reviewed existing literatures to assess the effect of seizure on academic performance. The review indicated no significant adverse effects of seizure on academic performance, although there appears to be a subgroup of about 10–25% of children that shows a clinically significant intellectual decline (Vingerhoets, 2006).

The findings of the studies by Reilly and Neville (2011) and Vingerhoets (2006) cannot be underestimated; however, they adopted the meta-analysis (review of existing literatures) which is influenced by publication bias (Walker, Kattan & Hernandez, 2008). Moreover, their study failed to give the number of literature they reviewed. According to Walker, Kattan and Hernandez (2008), the number of studies which are included in a meta-analytical review determine the reliability and validity of the conclusions.

McNelis, Dunn, Johnson, Austin and Perkins (2007) compared the academic performance of children with new-onset seizures between the ages of 4 to 14. Asthma patients were used as control group. The study was based on teachers’ ratings of academic performance. Findings indicated no significant differences in the academic performance ratings of the teachers among the asthma patients and the new-onset seizure patients. Another study was also conducted by
Aldenkamp, Alpherts, Dekkerr, and Overweg (1990) among 45 participants with the aim of assessing the level of academic deficits among seizure and normal control group. The findings of the study revealed no significant difference in level of academic achievement between children with epilepsy and normal control group. Whilst the study by McNelis, Dunn, Johnson, Austin and Perkins (2007) was questionable because teachers ratings of academic performance is subjective (Nyarko, 2011), the sample size (45 participants) of the study by Aldenkamp, Alpherts, Dekkerr, and Overweg (1990) was too small.

Though the above studies indicate no significant deficits in academic achievement among seizure children compared to healthy control group, some studies on the other hand have found significant decline in academic achievement of seizure patients. For example, Dakwa and Mudyahoto (2013) assessed the impact of seizure disorder on performance among 20 participants from 5 schools living with epilepsy. The children together with 10 children were interviewed to determine problems the children encountered which impacted on their learning. The study revealed higher academic underachievement among the epileptic children. Specific learning difficulties emanating from extensive brain abnormalities were also found among seizure patients. Dakwa and Mudyahoto (2013) study did not have a control group making it difficult to draw conclusion on the academic problems between epileptic children and normal healthy group. Moreover, interviews are not used for inferential statistics.

Similar findings on higher academic underachievement among seizure patients have been reported by other studies but focused on specific seizure type with a known cause compared to the present study which focused on seizure disorder (idiopathic) with no known cause. For example, a study by Aldenkamp, Weber, Overweg-Plandsoen, Reijs and van Mil (2005) reported
educational underachievement being more prominent in children with localized and symptomatic
generalized epilepsies than healthy control group. A study by Hoie, Mykletun, Sommerfelt,
Bjornaes, Skeidsvol and Waaler (2005) also revealed severe academic underachievement among
43% of patients with symptomatic epilepsy and myoclonic seizures compared to 3% of the
controls without seizure.

People with epilepsy also frequently complain of memory deficits with researchers citing
different reasons for the memory deficits. A study by Elliott, Lack and Smith (1999) revealed
significant higher memory skills among healthy control group compared to seizure patients
explaining that children suffering from poorly controlled epilepsy suffer from fatigue resulting in
transitory disruptions in memory. Helmstaedter (2002) compared episodic memory between
seizure patients and healthy control group and found out that seizure patients often show reduced
episodic memory compared to healthy group. Similarly, Thompson and Corcoran (1992) found
that 54% of over 700 people with epilepsy were found to have memory deficits. Hermann et. al.,
(1997) also found higher level of memory deficits among seizure patients compared to normal
healthy group.

Metternich, Wagner, Schulze-Bonhage, Buschmann and McCarthy (2013) also found that
seizure is associated with a significantly memory deficits compared to healthy control group. In
their study, Metternich, Wagner, Schulze-Bonhage, Buschmann and McCarthy (2013)
administered memory test to a sample of 12 epileptic patients and a matched group of 15 healthy
controls. Findings of the study indicated that epileptic patients with either damage to the left or
right hemisphere have significantly higher deficits in memory abilities. The sample size of 12
seizure patients employed by Metternich, Wagner, Schulze-Bonhage, Buschmann and McCarthy (2013) is too small and thus affect the external validity of the results.

Another study was conducted by Gascoigne, Smith, Barton, Webster, Gill, and Lah (2014) to assess long-term forgetting among children with epilepsy. Twenty-three (23) children with epilepsy were compared to 58 healthy control participants of similar age, sex and socioeconomic status. Participants were giving a battery of neuropsychological tests as well as two experimental tests requiring the learning of words and design locations to a criterion. Participants were tested on their ability to recall after short (30-min) and long (7-day) delays. Results indicated that word recalled for the short and the long terms were significantly poorer for the epileptic children compared to the healthy control group. The results suggested that long term memory deficit among epileptic children was similar to their short-term memory deficits.

Memory deficits for different stimulus (verbal and non-verbal) have also been found to be influenced by the laterality of the seizure. The left temporal lobe epilepsy for example has been found to cause more deficits in verbal memory and the right temporal lobe epilepsy has also been found to cause more deficits in non-verbal memory (Beardsworth & Zaidel, 1994; Thompson, Santos, Oakes & Radtke, 1996). A study was conducted by Fuentes, Malloy-Diniz, Gorenstein, Christe, and Busatto (2014) with the aim of comparing memory deficits among seizure patients according to the location of the damage of the brain. Two hundred patients with left and right temporal lobe epilepsy were tested with the Rey Auditory Verbal Learning Test (RAVLT) and the Logical Memory test for assessing verbal abilities and the Rey Visual Design Learning Test (RVDLT) and the Visual Reproduction test for assessing visual abilities. The results of the study revealed that left temporal lobe epileptic patients performed significantly worse on the RAVLT
and the Logical Memory tests than right temporal lobe epileptic patients. However, no significant difference emerged in the performance of the visual memory tests between the left temporal lobe epileptic patients and the right temporal lobe epileptic patients. The findings suggested that whilst verbal memory are dependent on the structural and functional integrity of the left temporal lobe, visual abilities are less dependent on the right temporal lobe.

Some studies have however, found clear deficits in memory abilities among epileptic children irrespective of the laterality of the seizure. For example, a study by Gonzalez, Anderson, Wood, Mitchell and Harvey (2007) revealed that there is no significant difference on any memory task among participants with left temporal lobe epilepsy and right temporal lobe epilepsy. However the deficits for memory of both verbal and non-verbal tasks were significantly worse for the epileptic children (left and right) than healthy control group.

Though most of the studies have found memory deficits among seizure patients, it is not all the studies that have ubiquitously confirmed memory deficits among epileptic children. A study was conducted by Piazzini, Canevini, Maggioiri and Canger (2001) to compare the severity of memory problems of patients with seizure disorders and other types of neurological disease and healthy control group. The results of the study revealed that many seizure patients perform at average or above-average levels and their memory performance did not differ significantly from those suffering from the neurological patients and the healthy control group. Similarly, Lendt, Helmstaedter and Elger (1999) found no significant difference in memory performance between epileptic patients and healthy control group.
In summary, studies on memory and academic deficits among seizure patients in comparison with healthy control group have revealed mixed results. The inconsistency of the impact of seizure on memory and academic performance demands for further clarity. Therefore, researchers must further examine memory and academic deficits among epileptic and healthy control group to gain clarity. This was one of the aims in which the study sought to clarify.

**Seizure and Attention Skills**

Attention skills deficit is one of the neuropsychological deficits which has been reported in children with epilepsy. Numerous researchers have revealed that seizure patients are prone to attention deficits in general. For example, Lendt, Helmstaedter, Kuczaty, Schramm, and Elger (2000) indicated that epilepsy surgery which involves the removal of epileptic focus lead to early improvements in attentiveness. Chou, Chang, Chin, Muo and Sung (2013) also evaluated the bidirectional correlation between attention deficit hyperactivity disorder (ADHD) and epilepsy using 2 cohorts from the same population database and found that ADHD incidence in 7.76 out of 10 epileptic children. The results of the study indicated a bidirectional association between ADHD and epilepsy in the 2 cohort studies. The researchers emphasized that patients with seizure deficit are generally prone to attention disorder.

The level of attention deficits among seizure patients has also been found to be higher than the general healthy population. Jones, Watson, Sheth, Caplan, Koehn, Seidenberg, and Hermann (2007), found that attention deficits is more prevalent in new onset idiopathic epilepsy children (26.4%) than in healthy controls (10%). Hermann, Jones, Dabbs, Allen, Sheth, Fine, McMillan, Seidenberg (2007) also found that inattention is prevalent in about 31% of epileptic children.
compared to 6% in healthy control. Kang, Yum, Kim, Kim and Ko (2015) also revealed higher level of attention deficits among seizure patients compared to healthy children.

Another study was conducted by Cerminara, D'Agati, Casarelli, Kaunzinger, Lange, Pitzianti, Parisi, Tucha and Curatolo (2013) to assess several components of attention in children with seizure disorder using a unique computerized test battery for attention performance which included selective attention, impulsivity, focused attention, divided attention, alertness, and vigilance. Twenty four (24) patients with seizure and 24 control participants matched for age and sex took part in the study. Findings of the study indicated that compared to the healthy control group, patients with seizure disorder made more errors in the selective attention, focused attention and divided attention tasks. Moreover, children with seizure deficits were impaired in alertness, vigilance and impulsivity compared to the healthy control group.

Similarly, Dibajnia, Moghadasin and Zahirrodin (2015) investigated the association between attention deficit hyperactivity disorder (ADHD) and epilepsy among one hundred epileptic children and 100 healthy children matched for age and sex. Parents of the epileptic children completed the Persian version of CSI 4 Test for evaluation of ADHD symptoms in children. The results indicated higher level of inattention and hyperactivity-impulsivity among the seizure patients compared to the healthy control group.

However, some studies have indicated that the level of attention among seizure patients may not differ from the general healthy people. For example, Kim, Kim, Byeon, Eun, Rhie, Seo, and Eun (2012) compared the accompaniment of ADHD in epileptic children with well-controlled seizures and no significant intellectual disability with that in healthy controls. One hundred and
two (102) participants took part in the study. Findings of the study indicated that differences exist in ADHD accompaniment according to seizure type and epilepsy syndrome. The finding also indicated that the accompaniment of ADHD in epileptic children with well-controlled seizures and no intellectual disability did not differ from that of the general pediatric population. In summary, studies on attention deficits among seizure patients and healthy control group indicate severe inattentiveness among seizure patients compared to healthy control group. However, few have revealed insignificant differences in executive function between healthy and seizure patients. This therefore needs further clarification with different participants from different cultural settings. The present study will thus clarify this by using participants from the Ghanaian context.

**Seizure and Executive Functioning**

Executive functions (EF) are a set of cognitive skills responsible for focusing, guiding, directing, managing and integrating cognitive functions, emotions and behaviours necessary for solving new problems (Kokkonen, Kokkonen, Saukkonen, & Pennanen, 1997). Researchers have documented higher executive function deficits among epileptic children. For example, a study by MacAllister, Bender, Whitman, Welsh, Keller, Granader and Sherman (2012) examined the severity of executive functions among epileptic children using the Tower of London and the Behavioral Rating Inventory of Executive Functioning (BRIEF). Ninety clinically referred children and adolescents with seizures were included in the study. The results indicated that the epileptic children score significantly higher in both the Tower of London and the Behavioral Rating Inventory of Executive Functioning (BRIEF). MacAllister, Bender, Whitman, Welsh, Keller, Granader and Sherman (2012) concluded that that objective measure of executive function deficits is more closely related to epilepsy severity. The problem with this study is that
it did not have control group to compare the seizure patients. This makes their conclusion questionable.

Other studies have however compared seizure patients with healthy group. Most of these studies have however concentrated on the effect of seizure on executive function based on the laterality of the seizure. For example, Culhane-Shelburne, Chapieski, Hiscock and Glaze (2002) conducted a study by comparing 12 children with frontal lobe epilepsy and 15 children with temporal lobe epilepsy with healthy control group on neuropsychological tests of attention, memory, executive functioning, and adaptive functioning. The results of the study indicated that the children with frontal lobe epilepsy compared to the healthy control group had deficits in planning and executive functions, whereas their verbal and nonverbal memory was intact. On the other hand, children with temporal lobe epilepsy compared to the healthy control group had deficits in verbal and nonverbal memory but their planning and executive functions were intact. These findings suggest that children with frontal lobe epilepsy have a pattern of cognitive deficits that differs markedly from the pattern seen in children with temporal lobe epilepsy. This was supported by Hernandez et al. (2003) study which indicated that children with frontal lobe epilepsy score lower than the healthy control group on measures of executive function but the deficits was negligible in children with temporal lobe epilepsy. It can be concluded from these findings that executive function deficits are more pronounced in children with frontal lobe epilepsy compared to those with lateral lobe epilepsy.

There are few studies about executive functions in patients with idiopathic epilepsy. Hernandez, Sauerwein, Jambaque, De Guise, Lussier, Lortie, Dulac and Lassonde (2002) assessed the impact of epilepsy on executive functioning among 32 epileptic patients and 200 healthy control group.
A neuropsychological test battery was administered to the 32 epileptic children (16 frontal lobe epilepsy (FLE), eight temporal lobe epilepsy (TLE) and 8 idiopathic epilepsy children). The performances of the three epileptic groups were further compared to normative data derived from 200 healthy children. The three epilepsy groups were found to have higher deficits in the components of the neuropsychological test battery compared to the normative sample. However, the FLE children showed deficits in planning and impulse control more than the other groups. Furthermore, they had significantly more coordination problems and exhibited greater rigidity than the other epilepsy groups on the motor tests. The comparison between the two groups (healthy and seizure patients) was questionable because the healthy control group participants (200) were more than five times that of the epileptic children (32).

Zamarian, Trinka, Bonatti, Kuchukhidze, Bodner, Benke, Koppelstaetter and Delazer (2011) also assessed different executive functions in epileptic children by adopting an extensive neuropsychological test battery. Performance of the epileptic children on the neuropsychological test was compared with healthy group and with normative data. The findings of the study indicated that relative to the healthy controls, epileptic patients performed poorly in tests of working memory, cognitive flexibility, categorical verbal fluency, set-shifting, categorization, and planning. Similarly, Ali, Rickards, and McCorry (2010) found that seizure patients have higher deficits in executive function such as deficits in abstraction, categorization, and set-shifting compared with healthy control.

Moreover, de Lima, Moreira, da Mota Gomes, and Maia-Filho (2014) assessed executive function in a sample of children and adolescents with idiopathic epilepsy. The cross-sectional, descriptive and analytical study was adopted in which executive functions of children and
adolescents with idiopathic epilepsy were compared with a control group. Thirty-one epileptic children and thirty-five controls participants took part in the study. The findings of the study indicated that patients with epilepsy had poorer executive function scores compared to the healthy control group. Similarly, Riva, Saletti, Nichelli, and Bulgheroni (2002) found out that although IQ was generally spared in epileptic children, the epileptic children showed a great variety of executive dysfunctions.

In conclusion, it appears that the significantly higher deficits in executive function is related to seizure patients with frontal lobe epilepsy though some have indicated deficits in executive function among the general epilepsy patients. Only few of the studies concentrated on idiopathic seizure patients in relations to their executive function deficits. This therefore calls for more studies on the executive function deficits using idiopathic patients.

**Seizure and Language Skills**

There are indications that epilepsy influence speech and language development. Rejno-Habte, Olsson and Jennische (2009) conducted four different studies to assess patterns of language and auditory dysfunction in 6-year-old children with epilepsy. In the first study, the medical records of 28 children with persistent speech and language disorder were reviewed in terms of speech and language development. The second and third studies investigated speech, language, auditory and cognitive functions in 20 children from a regional cohort of six-year-olds with epilepsy and normal intelligence. The epileptic children were compared with 30 reference children without epilepsy. In the fourth study, 19 individuals with sleep-activated epileptiform activity and language dysfunction in childhood were followed up with assessments for speech, language, auditory and cognitive functions and EEG registrations. The results of the follow-up
assessments were analyzed with respect to both the pattern of earlier language development and some prognostic factors. The result of the first study indicated higher percentage of children with language disorder had epilepsy compared to the healthy children who served as the control. The second and third studies also indicated that children with epilepsy but normal intelligence exhibited severe language dysfunction which was worse in the epileptic children with damage to the left hemisphere. The last study indicated diverse long-term outcomes for children with language dysfunction and epileptiform activity and no obvious differences were found between those with slow language development and those with deterioration in previously acquired language ability. The researchers concluded that children with epilepsy in comparison with the healthy control group have severe language dysfunction. The study by Rejno-Habte, Olsson and Jennische (2009) was longitudinal in nature which is influenced by a lot of factors which affect language development including the environment in which one stay, the school one attend etc.

A study by Duke, Tesfaye, Berl, Walker, Ritzl, Fasano, Conry, Pearl, Sato, Theodore and Gaillard (2012) also indicated that seizure patients have severe language deficits compared to healthy control group. However, there was a greater proportion of atypical language deficits in subjects with a mesial temporal focus compared with a frontal focus. Language deficits did not differ for subjects with a neocortical focus compared with a mesial focus or a frontal focus. The results also indicated that the longer the duration of the epilepsy, the lower the language deficits. Moreover, Caplan, Siddarth, Gurbani, Ott, Sankar and Shields (2004) investigated the effect of seizure related factors on intellectual and linguistic abilities in 101 seizure patients and 102 healthy children between 5 and 16 years old. The results of the study indicated a
significantly lower IQ scores and linguistic abilities among epileptic children than the healthy control group.

Berl, Balsamo, Xu, Moore, Weinstein, Conry, Pearl, Sachs, Grandin, Frattali, Ritter, Sato, Theodore, and Gaillard (2005) investigated the degree of language dominance in patients with left and right hemisphere seizure foci compared to normal control group using a fMRI reading comprehension task. Fifty patients with complex partial epilepsy, aged 8 to 56 years and 33 normal volunteers, aged 7 to 34 years were selected for the study. The study involved participants silently naming an object described by a sentence compared to a visual control. Findings of the study indicated that healthy control group had higher score on the language comprehension task compared to the seizure patients indicating severe language deficits among epileptic children compared to healthy control group. Moreover, left hemisphere focus patients had a severe language deficit than right hemisphere focus patients.

**Seizure and Neuropsychological Tests**

Some studies have however assessed indiscriminately a number of neuropsychological deficits among epileptic children. Among these studies include the cross-sectional survey conducted by Gulgonen, Demirbilek, Korkmaz, Dervent, and Townes (2000) to investigate several modalities of neuropsychological functioning among 21 seizure patients and 21 healthy controls group matched for age, sex, and socioeconomic status. A battery of age-appropriate neuropsychological tests was administered individually to all the participants. These age specific tests measured functioning in six domains: intellectual functioning, attention, memory, academic achievement, visualmotor functioning, and executive functioning. The findings of the study indicated no significant difference in any of the neurophysiological functions between the seizure patients and
the healthy control group except on attention and memory in which the seizure patients had lower mean score indicating severe attention and memory compared to the healthy control group.

A cross-sectional study was also conducted by Sharma, Singh, Goyal, Singla and Kaur (2011) to assess the neuropsychological deficits among 60 epileptic children between the ages of 8-16 years. The study utilized the symptom checklist and the Bhatia Battery to assess psychological and neuropsychological deficits associated with epilepsy. The findings of the study indicated that out of the 60 seizure patients who took part, 40 (60%) were free of psychological deficits, 36.7% had mild and 3.3% had moderate level of psychological deficits. Children had maximum psychological deficits score (50.08%) in anger hostility related symptoms and least (12.75%) in phobic anxiety symptoms. Moreover, 43% of epileptic children had borderline and dull normal IQ level which indirectly represented neuropsychological deficits, maximum in cognition i.e. 43.33% and lowest in loss of coordination or loss of fine motor control. Epileptic children had more mean percentage neurological deficits score. They were also found to have more problems related to the analytical- synthetics ability and the lowest mean percentage neurological deficits score (19.2%) in Immediate Memory Test. The researchers concluded that epileptic patients suffer from various degrees of neuropsychological problems but their conclusion was without any control group to make comparisons.

Another study was conducted by Jackson, Dabbs, Natalie, Jones, Hsu, Stafstrom, Seidenberg and Hermann (2013) to assess the neuropsychological and academic performance in children with new-onset epilepsy between the ages 8-18 years. Participants underwent neuropsychological assessment, and parents were interviewed regarding their child’s academic history. Cognitive scores for children with epilepsy were age and sex adjusted and compared with controls without
any trace of seizure. The findings of the study indicated that children with new/recent onset epilepsies exhibit considerable cognitive abnormality at base line, including slowing down of psycho motor reactions as well as deficits in executive function and language deficits. Academic difficulties were found in approximately 50% of the epileptic children.

Dunn, Johnson, Perkins, Fastenau, Byars, deGrauw, and Austin (2010) investigated the relationship between change in neuropsychological functioning and change in academic achievement among 219 children with seizures and healthy control group. Results of the study indicated that reading and math scores of children with seizures and siblings did not differ at baseline, but children with seizures had lower scores than siblings at 36 months. Writing scores were significantly lower for seizure patients than seizure patients at both baseline and after 36 months. Among children with seizures, there were positive correlations between neuropsychological functioning and academic achievement at baseline and 36 months. Changes in language and in verbal memory/learning were positively correlated with change in reading achievement. Age at onset moderated the association between change in neuropsychological functioning and change in reading and writing achievement, with stronger relationships among early onset. This study also failed to have control group which made it impossible for comparative analysis with healthy children.

Hermann, Jones, Sheth, Koehn, Becker, Fine, Allen, and Seidenberg (2008) assessed the determinants of normal and abnormal cognitive development in children with new onset epilepsy. One hundred (100) children consisting of 52 seizure patients and 48 healthy children took part in the study. The study was a longitudinal survey in which a comprehensive neuropsychological battery assessing intelligence, academic achievement, language, memory,
executive function, and psychomotor speed were assessed over a period of 2-year. The findings of the study indicated that children with new on set epilepsy experienced a significantly worse baseline and prospective cognitive trajectories across all cognitive domains, especially executive functions compared to the healthy control.

**Seizure Impact on Behavioural and Emotional Responses**

Children with epilepsy have also been found to be at an increased risk of behavioral and emotional problems compared with both children from the general population and children with other chronic illnesses not involving the central nervous system (Dunn, 2003). Higher level of anxiety and depression are among the behavioural and emotional problems found among epileptic children compared to the healthy population (Dunn, Austin & Huster, 1999). As stipulated by Kanner and Palac (2000) behavioural and emotional responses such as depression and anxiety in epilepsy are common but often unrecognized by researchers. Dunn, Austin and Huster (1999) indicated that approximately one-fourth of adolescents with epilepsy experience symptoms of behavioural and emotional symptoms such as anxiety and depression.

A study was conducted by Ettinger, Weisbrot and Nolan (1998) with the aim of assessing the rates of symptoms of anxiety and depression among pediatric patients with epilepsy. Revised Child Manifest Anxiety Scale and Child Depression Inventory were administered to 44 epilepsy patients aged 7-18 years. The results of the study indicated that no patients had been previously identified to have depression or anxiety. However, 26% had significantly increased depression scores and 16% met criteria for significant anxiety symptomatology. The researchers concluded that symptoms of depression and anxiety are common among pediatric patients, however they
failed to have control group to compare and determine whether the symptoms of depression and anxiety among the epileptic children were higher compared to the healthy control group.

Adewuya and Ola (2005) also examined whether the emotional response of adolescents to a chronic illness like epilepsy may differ across cultures. This study investigated the prevalence of and risk factors for anxiety and depressive disorders in a group of Nigerian adolescents with epilepsy. The sample consisted of 102 epileptic children aged between 12 and 18. Results indicated that, anxiety disorder was common in 32 (31.37%) of the adolescents and a depressive disorder was reported in 29 (28.43%). Regression analysis conducted indicated that predictors of anxiety and depressive disorders were uncontrolled seizures, polytherapy and stigma associated with the disorder. Moreover, emotional disorders in adolescents with epilepsy were found to cut across cultures. Just like Ettinger, Weisbrot and Nolan (1998), Adewuya and Ola (2005) also failed to have control group and so comparative analysis were not made to determine whether the symptoms of depression and anxiety among the epileptic children were higher than the healthy control group.

Reilly, Agnew, Brian, and Neville (2011) conducted a population based study to assess depression and anxiety among epileptic children. The findings of the study indicated that symptoms of depression and anxiety are more frequent in children and adolescents with epilepsy compared with the general population. The study also indicated that child and family attitude/adaptation to epilepsy also serve as risk factors for depression and anxiety among epileptic children. A study by Moreira, Lima, Fonseca and Filho (2014) also assessed the emotional and behavioural problems among epileptic children. The participants were evaluated on neuropsychological dysfunctions and a psychopathology questionnaire (Child Behavior
Checklist – CBCL). Findings indicated that there were significant differences in CBCL, with poorer results showed mainly by patients with epilepsy.

Caplan, Siddarth, Gurbani, Hanson, Sankar and Shields (2005) examined the presence of anxiety and depression disorders, and suicidality in children with epilepsy. A structured mood self-report scales as well as cognitive and language testing were administered to 100 children with seizures (CPSs), and 93 normal children. Parents provided behavioral information on each child through a structured psychiatric interview and behavior checklist. The finding of the study indicated a significantly more patients with epilepsy had anxiety disorder diagnoses (33%) as well as suicidal ideation (20%) emanating from depression than did the normal group. Goldstein and Harden (2000) also found that anxiety and depression symptoms in epileptic children were significantly higher than that of the normal control group.

Alwash, Hussein and Matloub (2000) also assessed the psychosocial outcome of epilepsy among adolescents. The study included 101 epileptic adolescents and 101 non-epileptic controls. Socio-demographic characteristics and all relevant clinical data were collected through interview. Identification of the symptoms of anxiety and depression were also made according to DSM-IV criteria. The results of the study revealed that adolescents with epilepsy have significantly higher tendency to develop symptoms of anxiety and depression than the control group. The anxiety and depression symptoms were more profound when seizures had not been properly medically controlled. Parents reported the anxiety and depressive symptoms of the epileptic children which may not necessarily reflect the true depression and anxiety feeling of the participants.
Another study conducted by Oguz, Kurul and Dirik (2002) with the aim of comparing anxiety and depression in epileptic children with that of a healthy control group and to determine the relationship of anxiety and depression scores to epilepsy-related factors. The State Trait Anxiety Inventory (STAI) and Children's Depression Inventory (CDI) were applied to 35 patients with epilepsy and 35 healthy control participants. The results of the study indicated significant higher level of depression and suicidal ideation among the seizure group compared to the healthy control group. Among the epileptic-related factors, epilepsy duration, and frequency of seizure were found to increase the level of anxiety and depression among epileptic children. The study also found that age of seizure onset and the seizure type were not related to anxiety and depression.

Factors Influencing the Neuropsychological Deficits among Seizure Patients

Previous studies reviewed above have proven that seizure disorder is associated with significant increase in neuropsychological deficits. However, according to Dunn (2003), some seizure patients exhibit higher deficits compared to others. If this is the case, then some factors have the potential to influence these deficits of these seizure patients. Several epilepsy variables seem to impact on the deficits including age of onset, disease duration, seizure severity, seizure type, antiepileptic drugs, medication compliance and sex (Anderson, Northam, Hendy, & Wrennall, 2001). Among the factors, the present study considered medication compliance, age at onset, socio-economic status and sex of the seizure patient.

Compliance with medication on the Deficits

One of the factors which have been found to influence the deficits of seizure patients is compliance with medication. Anticonvulsant medications are aimed at curbing the abnormal
surges characteristic of seizures. However, effective treatment of epilepsy with the anticonvulsant medications depends on medication compliance across a lifetime (Eddy, Rickards & Cavanna, 2011).

Nolan, Redoblado, Lah and Sabaz (2003) investigated the impact of anticonvulsant drug, compliance with medication, seizure frequency and age at onset of the seizure disorder on neuropsychological deficits among epileptic children. The study employed 69 epileptic children whose age ranged from 0–18 years. The results of the study indicated that younger age of onset; higher seizure frequency (especially if daily) produced severe deficits and contributed to 26% of its variance. However, compliance with medication was found to reduce the deficits associated with seizure disorder. Eddy, Rickards, and Cavanna (2011) also found that complying with medication have the potential of reducing the deficits associated with seizure disorder.

Similarly, Gallassi, Morreale, Lorusso, Procacciante, Lugaresi and Baruzzi (1990) also used a discontinuation design to study the effects of anticonvulsants on neuropsychological deficits. A group of 16 young adults seizure-free on anticonvulsants were tested before, during, and up to 1 year after discontinuation of the medication. Before discontinuation, patients who were complying with medication have lower neuropsychological deficits compared to those who were not complying with medication. One year after discontinuation, patients who were using the medication had lower neuropsychological deficits than those who were using the medication.

Some studies have however found that compliance with medication do not have any significant impact on neuropsychological deficits associated with seizure disorder. A study was conducted by Wolf, Forsythe, Stunden, Friedman, and Diamond (1981) aimed at assessing the impact of
anticonvulsant compliance on neuropsychological deficits among seizure patient. The study employed 25 epileptic children who were still using their medication and 25 epileptic children who have discontinued in using their medication over a short while. Compliance was assessed based on seizure patients who have stopped using their antiepileptic drug. The results of the study indicated that there were no differences between treated patients and those who have discontinued with the use of their medication on neuropsychological deficits such as attention, executive function and memory.

**Impact of Age at Onset of the Seizure Disorder on the Deficits**

The risk involved in the age of onset of seizure disorder has received support by previous researchers (e.g., Griffin & Tranel, 2007; Pataria, Billingsley-Marshall & Castillo, 2005). Most researches (e.g., Dunn & Austin, 1999; Hoare & Kerley, 1991) have suggested that age at onset is a strong predictor of neuropsychological deficits more than other seizure variables like sex, duration of treatment, compliance with medication and number of seizures.

However, the findings on the impact of age at onset of seizure disorder on neuropsychological deficits have been inconsistent. Some studies have reported that early onset of seizure disorder has a greater negative impact on neuropsychological functioning than in later life. A study was conducted by Narita, Hamano, Kuroda and Kawachi (2006) using thirty-one children to investigate the influences of the age at the onset of the seizures, the number of anticonvulsants, and the duration of medication, on neuropsychological deficits. The results indicated that there were high neuropsychological deficits among epileptic children who suffered from epilepsy before the age of one year than children who suffered from epilepsy after the age of one year. Saykin, Gur, Sussman, O’Connor, and Gur (1989) found that early onset subjects deteriorated in
memory performances following surgery, whereas late onset subjects did not indicating that early onset is associated with higher memory deficits compared to late onset.

A study by Griffin and Tranel (2007) investigated 66 patients with epilepsy all of whom completed comprehensive neuropsychological assessment. The participants consisted of 34 patients with early onset (EO) epilepsy and 32 patients with late onset (LO) epilepsy. The results of the study indicated that early age onset patients demonstrated significantly higher neuropsychological deficits compared to patients diagnosed with seizure later in life. Similar study was conducted by Lespinet, Bresson, N’Kaoua, Rougier and Claverie (2000) with the aim of assessing the impact of age at onset of seizure disorder on neuropsychological measures (executive function, language and attention). Early-onset seizure patients were found to have higher scores on neuropsychological measures compared to late-onset patients.

Anderson, Spencer-Smith, Coleman, Anderson, Williams, Greenham, Leventer and Jacobs (2010) investigate executive function in children with epilepsy. The researchers were interested in assessing whether brain injury in late childhood would have fewer consequences than early injury. One hundred and sixty four (164) children with seizure disorder took part in the study. Results indicated that children with seizure disorder had increased risk for impairment across all aspects of executive function. Children who sustained injury before age 3 recorded more global and severe executive function deficits compared to those who sustained injury after age 3.

Research has indicated high language deficits among seizure patients with early age at onset. The idea of high neuropsychological deficits in language among seizure patients with early age at onset was echoed by Pataraiia, Billingsley-Marshall and Castillo (2005) who reported that early onset of seizures was strongly associated with atypical language lateralization (mainly, a
displacement of receptive language functions to the non-dominant hemisphere). Stafiniak, Saykin, Sperling, Kester, Robinson and O’Connor (1990) explained the reason why early onset leads to high language deficits by emphasizing that early onset patients have not had time for complete lateralization of language to occur, and thus reorganization is more likely in such individuals and the resultant effects of surgery on language are diminished.

Not all studies have supported that high neuropsychological deficits are associated with early age at onset compared to late age at onset. Some studies have revealed otherwise. Hermann et al. (2002) for example found that late age at onset of seizure disorder leads to higher level of neuropsychological deficits in young children even when seizure frequency was controlled. As concluded by Hermann et al. (2002), earlier onset is associated with better outcome and patients who experience early onset may have relatively less ground to lose, compared to late onset patients. Powell et al. (1985) also reviewed that early age at onset (above 5 years) is associated with less neuropsychological deficits compared to late age at onset. Powell et al. (1985) explained that there is significant reorganization in early onset patients, whereby the undamaged temporal lobe assumes functions of the damaged temporal lobe, explaining why there is less change in functions like memory following surgical resection in early onset patients.

Though age at onset has been a predictor for neuropsychological deficits, it has been less reliable as a predictor of behavioral problems (Dunn & Austin, 1999). Hoare and Kerley (1991) conducted a study on the age at onset on behavioural symptoms among seizure patients. The results of the study indicated no significant impact of age at onset on behavioural problems such as depression and anxiety. Similarly, a study by Austin and Huberty (1993) found no significant
difference in depression and anxiety levels between seizure patients with early age at onset and seizure patients with late at onset.

A study was conducted by Oguz, Kurul and Dirik (2002) with the aim of comparing anxiety and depression in epileptic children with that of a healthy control group and to determine the relationship of anxiety and depression scores to epilepsy-related factors. The State Trait Anxiety Inventory (STAI) and Children's Depression Inventory (CDI) were applied to 35 patients with epilepsy and 35 healthy control participants. The results of the study indicated significant higher level of depression and suicidal ideation among the seizure group compared to the healthy control group. Among the epilepsy-related factors, epilepsy duration, and frequency of seizure were found to increase the level of anxiety and depression among epileptic children. Age of seizure onset and seizure type was not related to anxiety and depression.

In summary, age at onset of seizures has been associated with cognitive and neuropsychological deficits but not with behavioral deficits such as depression and anxiety. Though the results of the impact of age at onset on neuropsychological deficits have either supported early or late age at onset to be associated with higher neuropsychological deficits, almost all the studies have concluded an insignificant impact of age at onset on behavioural problems such as depression and anxiety.

*Impact of Socio-Economic Status on the Deficits Associated with Seizure Disorder*

One family characteristic which has been found to influence deficits associated with seizure disorder is the socioeconomic status (SES) of the family. Austin et al. (1999) found in a study of family characteristics of children with epilepsy and behaviour problems that children with the most problems came from families with low family mastery.
A study was conducted by Piccinelli, Beghi, Borgatti, Aldini, Ferri, Giordano, Romeo, Termine, Viri, Zucca, and Balottin (2009) to assess the neuropsychological functions in children with idiopathic epilepsy at onset of treatment and after 1 year of therapy and to identify factors associated with cognitive impairment. Forty three (43) children aged 5.2–16.9 years with newly diagnosed idiopathic epilepsy took part in the study. At admission and after 12 months, all patients underwent clinical examinations, the Child Behavioural Checklist, EEG and a neuropsychological test battery. The results of each test were correlated to demographic, clinical, electrophysiological and therapeutic variables. Results of the study indicated that except for attention, all neuropsychological functions were normal at admission and after 12 months. Low socio-economic level was found to positively correlate with intelligence and memory. Emotional and behavioural difficulties were not found to relate with socio-economic status. However, socio-economic status was found to predict cognitive impairment.

Fastenau, Shen, Dunn, Perkins, Hermann, and Austin (2004) examined the relation between neuropsychological functioning and academic achievement. The study also assessed the degree to which demographic, seizure, and psychosocial variables moderate that relation. Children with chronic epilepsy (N = 173) with age ranging from 8 to 15 years completed a comprehensive neuropsychological battery. The finding of the study revealed a positive relationship between neuropsychological functioning and academic achievement. Family variable such as socio-economic status moderated the impact of neuropsychological deficits and academic achievement. Neuropsychological deficits had a smaller impact on achievement for children in supportive homes compared with children in unsupportive homes.
Gender Differences on the Deficits

Epilepsy literature suggests that individuals’ background traits have some influence on the deficits (Fastenau, Shen, Dunn, Perkins, Hermann, & Austin, 2004). One of this background characteristic is the gender of the seizure patients. Careful review of the literature shows that the findings on the impact of gender of the seizure patient on the deficits have not been consistent.

Some studies have favoured higher level of deficits among females compared to males. For example, a study was conducted by Hoie, Sommerfelt, Waaler, Alasker, Skeidavoll and Mykletun (2006) on the differences in deficits associated with seizure patients based on the sex of the patient. The study revealed that girls with epilepsy reported more neuropsychological deficits and depression/anxiety compared to boys. Another study by Austin et al. (1996) on the neuropsychological deficits associated with male and female seizure patients indicated that seizure girls experience more neuropsychological problems compared to seizure boys.

Similarly, Koleoso and Uwadiae (2013) assessed the role of epilepsy-related factors, such as sex on general intellectual functions among Nigerian children with epilepsy. Sixty epileptic children (38 males and 22 females) with a mean age of 12.9 years (SD= 2.9 years) were randomly selected from a population of epileptic children for a study. The Wechsler Intelligence Scale for Children (WISC-R) was administered. The result showed that 73.4% of the epileptic children had mental retardation. Multiple regression analysis revealed that sex independently predicted performance IQ of the epileptic children with females having lower performance on the Wechsler Intelligence Scale for Children (WISC-R) than males.

Some studies have also indicated higher level of neuropsychological deficits among males compared to females. Austin, Harezlak, Dunn, Huster, Rose, and Ambrosius (2001) for example,
assessed gender differences in behavioural and emotional problems among seizure patients. Findings of the study indicated that boys with seizure disorder experienced more problems compared to girls with seizure disorder. Another study by Austin, Huberty, Huster and Dunn (1998) reported higher cognitive and behavioural problems among males with seizure disorder compared to females with seizure disorder. Stores (1978) also found that seizure boys have high deficits of neuropsychological functioning compare to seizure boys.

Better still, other studies have revealed no significant difference in neuropsychological deficits between males and females with seizure disorder. Hoare and Kerley (1991) conducted a study to find out effect of gender of seizure patient on neuropsychological problems encountered in their daily lives. The study involved seizure patients between 3 – 18 years. Results of the study revealed that there was no significant gender difference in neuropsychological problems among seizure patients. Moreover, Seidenberg, Beck and Geisser (1974) assessed gender differences in deficits of seizure patients. Seizure patients were assessed on multiple neuropsychological deficits. Findings indicated no gender differences in all the deficits. A study by Bailet and Turk (2000) revealed that no significant difference exist in neuropsychological deficits of seizure males and seizure female patients.

With the inconsistencies in findings, Oostrom (2000) emphasized that the independent risk factors (socio-economic status, age at onset and type of medication) contribute with different prominence to neuropsychological deficits in boys and girls in the epilepsy population. As postulated by Oostrom (2000), having seizure disorder is a much stronger risk factor of developing neuropsychological problems in girls, whereas boys with epilepsy are affected by low socioeconomic status as having epilepsy. This means that the neuropsychological deficits associated with seizure among males and females may depend on independent factors such as
socio-economic status, age at onset etc. and need to be verified. Austin et. al. (2000) found girls with epilepsy to have more problems with anxiety whereas boys had more social problems.

**Rationale of the Present Study**

Most studies have been conducted to assess the neuropsychological deficits associated with seizure disorders. These studies have largely focused on either neuropsychological deficits (e.g., Gulgonen, Demirbilek, Korkmaz, Dervent, & Townes, 2000) or other deficits (e.g., Ettinger, Weisbrot & Nolan, 1998). Just few of these studies assessed both neuropsychological and other deficits at a time (e.g., Dunn, Johnson, Perkins, Fastenau, Byars, deGrauw, & Austin, 2010; Sharma, Singh, Goyal, Singla & Kaur, 2011).

Moreover, few of these numerous studies on the neuropsychological deficits associated with seizure disorder have assessed the factors that predict the deficits of patients with seizure disorders. It is an undeniable fact that most of these studies have found that seizure disorders are associated with neuropsychological deficits. However, Fastenau (2013) estimated that 30% of children after age of seizure disorders onset encounter severe intelligence, attention, verbal, visual and behavioural difficulties whilst the rest develops normal. The question is what are the factors that predispose the remaining 70% to develop normally after onset? Would it be a factor of age at onset, socio-economic status of the parent, compliance with medication or sex of the seizure patient? Most of the numerous studies failed to assess these factors as contributing to the recovery rate of children with seizure disorder.

Moreover, despite the high deficits among seizure patients and the potential moderating variables which influence these deficits, to date, only a handful of studies have focused on understanding
the potential variables (age at onset, socioeconomic status) on explaining the deficits associated with seizure especially in Africa (Adewuya & Ola, 2005; Oguz, Kurul & Dirik, 2002). Adewuya and Ola (2005) noted that most of the studies on neuropsychological deficits were conducted in the Western world (e.g., Dunn & Austin, 1999), the Far East (Alwash, Hussein & Matloub, 2000), and in Europe (e.g., Reilly, Agnew, Brian, & Neville, 2011). This is startling, given that the high prevalence rate of seizure disorder in the African continent. Moreover, studies on the deficits among seizure patients have revealed an inconsistent result. This particular study is therefore aimed at assessing the deficits associated with seizure disorder and the factors that influence the deficits among seizure patients in the Ghanaian context.

**Statement of Hypotheses**

Based on the literature reviewed, the study sought to test the following hypotheses:

1. Participants with seizure disorders will experience significantly higher neuropsychological deficits (language skills, attention skills, memory, executive functioning) than healthy control group.

2. Males with seizure disorder will experience significantly higher neuropsychological deficits (language skills, attention skills, memory, executive functioning) than females with seizure disorder.

3. Participants with seizure disorders from high socio-economic background will experience significantly lower neuropsychological deficits (language skills, attention skills, executive functioning) compared to participants with seizure disorders from low socio-economic background.

4. Participants with seizure disorders will experience significantly higher deficits in academic achievement, anxiety and depression than healthy control group.
5. Females with seizure disorder will experience significant higher deficits in academic achievement, anxiety and depression than males with seizure disorder.

6. Participants with seizure disorder from high socio-economic background will experience significantly lower deficits in academic achievement, anxiety and depression than participants with seizure disorder from low socio-economic background.

7. Early diagnosed seizure patients will have significantly higher neuropsychological deficits (language skills, attention skills, memory and executive functioning) compared to those who were diagnosed with the disorder later in life.

8. Early diagnoses of the seizure disorder will have significant impact on the neuropsychological deficits of females compared to males.

9. Early diagnosed seizure patients will have severe deficits in academic achievement, anxiety, and depression than late diagnosed seizure patients.

10. Females diagnosed with seizure disorder early will have higher deficits in academic achievement, depression and anxiety compared to males.

11. Compliance with medication will have a positive relationship with academic performance, attention, language skills and memory skills among seizure patients.

12. There will be a significant positive correlation between executive functioning, depression and anxiety among seizure patients.
2.5 Conceptual Model

Seizure Patients
- Age at Onset
- SES
- Medication Compliance
- Sex

Healthy Control

Neuropsychological Deficits
- Language skills
- Attention skills
- Memory skills
- Executive Functions

Other Deficits
- Academic Performance
- Anxiety
- Depression

Figure 1: Conceptual Framework showing the expected relationships between seizures and the deficits.

In the model above, healthy status of the participants (seizure and healthy participants) is hypothesized to differ in their level of neuropsychological and other deficits. The neuropsychological deficits assessed include language skills, attention skills, memory skills, and executive functions. Other deficits assessed include academic achievement, anxiety and depression. Other factors were hypothesized to influence the neuropsychological deficits among the seizure patients. The variables predicted to influence neuropsychological disorders among seizure patients included age at onset, socio-economic status, compliance with medication, and sex of the patient

2.6 Operational Definition of Terms

High socio-economic background: a score above 10 on the modified Kuppuswamy’s Socioeconomic Status Scale
Low socio-economic background: a score of 10 and below on the modified Kuppuswamy’s Socioeconomic Status Scale

Early diagnosis: patients who were diagnosed with the disorder before 5 years

Late diagnosis: patients who were diagnosed with the disorder at age 5 and above

Neuropsychological deficits: attention, language, memory and executive functions

Other deficits/Behavioural deficits: anxiety, depression and academic achievement

Health Status: seizure patients and healthy control.
CHAPTER THREE
METHODOLOGY

Introduction

The chapter discusses the research methodology that was used to investigate the cognitive and neuropsychological deficits associated with children with seizure disorders. It specified the appropriate methods employed in order to test the hypotheses and discussed the reasons and assumptions underlying the choices made. The chapter covered the participants, the sampling technique, the measuring instruments, research design, and the data collection procedure. The chapter concluded by given a summary of the ethical considerations of the research.

Research Setting and Population

This study was conducted in the Accra metropolis, the capital of Ghana in the Greater Accra Region. It is located in the southern part of the country. The target group was all patients diagnosed with seizure disorder and healthy individuals without any trace of seizure disorders or history of seizure disorders. Those with seizure disorders were selected from the Korle-Bu Teaching Hospital. Korle-Bu Teaching Hospital was selected because that is where most children with seizure disorder go for treatment. Persons with seizure disorder in this special institution are diagnosed by qualified medical officers. Based on the educational background and the age of the participants with seizure disorders selected, the healthy control participants were also selected from West African Basic School at Adenta through matching.

Korle Bu Teaching Hospital runs a neurological clinic where seizure patients are treated and therefore provided a good source of potential participants who have been properly diagnosed by a qualified physician.
Sample/Sampling Technique

The study made use of the purposive sampling technique. The purposive sampling is a non-probability sampling technique used in selecting the patients with seizure disorder for the study. The purposive sampling technique was based on voluntary participants after the seizure patients had been contacted by the researcher.

The control group (healthy individuals with no known history of seizure or neurological disorders) were obtained after selecting the seizure patients from West African Basic School was done using matching. The control was matched on sex, age and educational level.

The sample size was determined using two approaches. These are Tabachnick and Fidel (1996) formula for computing sample size and Cohen (1992) proposed sample size for correlational and regression analysis. According to Tabachnick and Fidel (1996), for a sample size to be appropriate for a targeted population, \( n > 50 + 8M \) (\( n \) = sample size, \( M \) = number of Independent Variables). Since there are 5 Independent Variables in the present study, the sample size was estimated to be more than 90 (\( n > 90 \)). As suggested by Cohen (1992), the sample size that is required for correlational and multiple regression analyses are 85 and 116 respectively. On the basis of this, 100 participants (50 seizure patients and 50 healthy patients) were targeted for the study.

Since the sample size targeted was 50 seizure patients and 50 healthy patients, 50 questionnaires were first distributed to the seizure patients but only 36 responses were sampled. The sampling was done by matching the demographic characteristics of the respondents with the healthy control group and healthy participants with similar characteristics like that of the seizure patients.
selected for the study. Fourteen (14) of the questionnaires were not appropriately filled. To ensure equivalent sample size among the two groups, thirty six (36) healthy control participants were also selected. The total responses obtained therefore consisted of 72 respondents (36 seizure patients and 36 healthy patients). The sample size of 72 did not affect the statistical power since according to Cohen (1992), a response rate of 70% and above do not affect the statistical power of a study.

**Demographic Data**

The seventy two (72) participants consisted of 36 patients with seizure disorder and 36 healthy individuals without any trace of seizure disorders or history of seizure disorders. The seizure patients in this study were idiopathic patients who have been receiving treatment from Korle-Bu Teaching hospital for at least six months. The age range of the participants was from 10 – 14 years of age.

The demographic distribution of participants indicated that their ages ranged from 10 years to 14 years (M= 11.75, SD=1.27). The age range of males and females in the study were 11.24 years (SD=1.42) and 12.26 years (SD=1.12) respectively. Among the 72 participants, 40 were males and 32 were females. The educational level of the respondents ranged from class 4 to Junior Secondary 2. Table 1 summarizes the characteristics of the respondents used in this study.
Table 1: Demographic Characteristics of the Respondents

<table>
<thead>
<tr>
<th>Variables</th>
<th>Seizure Patients (n = 36)</th>
<th>Healthy Control (n = 36)</th>
<th>Total (n = 72)</th>
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<td>Gender</td>
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<td>JSH 2</td>
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**Design**

The study was a survey. The specific type of survey that was adopted was the cross sectional survey which was used to sort participants views using structured questionnaires. The time dimension of the study is cross-sectional as large amount of data on the deficits were collected from among many participants within a relatively short time.

**Measures**

The intention of the researcher was to measure functional areas in the brain that may reflect deficits in memory abilities, attention skills, executive functions, language (neuropsychological deficits) and academic achievement, anxiety and depression (other deficits) associated with seizure disorders. The tests administered include a demographic measure, Digit Span Tasks (subtests of the Wechsler Intelligence Scale for Children – IV Edition, WISC-IV) for measuring attention, Kilifi Naming Test (KNT) for language skills, Trail Making Test (TMT) for executive function, Literacy and Numeracy Measure (LNM) for academic performance, Nonsense Syllables for memory skills, the Spence anxiety scale for children (SASC) and the Children's Depression Inventory (CDI) for measuring behavioural and emotional responses and Morisky 8-
Item Medication Adherence Scale (MMAS-8) for measuring medication adherence. Comprehensive descriptions of the scales used are presented below:

**Demographic Variables**

This part of the questionnaire was used to gather information of respondents’ demographic characteristics such as child age, child sex, and age at onset of seizure disorder. Other relevant questions asked in this questionnaire were about the duration of treatment and class of study. The data were obtained through the caregiver or the seizure patient.

**The Digit Span Scale (Wechsler, 2003)**

The Digit Span is a sub-scale of the WISC-IV (Wechsler Intelligence Scale for Children- Fourth Edition) for assessing cognitive ability of children between the ages of 6 years and 16 years 11 months. The WISC-IV provides subtest and composite scores which represent intellectual functioning in specific cognitive domains as well as a composite score which represents general intellectual ability. The WISC-IV has four main components that are referred to as Indexes. These are Verbal Comprehension Index, the Perceptual Reasoning Index, the Working Memory Index and the Processing Speed Index. Within each of these four domains are a variety of subtests that form the index score.

The Digit Span subtest of the Working Memory Index (WMI) was used to measure attention and mental concentration. The digit span subtest requires working memory processes to manipulate orally presented verbal sequences or to simply recall orally presented sequential information. The digit span contains both forward and backward items (9 forward items and 8 backward items). Each item also consists of two questions making it 18 forward and 16 backward items. To
complete the task children need to hold and manipulate (reverse) a series of numbers in their minds. In the digit span, children are told they are going to play a number game. The children are told that they will hear some numbers and they will need first repeat the numbers to the examiner and then later they are asked to repeat the numbers backwards (e.g., If I say ‘1, 3,’ you say ‘3,1’). The reliability of the digit span is .86 (Watkins & Smith, 2013).

In scoring the digit span, for each test item (forward and backward), the child gets 1 point for each number sequence recalled correctly. For example, if a child was given the sequence 587 to recall backwards and said 875, he/she would get a score of 0 for that item. If he/she said 785, a score of 1 for that item would be given. The longest span correctly recalled across the test items (9 possible for forward and 8 possible for backward) with at least one trial was given 1. Possible final score of 0 – 18 and 0 – 16 was awarded for the forward and backward series respectively. Higher score represents lower deficits in attention.

**Kilifi Naming Test (KNT; Kitsao-Wekulo, Holding, Taylor, Abubakar & Connolly, 2012)**

The Kilifi Naming Test (KNT), a test of confrontation naming, was used to assess language skills (Kitsao-Wekulo et al., 2012). The KNT measures expressive vocabulary in which the child is required to provide names of common pictures as they are presented. In the KNT, the child is asked to spontaneously give one-word responses when presented with a black and white line drawing of a familiar object. If at the first attempt the child provides the correct responses, a score of 2 is encoded. A stimulus cue is provided when no response is given. A score of 1 is given when the child provides correct response after the naming cue is provided. If the child does not provide a correct response after the stimulus cue, the word that is provided is recorded verbatim or the child is given a score of 0. The final score is calculated by summing the number
of spontaneously correct items and the number of correct items following a stimulus cue. Lower score represent higher level of impairment. The reliability of the scale is .88 (Kitsao-Wekulo et al., 2012).

**Trail Making Test (TMT) for Executive Function (Reitan, 1958)**

The trail making test consists of two parts and in both parts of the Trail Making Test consist of 25 circles distributed over a sheet of paper. In Part A, the circles are numbered 1 – 25, and the patient should draw lines to connect the numbers in ascending order. In Part B, the circles include both numbers (1 – 13) and letters (A – L); as in Part A, the patient draws lines to connect the circles in an ascending pattern, but with the added task of alternating between the numbers and letters (i.e., 1-A-2-B-3-C, etc.). The patient should be instructed to connect the circles as quickly as possible, without lifting the pen or pencil from the paper. The patient is timed as he or she connects the "trail." If the patient makes an error, it is pointed out immediately and the patient is allowed to correct it and continue. Errors affect the patient's score only in that the correction of errors is included in the completion time for the task. It is unnecessary to continue the test if the patient has not completed both parts after five minutes have elapsed. The patient is therefore asked to stop after five minutes. Gaudino and Geisler (1995) reported the validity of the scale to be .84.

Results for both TMT A and B are reported as the number of seconds required to complete the task with higher scores (seconds used in completing the tasks) indicating higher impairment. The highest time (score) a participant could obtain was 600 seconds (five minutes each for Part A and B).
Literacy and Numeracy Measure

Academic performance was measured using the Literacy and Numeracy measure scale. The scale consists of two components: the literacy and the numeracy measures. The literacy measure was developed to measure school achievement based on the academic curricular for basic schools in Ghana. It involves English letter recognition, word reading, true sentence recognition, comprehension, paragraph expression and writing short stories. It has six levels in all.

The numeracy is also a bunch of Arithmetic problems that measure school achievement based also on the Ghanaian academic curriculum for basic schools. It involves number recognition, computation, addition, subtraction, multiplication, written mathematics problems and division. It also has 6 levels.

In both Literacy and Numeracy, a child is required to pass a previous level of difficulty before moving on to the next level. The reliability of the scale was found to be .82 (Family Inventory of Resources for Management, 2007).

Nonsense Syllables for Memory Skills

Memory was measured using the self-designed nonsense syllables based on Ebbinghaus (1885) nonsense syllables technique. Nonsense syllables are meaningless non-word letter combinations. Nonsense syllables consisting of three letters that is consonant, vowel, and consonant trigram were used. Ten list of nonsense syllables were presented for use in the study. Knowing that the main problem in testing memory is that prior knowledge of words and understanding of them would influence test results, the nonsense syllables was most appropriate as a measure of recall to avoid learning effect (Ebbinghaus, 1885).
To assess the extent to which participants can memorize words, the 10 lists of nonsense syllables were given for them to study for 2 minutes. After that, 2 minutes was given to them to recall the ten lists in any order. Participants went through five trials. The average number of words recalled for the five trials were calculated and used as participants score for recall. Scores therefore ranged from 0 – 10. Some of the items in the self-designed nonsense syllables test include DEP, WAF etc.

**Spence Anxiety Scale for Children (SASC, Spence, 1998)**

The Spence Children’s Anxiety Scale (Spence, 1998), is a list of 38 items that describe children anxiety symptoms. For each item, the participant circles the response that best describes the child. With the Spence Anxiety Scale, children’s respondents are asked to indicate frequency with which each symptom occurs on a four-point scale ranging from Never (scored 0) to Always (scored 3). Spence (1998) found the reliability of the scale to be .82. The reliability of the scale has been found to be .81 in Ghana (Marbell & Grolnick, 2012). Some items on the scale include: “I suddenly start to tremble or shake when there is no reason for this”, “I feel scared when I have to take a test”, “I worry about what other people think of me”, “I feel afraid if I have to talk in front of my class”, “All of a sudden I feel really scared for no reason at all”.

A total score on the SASC was obtained by summing scores of the 38 anxiety symptom items. Scores ranging from 0 – 114 was awarded with higher score indicating higher level of anxiety.

**The Children’s Depression Inventory (CDI; Kovacs, 1985)**

The Children’s Depression Inventory (CDI; Kovacs, 1985) is a commonly used self-report measure of depressive symptoms for children between 7–17 years of age. The scale has 27 items dealing with sadness, self-blame, insomnia, loss of appetite, interpersonal relationships, and
school adjustment. The scale has high internal consistency of 0.79-0.88 (Orvaschel, Weissman, & Kidd, 1980) and test–retest reliability of 0.87 (Kovacs, 1985). In the Ghanaian context, the reliability of the scale was found to be .78 (Marbell & Grolnick, 2012). Some items on the inventory include: “I do not have any friends”, “I feel alone all the time”, “Most days I do not feel like eating”.

For each of the 27 item, there were three alternatives yielding a possible score of 0, 1 or 2. Scores ranging from 0 – 54 was awarded with higher scores reflecting severe depression.

**Morisky 8-Item Medication Adherence Scale (MMAS-8, Morisky, Green & Levine, 2008)**

The Morisky 8-Item Medication Adherence Scale (MMAS-8) is a self-report measure of medication-taking behaviour. The scale addresses barriers to medication-taking and has an Alpha Reliability of 0.83 (Morisky, Green & Levine, 2008). Among Ghanaian populace, the reliability of the scale was found to be .79 (Beune, van Charante, Beem, mohrs, & Agyemang, 2014). Participants respond to the scale on a five point likert scale ranging from Never/rarely (0), Once in a while (1), Sometimes (2), Usually (3) and All the time (4). Scores ranged from 0 – 32. Some items on the scale include: “Have you ever cut back or stopped taking your medicine without telling your doctor because you felt worse when you took it”, “When you travel or leave home, do you sometimes forget to bring along your medicine” etc.

**Kuppuswamy's Socio-Economic Status Scale (Kuppuswamy, 1976)**

The socio-economic status of the seizure patients was assessed using the modified version of the Kuppuswamy’s Socioeconomic Status Scale and used by Mishra (2006). The modified version of the Kuppuswamy's scale accounts for the differences in economic status across different countries (Mishra (2006). The modified version of the Kuppuswamy’s Socioeconomic Status
Scale contained 5 items. The scale measures socio-economic status of an individual based on five variables namely education, occupation, monthly family income, place of residents and marital status.

In scoring the items, monthly income below 500 was awarded 1, 500 – 999 was awarded 2, 1000 – 1999 was awarded 3, 2000 – 2999 was awarded 4, 3000 – 3900 was awarded 5 and 4000 and above was awarded 6. Educational background was also scored based on the level of educational attainment with Basic School (Primary and Junior High School) awarded 1, Senior Secondary awarded 2, Poly and Training awarded 3, Degree awarded 4 and Post Degree awarded 5. All item of the scale were found to have acceptable internal consistency reliability ranging from .75-.91 in an African setting (Family Inventory of Resources for Management, 2007).

**Pilot Study**

Although it is difficult to assess the quality of the data that one collects, it is possible to assess the accuracy of the survey tools used to collect data in any investigation and that can serve as means of assessing the quality of the data collected (Litwin, 1995). An assessment of the data relies upon determining the reliability and validity of the survey instruments. According to Churchill (1992), the pretest is the most inexpensive insurance for assessing the reliability and validity of the instrument. The scales for this study were pretested with 10 patients diagnosed with Epileptic disorder at Accra Psychiatric Hospital and 10 students from Ashongman Basic School in Accra.

The pilot testing of the draft questionnaires took place in January, 2015. This was to determine whether participants could easily understand and respond to the questionnaire and whether the
scales measure what they are supposed to measure. Precisely, the pilot testing aimed at; identifying possible gaps in the questionnaire, determining practical issues in their usage and recommend possible changes. The analysis of the piloted questionnaires using SPSS version 17.0 indicates a good reliability of $\alpha = .86$ for the whole scale. Reliability coefficients of the subscales range from .78 to .94. However, based on comments from participants of the pilot study, some minor changes were made to arrive at the final questionnaire used for the study. Changes to the draft questionnaire comprised rewording some of the questions for clarity and comprehension and correcting few typographical errors. Example, statement such as “do you sometimes forget to take your high pills” was changed to “I sometimes forget to take my antiepileptic drugs”.

**Procedure for Data Collection**

Ethical clearance was sought from Ethics Committee for Humanities (ECH) followed by distribution of introductory letters to the hospital (Korle-Bu Teaching Hospital) and the school (West African Basic School at Adenta). The approvals from the institutions and consent of the participants were sought before administration of the questionnaires. Collection of data among the seizure patients took approximately one and half months whilst data from the control group (healthy participants) took approximately one week. After collecting the data, responses were coded and quantified for analyses using the statistical package for social sciences (SPSS).

**Ethical Consideration**

The American Psychological Association (APA) ethical guidelines were strictly followed throughout the study. Ethical approval was obtained from the Ethics Committee for Humanities (ECH), University of Ghana, Legon before commencing the research. The researcher took the next step of gaining access and acceptance by the authorities of the hospital and the school. This
involved obtaining permission to carry out a study in a community, institution or organisation (Bell, 2005). Getting acceptance and access into organizations to investigate deficits among some people especially seizure patients with high brain abnormality was not an easy task. The principle of informed consent which is supposed to be a standard feature for ethical consideration in all social research was strictly adhered.

Participants were assured of the privacy, anonymity and confidentiality of data collected and that no individual organization or participant was identified in reports or scientific publications written on the basis of the research findings. The researcher did not engage in any form of deception regarding the aim, content or nature of the research. Ethics of justice and fairness, objectivity and respecting the dignity of all participants were adhered to. The ethics of justice and fairness were obtained because the participants employed in this study were minors, caregivers consent were sought and the caregivers also guided the respondents in the filling of the questionnaire
CHAPTER FOUR

RESULTS

Introduction

The study was guided by two main objectives as means of assessing the cognitive and neuropsychological deficits associated with seizure disorders among patients seeking care in Ghana. The primary objective was to determine the cognitive and neuropsychological deficits associated with seizure disorders and the predictive factors of age at onset, socio-economic status, compliance with medication and sex of the patient.

The main dependent variables in the study are neuropsychological deficits (language skills, attention skills, memory skills and executive functions) and other deficits (academic achievement, depression and anxiety). The independent variables in the study are age at onset, socio-economic status, compliance with medication and sex of the patient. Digit Span Tasks (subtests of the Wechsler Intelligence Scale for Children – IV Edition, WISC-IV) was used for measuring attention; Kilifi Naming Test (KNT) for language skills; Trail Making Test (TMT) for executive function; Literacy and Numeracy Measure (LNM) for academic achievement; Self-Design Nonsense Syllables for memory skills; the Spence anxiety scale for children (SASC) and the Children's Depression Inventory (CDI) for measuring behavioural and emotional responses and Morisky 8-Item Medication Adherence Scale (MMAS-8) for measuring medication adherence.
Preliminary Analysis

The results displayed in Table 2 indicated that the data was normally distributed because the test for normality produced Skewness and Kurtosis figures ranging between -1 and +1. This indicated that the variables were all normal and could be used for parametric analyses (Field, 2005).

Intercorrelations among the variables were also computed using Pearson Product-Moment Correlation. The results of the correlation coefficient and the Cronbach alpha of the scales used are presented in Table 3. The Cronbach alpha value of all the scales used in the study was .86. The subscales for this study had Cronbach alpha values ranging from .72 to .91 (Table 2).

Table 2: Descriptive Statistics and Normality of the Study Variables (N=72)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication Compliance</td>
<td>6.00</td>
<td>28.00</td>
<td>17.22</td>
<td>6.92</td>
<td>.09</td>
<td>-.40</td>
<td>.79</td>
</tr>
<tr>
<td>Language</td>
<td>19.00</td>
<td>127.00</td>
<td>76.23</td>
<td></td>
<td>28.35</td>
<td>.24</td>
<td>-.97</td>
</tr>
<tr>
<td>Executive Function</td>
<td>25.00</td>
<td>530.00</td>
<td>200.67</td>
<td></td>
<td>160.72</td>
<td>.70</td>
<td>-.51</td>
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<tr>
<td>Memory</td>
<td>2.00</td>
<td>9.00</td>
<td>4.98</td>
<td>1.62</td>
<td>-.05</td>
<td>-.33</td>
<td>.72</td>
</tr>
<tr>
<td>Attention</td>
<td>3.00</td>
<td>28.00</td>
<td>13.09</td>
<td>5.96</td>
<td>.59</td>
<td>.11</td>
<td>.79</td>
</tr>
<tr>
<td>Academic achievement</td>
<td>10.00</td>
<td>55.00</td>
<td>35.12</td>
<td>10.10</td>
<td>-.30</td>
<td>-.30</td>
<td>.81</td>
</tr>
<tr>
<td>Depression</td>
<td>9.00</td>
<td>49.00</td>
<td>24.84</td>
<td>10.68</td>
<td>.59</td>
<td>-.57</td>
<td>.91</td>
</tr>
<tr>
<td>Anxiety</td>
<td>19.00</td>
<td>95.00</td>
<td>57.41</td>
<td>21.45</td>
<td>.23</td>
<td>-.10</td>
<td>.88</td>
</tr>
</tbody>
</table>
### Table 3: Correlations among Variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Medication Compliance</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Academic Performance</td>
<td>.25*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Language Skills</td>
<td>.21*</td>
<td>.04</td>
<td>-</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Attention Skills</td>
<td>.30*</td>
<td>.43**</td>
<td>.15*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Memory Skills</td>
<td>.48**</td>
<td>.33*</td>
<td>.01</td>
<td>.46**</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Executive Functions</td>
<td>-.21*</td>
<td>-.33*</td>
<td>.18*</td>
<td>.28*</td>
<td>.44**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Anxiety</td>
<td>-.64**</td>
<td>-.36**</td>
<td>-.21*</td>
<td>-.26*</td>
<td>-.15*</td>
<td>.28*</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Depression</td>
<td>-.36*</td>
<td>-.14*</td>
<td>-.25*</td>
<td>-.21*</td>
<td>-.16*</td>
<td>.12*</td>
<td>.88**</td>
</tr>
</tbody>
</table>

**p<.01, *p<.05

### Testing the Hypotheses

#### Impact of Health Status, Sex and Socioeconomic Status on each of the Neuropsychological Deficits

**H1:** Participants with seizure disorders will experience significantly higher neuropsychological deficits (language skills, attention skills, memory, executive functioning) than healthy control group.

**H2:** Males with seizure disorder will experience significantly higher neuropsychological deficits (language skills, attention skills, memory, executive functioning) compared to females with seizure disorder.

**H3:** Participants with seizure disorders from high socio-economic background will experience significantly lower neuropsychological deficits (language skills, attention skills, executive functioning) compared to participants with seizure disorders from low socio-economic background.
Hypotheses 1, 2 and 3 were analyzed using the Three Way Analysis of Variance. This is because there were (3) independent variables compared on each of the dependent variables (language skills, attention skills, executive functioning).

Table 4: Mean Scores of the Health Status, Sex and Socio-economic Status on Neuropsychological Deficits

<table>
<thead>
<tr>
<th>Health Status</th>
<th>Seizure</th>
<th>Language</th>
<th>Memory</th>
<th>Attention</th>
<th>Exec Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seizure Means</td>
<td>61.50</td>
<td>4.69</td>
<td>9.72</td>
<td>250.00</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>28.25</td>
<td>1.84</td>
<td>4.58</td>
<td>183.03</td>
<td></td>
</tr>
<tr>
<td>Healthy Means</td>
<td>90.97</td>
<td>5.27</td>
<td>16.47</td>
<td>151.33</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>19.64</td>
<td>1.32</td>
<td>5.26</td>
<td>117.88</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males Means</td>
<td>59.20</td>
<td>4.65</td>
<td>9.00</td>
<td>267.15</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>25.13</td>
<td>2.03</td>
<td>4.92</td>
<td>176.44</td>
<td></td>
</tr>
<tr>
<td>Females Means</td>
<td>64.37</td>
<td>4.75</td>
<td>10.62</td>
<td>228.56</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>32.36</td>
<td>1.65</td>
<td>4.11</td>
<td>194.55</td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Means</td>
<td>78.86</td>
<td>5.69</td>
<td>13.72</td>
<td>195.88</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>29.70</td>
<td>1.45</td>
<td>6.30</td>
<td>163.78</td>
<td></td>
</tr>
<tr>
<td>Low Means</td>
<td>73.61</td>
<td>4.27</td>
<td>12.47</td>
<td>205.44</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>27.10</td>
<td>1.48</td>
<td>5.61</td>
<td>159.78</td>
<td></td>
</tr>
</tbody>
</table>

Assessing Table 4 above, differences were observed on the scores on the neuropsychological deficits (language, memory, attention and executive function) among the various groups. The significance in mean score differences among the groups are demonstrated below.

Language skills

The results from the 3-way ANOVA showed that there was a significant main effect for health status (healthy control and seizure patients) on language deficits ($F_{(1, 64)} = 26.279$, $p < 0.001$).
Since lower score indicate poorer performance on language deficits, the results showed that seizure patients have higher language deficits (M = 61.50, SD = 28.25) compared to the healthy control group (M = 90.97, SD = 19.64) (Table 4). This means that participants with seizure disorders experienced poor language performance than the healthy control group. The results from the ANOVA are reported in Table 5. The hypothesis that participants with seizure disorders will experience significantly higher language deficits than healthy control group is therefore supported.

There were no significant effects for sex, SES and the interaction among the independent variables. The hypotheses that males with seizure disorder will experience significantly higher language deficits compared to females with seizure disorder and participants with seizure disorders from high socio-economic background will experience significantly lower language deficits compared to participants with seizure disorders from low socio-economic background are not supported.
Table 5: ANOVA summary results of the effects of Health Status, sex and socio-economic status on language

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Status</td>
<td>16114.586</td>
<td>1</td>
<td>16114.586</td>
<td>26.279</td>
<td>.000</td>
</tr>
<tr>
<td>Sex</td>
<td>629.147</td>
<td>1</td>
<td>629.147</td>
<td>1.026</td>
<td>.315</td>
</tr>
<tr>
<td>Socioeconomic</td>
<td>340.063</td>
<td>1</td>
<td>340.063</td>
<td>.555</td>
<td>.459</td>
</tr>
<tr>
<td>Health Status * Sex</td>
<td>18.219</td>
<td>1</td>
<td>18.219</td>
<td>.030</td>
<td>.864</td>
</tr>
<tr>
<td>Health Status * Socioeconomic</td>
<td>356.176</td>
<td>1</td>
<td>356.176</td>
<td>.581</td>
<td>.449</td>
</tr>
<tr>
<td>Sex * Socioeconomic</td>
<td>31.107</td>
<td>1</td>
<td>31.107</td>
<td>.051</td>
<td>.823</td>
</tr>
<tr>
<td>Health Status * Sex * Socioeconomic</td>
<td>569.953</td>
<td>1</td>
<td>569.953</td>
<td>.929</td>
<td>.339</td>
</tr>
<tr>
<td>Error</td>
<td>39244.972</td>
<td>64</td>
<td>613.203</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>475559.000</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Executive function

Consistent with the previous results, it was again found that there was a significant main effect for impact of health status on executive functioning ($F_{(1, 64)} = 6.551, p < 0.05$). Participants with seizure disorders had higher scores which is an indication of executive function deficits shown in the means. The results from the analysis showed that seizure patients obtained a mean of 250 sec compared to the healthy control group (M=151.33 sec) (see Table 4) This means that seizure patients have poor executive functioning than the healthy control group. As was the case with language skills, there were no other significant main and interaction effects. Results for the ANOVA are presented in Table 6.
The hypothesis that participants with seizure disorders will experience significantly higher executive function deficits than healthy control group is therefore supported. However, the hypotheses that males with seizure disorder will experience significantly higher executive function compared to females with seizure disorder and participants with seizure disorders from high socio-economic background will experience significantly lower executive function compared to participants with seizure disorders from low socio-economic background are not supported.

Table 6: ANOVA summary results of Health Status, sex and socio-economic status on executive function

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Status</td>
<td>166659.583</td>
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<td>166659.583</td>
<td>6.551</td>
<td>.013</td>
</tr>
<tr>
<td>Sex</td>
<td>8651.320</td>
<td>1</td>
<td>8651.320</td>
<td>.340</td>
<td>.562</td>
</tr>
<tr>
<td>Socioeconomic</td>
<td>82.529</td>
<td>1</td>
<td>82.529</td>
<td>.003</td>
<td>.955</td>
</tr>
<tr>
<td>Health Status * Sex</td>
<td>3684.864</td>
<td>1</td>
<td>3684.864</td>
<td>.145</td>
<td>.705</td>
</tr>
<tr>
<td>Health Status * Socioeconomic</td>
<td>506.629</td>
<td>1</td>
<td>506.629</td>
<td>.020</td>
<td>.888</td>
</tr>
<tr>
<td>Sex * Socioeconomic</td>
<td>11002.076</td>
<td>1</td>
<td>11002.076</td>
<td>.432</td>
<td>.513</td>
</tr>
<tr>
<td>Health Status * Sex * Socioeconomic</td>
<td>4994.570</td>
<td>1</td>
<td>4994.570</td>
<td>.196</td>
<td>.659</td>
</tr>
<tr>
<td>Error</td>
<td>1628281.277</td>
<td>64</td>
<td>25441.895</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4733370.000</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Testing the effects of the independent variables on memory another 3-way ANOVA was conducted. The results are presented in Table 7. The expected main effects for health status and sex were not observed. There was a significant main effect for SES ($F_{(1, 64)} = 20.453, p < .001$). With higher score indicating lower memory deficits, the results showed that participants from low socio-economic background have higher memory deficits ($M = 4.27, SD = 1.48$) compared with participants from high socio-economic background $M = 5.69, SD = 1.45$). There was also a significant interaction between health status and socio-economic status on memory ($F_{(1, 64)} = 10.664, p < .05$). Assessing the mean scores based on the interaction, it means that seizure participants from low socio-economic background have higher memory deficits ($M = 3.44, SD = 1.29$) compared with seizure participants from high socio-economic background ($M = 5.94, SD = 1.43$).

The hypothesis that participants with seizure disorders will experience significantly higher memory deficits than healthy control group is not supported. The hypothesis that males with seizure disorder will experience significantly higher memory deficits compared to females with seizure disorder is also not supported. However, the hypothesis that participants with seizure disorders from high socio-economic background will experience significantly lower memory deficits compared to participants with seizure disorders from low socio-economic background was supported ($p < .05$).
Table 7: ANOVA summary results of Health Status, sex and socio-economic status on memory

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Status</td>
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<td>4.050</td>
<td>2.264</td>
<td>.137</td>
</tr>
<tr>
<td>Sex</td>
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<td>1</td>
<td>3.339</td>
<td>1.867</td>
<td>.177</td>
</tr>
<tr>
<td>Socioeconomic Status</td>
<td>36.583</td>
<td>1</td>
<td>36.583</td>
<td>20.453</td>
<td>.000</td>
</tr>
<tr>
<td>Health Status * Sex</td>
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<td>1</td>
<td>.000</td>
<td>.000</td>
<td>.988</td>
</tr>
<tr>
<td>Health Status * Socioeconomic</td>
<td>19.074</td>
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<td>19.074</td>
<td>10.664</td>
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</tr>
<tr>
<td>Sex * Socioeconomic</td>
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<td>1.374</td>
<td>.768</td>
<td>.384</td>
</tr>
<tr>
<td>Health Status * Sex * Socioeconomic</td>
<td>4.234</td>
<td>1</td>
<td>4.234</td>
<td>2.367</td>
<td>.129</td>
</tr>
<tr>
<td>Error</td>
<td>114.471</td>
<td>64</td>
<td>1.789</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1977.000</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Attention Deficits

Testing the effects of the independent variables on attention, another 3-way ANOVA was conducted. The results are presented in Table 8 below. It was found that there was a significant main effect for impact of health status on attention ($F_{(1, 64)} = 6.551$, $p < 0.05$). ($F_{(1, 64)} = 37.294$, $p < 0.001$). With higher score indicating lower attention deficits, analyses of means illustrated on Table 4 showed that participants with seizure disorder have significant higher deficit in attention ($M = 9.72$, $SD = 4.58$) compared to healthy control group ($M = 16.47$, $SD = 5.26$). This means that seizure patients have poor attentiveness than the healthy control group. As was the case with language skills, there were no other significant main and interaction effects. There were no significant effects for sex, SES and the interaction among the independent variables on attention.
The hypothesis that participants with seizure disorders will experience significantly higher attention deficits than healthy control group is therefore supported. The hypotheses that males with seizure disorder will experience significantly higher attention deficits compared to females with seizure disorder and participants with seizure disorders from high socio-economic background will experience significantly lower attention deficits compared to participants with seizure disorders from low socio-economic background are not supported.

Table 8: ANOVA summary results of Health Status, sex and socio-economic status on attention

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Status</td>
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<td>1</td>
<td>860.133</td>
<td>37.294</td>
<td>.000</td>
</tr>
<tr>
<td>Sex</td>
<td>.926</td>
<td>1</td>
<td>.926</td>
<td>.040</td>
<td>.842</td>
</tr>
<tr>
<td>Socioeconomic Status</td>
<td>25.462</td>
<td>1</td>
<td>25.462</td>
<td>1.104</td>
<td>.297</td>
</tr>
<tr>
<td>Health Status * Sex</td>
<td>31.574</td>
<td>1</td>
<td>31.574</td>
<td>1.369</td>
<td>.246</td>
</tr>
<tr>
<td>Health Status * Socioeconomic</td>
<td>34.720</td>
<td>1</td>
<td>34.720</td>
<td>1.505</td>
<td>.224</td>
</tr>
<tr>
<td>Sex * Socioeconomic</td>
<td>9.169</td>
<td>1</td>
<td>9.169</td>
<td>.398</td>
<td>.531</td>
</tr>
<tr>
<td>Health Status * Sex * Socioeconomic</td>
<td>116.810</td>
<td>1</td>
<td>116.810</td>
<td>5.065</td>
<td>.028</td>
</tr>
<tr>
<td>Error</td>
<td>1476.076</td>
<td>64</td>
<td>23.064</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14877.000</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comparing health status, sex and socioeconomic status on neuropsychological tests

H5: Participants with seizure disorders will experience significant higher deficits in academic achievement, anxiety and depression than healthy control group

H5: Females with seizure disorder will experience significant higher deficits in academic achievement, anxiety and depression than males with seizure disorder
H6: Participants with seizure disorder from high socio-economic background will experience significantly lower deficits in academic achievement, anxiety and depression than participants with seizure disorder from low socio-economic background.

The Three-Way Analysis of Variance was used to analyze hypotheses 4, 5 and 6. This is because there are 3 independent variables with each having two levels. Each of the independent variable was compared on each of the dependent variables (academic achievement, anxiety and depression).

Table 9: Descriptive Statistics of Health Status, Sex and SES on Other Deficits

<table>
<thead>
<tr>
<th></th>
<th>Academic</th>
<th>Depression</th>
<th>Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Health Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seizure</td>
<td>32.86</td>
<td>9.32</td>
<td>30.50</td>
</tr>
<tr>
<td>Healthy</td>
<td>37.38</td>
<td>10.46</td>
<td>19.19</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>31.65</td>
<td>9.75</td>
<td>31.40</td>
</tr>
<tr>
<td>Females</td>
<td>34.37</td>
<td>8.83</td>
<td>29.37</td>
</tr>
<tr>
<td>SES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>37.33</td>
<td>9.03</td>
<td>26.11</td>
</tr>
<tr>
<td>Low</td>
<td>32.91</td>
<td>10.74</td>
<td>23.58</td>
</tr>
</tbody>
</table>

Assessing Table 9 above, differences were observed on the scores on the deficits in academic achievement, anxiety and depression among the various groups. The significance in mean score differences among the groups are demonstrated below.

Academic Achievement

The results from the 3-way ANOVA showed shown on Table 10 illustrates that the expected main effects for health status and sex were not observed. There was a significant main effect for
SES ($F_{(1, 64)} = 3.828, p < .05$). With higher score indicating higher academic achievement, the results showed that participants from higher socio-economic background had higher academic achievement ($M = 37.33$, $SD = 9.03$) compared to participants from lower socio-economic background ($M = 32.91$, $SD = 10.74$).

There was also a significant interaction between health status and socio-economic status on academic achievement ($F_{(1, 64)} = 5.794, p < .05$). Assessing the mean scores based on the interaction, it means that seizure participants from low socio-economic background have higher academic deficits ($M = 27.77$, $SD = 8.56$) compared to seizure participants from high socio-economic background ($M = 37.94$, $SD = 7.14$).

The hypothesis that participants with seizure disorders will experience significantly higher academic deficits than healthy control group was not supported. The hypothesis that males with seizure disorder will experience significantly higher academic deficits compared to females with seizure disorder is also not supported. However, the hypothesis that participants with seizure disorders from high socio-economic background will experience significantly lower academic deficits compared to participants with seizure disorders from low socio-economic background was supported.
Table 10: ANOVA summary results of Health Status, sex and socio-economic status on academic achievement

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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</thead>
<tbody>
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<td>323.856</td>
<td>3.553</td>
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</tr>
<tr>
<td>Sex</td>
<td>5.011</td>
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<td>5.011</td>
<td>.055</td>
<td>.815</td>
</tr>
<tr>
<td>Socioeconomic</td>
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<td>348.983</td>
<td>3.828</td>
<td>.049</td>
</tr>
<tr>
<td>Health Status * Sex</td>
<td>.092</td>
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<td>.092</td>
<td>.001</td>
<td>.975</td>
</tr>
<tr>
<td>Health Status * Socioeconomic</td>
<td>528.183</td>
<td>1</td>
<td>528.183</td>
<td>5.794</td>
<td>.019</td>
</tr>
<tr>
<td>Sex * Socioeconomic</td>
<td>42.875</td>
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<td>42.875</td>
<td>.470</td>
<td>.495</td>
</tr>
<tr>
<td>Health Status * Sex * Socioeconomic</td>
<td>49.442</td>
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<td>49.442</td>
<td>.542</td>
<td>.464</td>
</tr>
<tr>
<td>Error</td>
<td>5834.329</td>
<td>64</td>
<td>91.161</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>96081.000</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Depression

Testing the effects of the independent variables on memory, the 3-way ANOVA was again conducted. The results are presented in Table 11. The results from the 3-way ANOVA showed that there was a significant main effect for health status (healthy control and seizure patients) on depression \(F_{(1, 64)} = 28.141, p < 0.001\). Since higher score indicate higher level of depression, the results showed that seizure patients have higher level of depression (\(M = 30.50, SD = 11.40\)) compared to the healthy control group (\(M = 19.19, SD = 5.98\)) (Table 9). The hypothesis that participants with seizure disorders will experience significantly higher level of depression than the healthy control group is therefore supported.
However, there were no significant effects for sex, SES and the interaction among the independent variables on depression. The hypotheses that males with seizure disorder will experience significantly higher level of depression compared to females with seizure disorder and participants with seizure disorders from high socio-economic background will experience significantly lower level of depression compared to participants with seizure disorders from low socio-economic background were all not supported.

Table 11: ANOVA summary results of Health Status, sex and socio-economic status on depression

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
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<th>F</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
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<td>2378.662</td>
<td>28.141</td>
<td>.000</td>
</tr>
<tr>
<td>Sex</td>
<td>90.276</td>
<td>1</td>
<td>90.276</td>
<td>1.068</td>
<td>.305</td>
</tr>
<tr>
<td>Socioeconomic</td>
<td>135.346</td>
<td>1</td>
<td>135.346</td>
<td>1.601</td>
<td>.210</td>
</tr>
<tr>
<td>Health Status * Sex</td>
<td>.840</td>
<td>1</td>
<td>.840</td>
<td>.010</td>
<td>.921</td>
</tr>
<tr>
<td>Health Status *</td>
<td>87.170</td>
<td>1</td>
<td>87.170</td>
<td>1.031</td>
<td>.314</td>
</tr>
<tr>
<td>Socioeconomic</td>
<td>11.573</td>
<td>1</td>
<td>11.573</td>
<td>.137</td>
<td>.713</td>
</tr>
<tr>
<td>Health Status * Sex</td>
<td>93.588</td>
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<td>93.588</td>
<td>1.107</td>
<td>.297</td>
</tr>
<tr>
<td>Socioeconomic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>5409.633</td>
<td>64</td>
<td>84.526</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>52555.000</td>
<td>72</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Anxiety

Consistent with the previous results, it was again found that there was a significant main effect for impact of health status on anxiety ($F_{(1, 64)} = 86.846$, $p < .001$). Participants with seizure
disorders had lower scores on academic achievement which is an indication of academic deficits shown in the means. The results from the analysis showed that seizure patients obtained a mean of 73.58 compared to the healthy control group (M = 41.25) (see Table 9). There were however no other significant main and interaction effects (sex and SES) on academic achievement. Results for the ANOVA are presented in Table 12.

The hypothesis that participants with seizure disorders will experience significantly higher anxiety level than healthy control group is therefore supported. However, the hypotheses that males with seizure disorder will experience significantly higher anxiety level compared to females with seizure disorder and participants with seizure disorders from high socio-economic background will experience significantly lower anxiety compared to participants with seizure disorders from low socio-economic background were all not supported.
Table 12: ANOVA summary results of Health Status, sex and socio-economic status on anxiety

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
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<th>Sig.</th>
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</thead>
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<td>.025</td>
<td>.874</td>
</tr>
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<td>Socioeconomic</td>
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<td>155.430</td>
<td>.765</td>
<td>.385</td>
</tr>
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<td>Health Status * Sex</td>
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<td>476.382</td>
<td>2.344</td>
<td>.131</td>
</tr>
<tr>
<td>Health Status *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socioeconomic</td>
<td>150.305</td>
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<td>150.305</td>
<td>.740</td>
<td>.393</td>
</tr>
<tr>
<td>Sex * Socioeconomic</td>
<td>6.692</td>
<td>1</td>
<td>6.692</td>
<td>.033</td>
<td>.857</td>
</tr>
<tr>
<td>Health Status * Sex</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socioeconomic</td>
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<td>69.248</td>
<td>.341</td>
<td>.561</td>
</tr>
<tr>
<td>Error</td>
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<td>203.251</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>270052.000</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Impact of Age Onset and Sex on Neuropsychological tests

H7: Seizure patients who were diagnosed with the disorder earlier will have significantly higher neuropsychological deficits (language skills, attention skills, memory executive functioning) compared to those who were diagnosed with the disorder later in life.

H8: Early diagnoses of the disorder will have significant impact on the neuropsychological deficits of females compared to males.

The Two-Way Analysis of Variance was used to analyze hypotheses 7 and 8. This is because there are 3 independent variables compared on each of the dependent variables (academic achievement, anxiety and depression).
Table 13: Mean Scores of Sex and Age-at-Onset Status on Neuropsychological Deficits

<table>
<thead>
<tr>
<th>Age at Onset</th>
<th>Sex</th>
<th>Language</th>
<th>Memory</th>
<th>Attention</th>
<th>Exec Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Means</td>
<td>Males</td>
<td>48.82</td>
<td>4.44</td>
<td>9.22</td>
<td>290.71</td>
</tr>
<tr>
<td>SD</td>
<td>Females</td>
<td>22.36</td>
<td>1.58</td>
<td>3.86</td>
<td>228.77</td>
</tr>
<tr>
<td>Late Means</td>
<td>Males</td>
<td>92.28</td>
<td>5.14</td>
<td>12.42</td>
<td>180.22</td>
</tr>
<tr>
<td>SD</td>
<td>Females</td>
<td>24.92</td>
<td>1.77</td>
<td>3.95</td>
<td>160.34</td>
</tr>
</tbody>
</table>

Descriptive statistics illustrated on Table 15 above shows that the mean score of patients with early age at onset and those with late age at onset differed on the neuropsychological deficits (language, memory, attention and executive function) scores among the various groups. The significance of these mean scores is illustrated below.

Language

Testing the effects of sex and age at onset on language, the 2-way ANOVA was conducted. The results are presented in Table 14. The results from the 2-way ANOVA showed that there was a significant main effect for age at onset on language ($F_{(1, 64)} = 11.882$, $p < .01$). Since lower score indicate higher language deficits, the results show that patients with early age at onset have higher language deficits ($M = 48.82$, $SD = 22.36$) compared to the language deficits of seizure patients with late age at onset ($M = 92.36$, $SD = 24.92$) (Table 13). This means early age at onset is associated with higher language deficits compared to late age at onset. The hypothesis that seizure patients who were diagnosed with the disorder earlier will have significantly higher language deficits compared to those who were diagnosed with the disorder later in life is therefore supported.
There was also a significant interaction between age at onset and sex on language ($F_{(1, 64)} = 7.459, p < .05$). Assessing the mean scores based on the interaction, with higher score indicating lower deficits in language, the results shows that females who experience the disorder at later age experienced significantly lower language deficits ($M=92.28, SD=24.92$) compared to males who experience the disorder at early age ($M=55.75, SD=26.70$), males who experience the disorder at later age ($M=61.50, SD=24.95$) and females who experience the disorder at early age ($M=42.66, SD=24.92$). The hypothesis that early diagnoses of the disorder will have significant impact on the language deficits of females compared to males is also supported.

Table 14: ANOVA summary results of Age at onset and Sex on Language

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Onset</td>
<td>6631.453</td>
<td>1</td>
<td>6631.453</td>
<td>11.882</td>
<td>.002</td>
</tr>
<tr>
<td>Sex</td>
<td>677.857</td>
<td>1</td>
<td>677.857</td>
<td>1.215</td>
<td>.279</td>
</tr>
<tr>
<td>Age at Onset * Sex</td>
<td>4162.853</td>
<td>1</td>
<td>4162.853</td>
<td>7.459</td>
<td>.010</td>
</tr>
<tr>
<td>Error</td>
<td>17859.929</td>
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<td>558.123</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
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<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Executive Function

The results from the 3-way ANOVA showed that there was a significant main effect for age at onset on executive function ($F_{(1, 64)} = 5.184, p < .05$). With higher time recorded indicating higher executive function deficits, the results from the analysis showed that seizure patients with early age at onset have higher executive function deficits ($M=290.71$ sec, $SD=228.77$) compared to the seizure patients with later age at onset ($M=180.22$ sec, $SD=160.34$) (Table 13).
This means that early age at onset is associated with higher executive function deficits than late age at onset. There was however no significant interaction between age at onset and sex of the seizure patient on executive function. The results from the ANOVA are reported in Table 15.

The hypothesis that seizure patients who were diagnosed with the disorder earlier will have significantly higher executive function deficits compared to those who were diagnosed with the disorder later in life is supported. However, the hypothesis that early diagnoses of the disorder will have significant impact on the language deficits of females compared to males is also not supported.

Table 15: ANOVA summary results of Age at Onset and Sex on Executive Function

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Onset</td>
<td>159779.672</td>
<td>1</td>
<td>159779.672</td>
<td>5.184</td>
<td>.030</td>
</tr>
<tr>
<td>Sex</td>
<td>2092.857</td>
<td>1</td>
<td>2092.857</td>
<td>.068</td>
<td>.796</td>
</tr>
<tr>
<td>Age at Onset * Sex</td>
<td>5582.070</td>
<td>1</td>
<td>5582.070</td>
<td>.181</td>
<td>.673</td>
</tr>
<tr>
<td>Error</td>
<td>986359.526</td>
<td>32</td>
<td>30823.735</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3422538.000</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Memory

The 2-way ANOVA results from Table 16 showed that the observed difference in memory performance between seizure patients with early age at onset and seizure patients with later age at onset was not significant. The interaction between sex of seizure patient and age at onset of seizure disorder on memory performance was also not significant. The hypotheses that seizure patients who were diagnosed with the disorder earlier will have significantly higher memory
deficits compared to those who were diagnosed with the disorder later in life and early diagnoses of the disorder will have significant impact on the memory deficits of females compared to males are all not supported.

Table 16: ANOVA summary results of Age at Onset and Sex on Memory Performance

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Onset</td>
<td>.562</td>
<td>1</td>
<td>.562</td>
<td>.163</td>
<td>.689</td>
</tr>
<tr>
<td>Sex</td>
<td>.005</td>
<td>1</td>
<td>.005</td>
<td>.001</td>
<td>.971</td>
</tr>
<tr>
<td>Age at Onset * Sex</td>
<td>7.864</td>
<td>1</td>
<td>7.864</td>
<td>2.275</td>
<td>.141</td>
</tr>
<tr>
<td>Error</td>
<td>110.621</td>
<td>32</td>
<td>3.457</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>913.000</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Attention Deficits

Testing the effects of sex and age at onset on attention deficits, the 2-way ANOVA was again conducted. The results are presented in Table 17. The results show that the expected effect of age at onset on attention was significant ($F_{(1, 64)} = 9.025, p < .01$). Since higher score indicates lower attention deficits, the results from the analysis show that seizure patients with early age at onset have higher deficit in attention ($M = 9.22, SD = 3.86$) compared to seizure patients with late age at onset ($M = 12.42, SD = 3.95$) (Table 13). This means that early age at onset is associated with higher executive function deficits than late age at onset. The hypothesis that seizure patients who were diagnosed with the disorder earlier will have significantly higher attention deficits compared to those who were diagnosed with the disorder later in life is supported.
There was however no significant interaction between age at onset and sex of the seizure patient on attention deficits. The hypothesis that early diagnoses of the disorder will have significant impact on the attention deficits of females compared to males is also supported.

Table 17: ANOVA summary results of Age at Onset and Sex of Seizure Patient on Attention Deficits

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Onset</td>
<td>153.162</td>
<td>1</td>
<td>153.162</td>
<td>9.025</td>
<td>.005</td>
</tr>
<tr>
<td>Sex</td>
<td>47.629</td>
<td>1</td>
<td>47.629</td>
<td>2.807</td>
<td>.104</td>
</tr>
<tr>
<td>Age at Onset * Sex</td>
<td>8.670</td>
<td>1</td>
<td>8.670</td>
<td>.511</td>
<td>.480</td>
</tr>
<tr>
<td>Error</td>
<td>543.062</td>
<td>32</td>
<td>16.971</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4140.000</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Impact of Age at Onset and Sex on Other Deficits

H9: The level of other deficits (academic achievement, anxiety, and depression) among seizure patients who were confirmed with the disorder early in life will be significantly higher than those who were diagnosed with the disorder later in life.

H10: Age of diagnosis will have significant impact on other deficits (academic achievement, depression and anxiety) of females compared to males.

Hypotheses 9 and 10 were analyzed using the Two-Way Analysis of Variance. This is because there were two (2) independent variables (sex and age at onset) with each in two levels. The two independent variables were compared on each of the other deficits (academic achievement, anxiety, and depression).
Table 18: Descriptive Statistics of Sex and Age at Onset on Other Deficits

<table>
<thead>
<tr>
<th>Age at Onset</th>
<th>Gender</th>
<th>Academic Achievement</th>
<th>Depression</th>
<th>Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>Males</td>
<td>Means 31.00</td>
<td>34.05</td>
<td>77.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD 9.12</td>
<td>11.89</td>
<td>12.99</td>
</tr>
<tr>
<td>Late</td>
<td>Males</td>
<td>Means 34.52</td>
<td>27.31</td>
<td>70.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD 9.43</td>
<td>10.21</td>
<td>17.90</td>
</tr>
<tr>
<td>Gender</td>
<td>Females</td>
<td>Means 31.65</td>
<td>31.40</td>
<td>75.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD 9.75</td>
<td>9.43</td>
<td>12.71</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>Means 34.37</td>
<td>29.37</td>
<td>70.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD 8.83</td>
<td>13.71</td>
<td>19.49</td>
</tr>
</tbody>
</table>

Descriptive statistics illustrated on Table 15 above shows that differences can be observed on the other deficits (academic achievement, depression and anxiety) scores among the various groups. The significance of these mean scores is illustrated below.

Academic achievement

Testing the effect of age at onset and sex on academic achievement, the 2-way ANOVA was conducted. The results are shown on Table 19. The findings showed that the observed difference in academic achievement between seizure patients with early age at onset and seizure patients with later age at onset was not significant. The interaction between sex of seizure patient and age at onset of seizure disorder on academic performance was also not significant. The hypotheses that seizure patients who were diagnosed with the disorder earlier will have significantly higher deficits in academic achievement compared to those who were diagnosed with the disorder later in life and early diagnoses of the disorder will have significant impact on the academic achievement deficits of females compared to males were all not supported.
Table 19: ANOVA summary results of Age at Onset and Sex on Academic Achievement

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Onset</td>
<td>134.484</td>
<td>1</td>
<td>134.484</td>
<td>1.527</td>
<td>.226</td>
</tr>
<tr>
<td>Sex</td>
<td>100.887</td>
<td>1</td>
<td>100.887</td>
<td>1.145</td>
<td>.293</td>
</tr>
<tr>
<td>Age at Onset * Sex</td>
<td>14.793</td>
<td>1</td>
<td>14.793</td>
<td>.168</td>
<td>.685</td>
</tr>
<tr>
<td>Error</td>
<td>2818.663</td>
<td>32</td>
<td>88.083</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>41919.000</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Depression

The results from the 2-way ANOVA showed that there was no significant impact of age at onset on depression among seizure patients. There was also no significant interaction between age at onset and sex of seizure patient on depression. The ANOVA results are demonstrated on Table 20. The hypotheses that seizure patients who were diagnosed with the disorder earlier will have significantly higher depression level compared to those who were diagnosed with the disorder later in life and early diagnoses of the disorder will have significant impact on the depression level of females compared to males were all not supported.

Table 20: ANOVA summary results of Age at Onset and Sex on Depression

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Onset</td>
<td>542.954</td>
<td>1</td>
<td>542.954</td>
<td>3.744</td>
<td>.057</td>
</tr>
<tr>
<td>Sex</td>
<td>81.045</td>
<td>1</td>
<td>81.045</td>
<td>.708</td>
<td>.406</td>
</tr>
<tr>
<td>Age at Onset * Sex</td>
<td>389.947</td>
<td>1</td>
<td>389.947</td>
<td>3.407</td>
<td>.074</td>
</tr>
<tr>
<td>Error</td>
<td>3662.204</td>
<td>32</td>
<td>114.444</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>38038.000</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Anxiety

From the ANOVA results demonstrated on Table 21, was no significant main effect for impact of age at onset on anxiety. Moreover, there was no interaction effect of age at onset and sex on anxiety. The hypotheses that seizure patients who were diagnosed with the disorder earlier will have significantly higher anxiety level compared to those who were diagnosed with the disorder later in life and early diagnoses of the disorder will have significant impact on the anxiety level of females compared to males we all not supported.

Table 21: ANOVA summary results of Age at Onset and Sex on Anxiety

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>658.097</td>
<td>1</td>
<td>658.097</td>
<td>2.604</td>
<td>.116</td>
</tr>
<tr>
<td>Sex</td>
<td>320.093</td>
<td>1</td>
<td>320.093</td>
<td>1.266</td>
<td>.269</td>
</tr>
<tr>
<td>Age * Sex</td>
<td>58.320</td>
<td>1</td>
<td>58.320</td>
<td>.231</td>
<td>.634</td>
</tr>
<tr>
<td>Error</td>
<td>8088.728</td>
<td>32</td>
<td>252.773</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>203897.000</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hypotheses 11 and 12:** Compliance with medication will have a positive relationship with academic achievement, attention, language skills and memory skills among seizure patients. There will be a significant positive correlation between executive functioning, depression and anxiety among seizure patients.

These hypotheses were tested using the Pearson Product Moment Correlation Coefficient because the relationship between continuous variables measured on an interval scale was established. The results are shown in the inter-correlation matrix on Table 3.
Significant positive correlations was found between medication compliance and academic achievement \((r = .25, p < .05)\), medication compliance and language skills \((r = .21, p < .05)\), medication compliance and attention \((r = .30, p < .05)\), medication compliance and memory skills \((r = .48, p < .01)\). This means hypothesis 11 which stated that compliance with medication will have a positive relationship with academic achievement, attention, language skills and memory skills among seizure patients was supported.

However, a significant negative relationship was found between medication compliance and executive functions \((r = -.21, p < .05)\), medication compliance and anxiety \((r = -.64, p < .01)\), as well as medication compliance and depression \((r = -.36, p < .05)\). This also means that hypothesis 12 which stated that there will be a significant positive correlation between executive functioning, depression and anxiety among seizure patients was also supported.

**Summary of Results**

In summary, the results of the study indicated that:

1. Participants with seizure disorders experienced higher neuropsychological deficits in language skills, attention skills and executive functioning than control group without seizure disorders. Memory was the only neuropsychological deficits that significant difference was not observed between the seizure group and the healthy control group.

2. Seizure patients’ also experienced higher depression and anxiety compared to healthy control group. Academic achievement was also the only deficits that significant difference was not observed between the seizure group and the healthy control group with regard to other deficits.
3. No significant differences were observed in neuropsychological deficits (language skills, attention skills, memory and executive functioning) and other deficits (academic achievement, depression and anxiety) of males and females with seizure disorder.

4. No significant differences were observed in neuropsychological deficits in language skills, attention skills and executive functioning between seizure patients from low socio-economic background and seizure patients from high socio-economic background. However, seizure patients from low socio-economic background were found to experience significantly higher memory deficits than those from high socio-economic background.

5. There were also no significant differences observed in depression and anxiety between seizure patients from low socio-economic background and seizure patients from high socio-economic background except in academic achievement where seizure patients from low socio-economic background were found to experience significantly lower academic achievement than those from high socio-economic background.

6. Early diagnosis of seizure disorder led to higher neuropsychological deficits in language skills, attention skills and executive functioning than late diagnosis. Memory was the only neuropsychological deficits that no significant difference was observed between early diagnosis seizure patients and late diagnosis seizure patients.

7. Early diagnosis of seizure disorder had no significant effect on any of the other deficits (academic achievement, depression and anxiety) of seizure patients.

8. Age of diagnosis did not influence males and females differently on neuropsychological deficits such as memory, attention skills, and executive functioning. However, age at onset had significant impact on language skills between males and females with the
finding indicating that early diagnosis have significant negative impact on language development of females than males.

9. Gender was not significantly influenced by age at onset on any of the other deficits (academic achievement, anxiety, and depression).

10. Compliance with medication was found to have a significant positive relationship with academic performance, attention, language skills and memory skills among seizure patients.

11. A significant negative relationship was found between medication compliance and executive functions and anxiety.
CHAPTER FIVE
DISCUSSION

Introduction
The purpose of the study was to assess the neuropsychological deficits (attention, language, memory and executive function) associated with seizure disorder. Other deficits such as academic achievement, depression and anxiety were also assessed. The study also assessed the factors that influence the deficits among the seizure patients. Twelve hypotheses were formulated and analyzed. The impact of seizure disorder on the deficits is discussed and the impact of each predictive factor (socio-economic status, sex, age at onset, compliance with mediation) on the deficits is also discussed based on the findings generated from the data.

Effects of Seizure disorders on neuropsychological functioning
Seizures have significant adverse impact on brain development among children and therefore we would see significant cognitive and behaviour deficits among seizure patients on a wide spectre of abilities. It was therefore expected in this study that compared to a healthy control matched on age, sex, and class of study, seizure patients would have significant deficit on neuropsychological abilities such as executive function, attention, memory, and language and also show higher levels of depression and anxiety and poorer academic achievement.

The major prediction was that seizure disorders will have adverse impact on executive functions, language, memory and attention; we did find support for executive function, attention and language, an indication that seizure patients performed poorly when compared to normally developing children. Development of executive function is mediated by a healthy functioning frontal lobe, particularly, the prefrontal cortex that regulates inhibition and working memory,
two key components of EF (Saboya, Franco & Mattos, 2002; Stuss, Murphy, Binns & Alexander, 2003). Seizures, be it global or focused can affect the frontal lobe because of the primary function of the frontal cortex integrating sensory information from different areas of the brain (references). EF also involves a range of behaviors such as planning, working memory, inhibition, mental flexibility, as well as the initiation and monitoring of action (Chan, Shum, Touloupolou, & Chen, 2008; Stuss & Alexander, 2000) which may be affected by other parts of the brain. For example, working memory (be it visual or auditory) is regulated by different parts of the brain. Therefore, EF deficits may be directly and indirectly related to disruptions to frontal cortex as well as other parts of the brain. Seizures therefore need not care in the frontal lobes for deficits to occur.

Moreover, the reason for the high deficits in executive function among seizure patient’s points to the implication of extratemporal functional and structural brain abnormalities associated with epilepsy (Keller & Roberts, 2008). For example, damage to frontosubcortical circuits, volume loss, or metabolic changes in extratemporal regions in the executive function disorders of seizure patients has the potential of causing executive function deficits.

Moreover, the observed poor performance in executive functions among seizure patients compared to the healthy control group is proffered by the nociferous cortex hypothesis. According to the nociferous cortex hypothesis (Hermann & Seidenbergs, 1995), executive function deficits in epileptic children result from the propagation of the epileptic discharges from the temporal lobe epileptic focus to the frontal lobes. The theory profess that, there are white matter tracts connecting the temporal lobes with the frontal lobes which help in the functioning of the executive function. Epilepsy also releases some discharges. The epileptic discharges may
propagate through the projections connecting the temporal lobes with the frontal lobes which lead to deficits in the executive function.

The higher attention deficits among seizure patients is because of certain predisposing factors that induce inattention such as frequency of seizure, drugs used etc (Hamoda, Guild, Gumlak, Travers, & Gonzalez-Heydrich, 2008). An underlying central nervous system (CNS) dysfunction caused by damage to the brain of seizure patients could be a major factor for the low level of attentiveness compared to the healthy control group. Because of the central nervous dysfunction, epileptic patients experience unusual electrical activity in their brains between seizures which interfere with the ability to focus on one’s attention. Moreover, the frequencies of seizures experience by epileptic children disrupt their sleep and causes fatigue which has the propensity to induce inattentiveness among seizure patients.

Regarding language measures, the control group performed better than the seizure group. The higher language deficits among seizure patients compared to the healthy control group can be due to injury to the Wernicke’s and the Broca’s areas of the left temporal lobe due to the disorder. The Wernicke’s and the Broca’s areas of the left temporal lobe are critical for language comprehension and production. Therefore, if there is an injury to these areas, speech production or verbal comprehension becomes a problem (Tsai, Vears, Turner, Smith et al, 2013).

The study did not find support between seizure patients and healthy control group for memory. The lack of significance to a large extent could be as a result of the test used for assessing memory. Firstly, the nonsense syllables memory test was constructed by the researcher through the guidance of the supervisors of this work. Self-designed test was used because it was difficult
getting appropriate measures for memory. Though the test was found to be reliable, reliability of the test does not indicate validity. Secondly, nonsense syllables are really difficult to remember especially when the inter-stimulus interval was too small making it difficult for participants to memorize those words.

**Other Deficits of Seizure Group and Healthy Control Group**

It was again expected in this study that compared to a healthy control matched on age, sex, and class of study, seizure patients would have significant deficit on other abilities such as academic achievement, anxiety and depression. Consistent with the second predictions, the study did find significant deficits in depression and anxiety among seizure patients which is an indication that seizure patients experienced higher level of depression and anxiety when compared to normally developing children.

The significantly higher level of depression among seizure patient’s stern from both internal and external factors (Austin, Perkins, Johnson, Fastenau, Byars, deGrauw & Dunn, 2011). Internal factors are as a result of problems in the structure or function of the brain, whereas external factors are not biologically based and instead result, for example, from the reactions of others to an individual's epilepsy or from a child's own response to feelings of anxiety or depression. The disapproval from family members and peers can all lead to higher level of depression among the seizure patients. Moreover, the irritability, withdrawal, and thoughts of death associated with seizure disorder are also responsible for the high level of depression among the seizure patients (Dunn, 2003).
Results on anxiety measure indicated that the seizure group had significantly higher level of anxiety compared to the healthy control group. The higher level of anxiety among epileptic children can be due to the unpredictability and lack of control associated with seizures. The fear of unexpected seizures in special places may lead to a variant of agoraphobia (Kanner & Palac, 2000). The fear of embarrassment about having a seizure in public may also lead to a variant of social phobia and result in isolation of the patient from social activities (Kanner & Palac, 2000). Moreover, the thoughts of death and the unpredictability of the seizure can cause physical symptoms that heighten the feeling of a lack of control resulting in higher level of anxiety. As explained by Reilly, Agnew, Brian, and Neville (2011), child and family attitude/adaptation to epilepsy serve as risk factors for depression and anxiety among epileptic children.

The result of the study did not find any significant differences in academic achievement between seizure patients and the healthy control group. The insignificant difference between the seizure and the healthy control groups in academic achievement may be as a result of the qualitative differences in the educational attainment of the control and the experimental groups. Though the study matched the groups on possible factors such as age, sex and educational level, type of school was not matched. The inability to match the participants based on schools is because the control group were obtained from only one school and also most of the seizure patients failed to indicate the type of school that attend. From the few seizure patients who indicated their schools, it was realized that most of them were from private schools whilst the healthy compared to all the control group participants who were selected from public schools. Because the quality of education in private and public schools vary, it could contribute to the findings of the present study. The qualitative education enjoyed by the seizure patient could have contributed to the lower cognitive deficits associated with seizure disorder.
Predictive Factors of Deficits in Seizure Patients

While the effects of seizures on neuropsychological and other deficits were found, the effect was found to be dependent on certain factors. The results indicated that sex did not have any significant impact on any of the deficits. Socio-economic status was found to influence only memory and academic achievement of respondents. Age at onset was found to influence attention, language and executive function. Age at onset did not have any significant influence on any of the other deficits (depression, anxiety and academic performance) of seizure patients. Medication compliance was also found to significantly correlate with all the neuropsychological deficits. These findings are discussed below.

Age at Onset on the Deficits

It was predicted that early onset of the disorder will lead to higher deficits compared to late age at onset of the seizure disorder. The results indicated that patients diagnosed with the disorder early have significantly higher neuropsychological deficits compared to those diagnosed with the disorder later except in memory where no significant difference was observed between seizure patients with early age at onset and those with later age at onset of the seizure. This means that seizure leads to the development of lower attentiveness, executive function and poor language development compared to healthy control group but not in memory.

The higher deficits in language skills, executive function and attention among seizure patients with early age at onset compared to those with later age at onset compared is in line with the reason proffered by Vingerhoets (2006) that the younger a child is when the seizures begin, the more widespread the area of the brain is affected, leading to poorer neuropsychological deficits in attention and executive function. According to Ho-Turner and Bennett (1999), the brain’s
susceptibility to seizures varies throughout lifespan. At birth, the susceptibility to seizure is very high but dramatically decreasing as a result of age. Therefore, as the patient grows, the risk of predisposition to seizures slows down and thus reduces the number of seizures and the deficits associated with the seizure (Danov, 2009). This explains why seizure patients with early age at onset experienced higher neuropsychological deficits compared to seizure patients with later age at onset.

On the influence of age at onset on executive function, Anderson, Northam, Hendy and Wrennall, 2001) explained that the executive function domains mature at different moments from childhood to adulthood. An earlier developmental period occurs between birth and 3 years old (attentional control skills, inhibition and self-regulation) and more complex processes (planning, organization, cognitive flexibility and concept formation) show the most significant developmental increments afterwards (Jacobs, Harvey, & Anderson, 2007). Such complex cognitive skills may be particularly susceptible to the early influence of epilepsy, due to their prolonged development, with the full extent of deficits not apparent until well into adolescence, when these skills are expected to be mature. Based on this, when seizure disorder occurs early in life, it has the potential to distort the complex processes development of the executive function domains.

The higher deficits in executive function, language and attention of seizure patients with early age at onset can be explained with the vulnerability theory (Giza, Prins, Hovda, Herschman & Feldman, 2002) which argues that early brain damage has the most detrimental impact on cerebral and cognitive development and leads to higher functional deficits. This is because the brain at a tender age will not have achieved functional specialization. Based on this, when there is early damage to the brain, the crowding effect will take place such that healthy tissue will take
over the damaged tissue in an attempt to recover the cognitive function at hand which will limit the tissue’s quantitative and qualitative resources (Satz, Strauss, Hunter & Wada, 1994) thereby leading to higher deficits in neuropsychological deficits.

The findings indicated no significant differences in anxiety, depression and academic achievement between seizure patients with early onset and those with later onset. The reason for the insignificant difference in anxiety and depression between seizure patients with early age at onset and those with late age at onset is because anxiety and depression are all behavioural problems not entirely associated with the brain. Among the seizure patients, they mostly result from external factors which are not biologically based. For example, reactions of others to an epilepsy child or from a child's own response to feelings. The disapproval from family members and peers are all external factors which result in higher level of depression among seizure patients. These external factors affect seizure patients equally no matter the age at onset.

With regard to the age at onset on memory and academic achievement, no significant differences were observed between early onset and later onset seizure patients. This can be due to the fact that though memory and academic performance are cognitive functions influenced by damage to the brain, these two functions can also be improved significantly though external factors. These external factors also influences seizure and healthy participants equally and can even be better for seizure patients compared to the heathy participants. For example, the quality of education seizure patients obtain, availability of academic needs etc. All these environmental factors influence seizure patients with early and late age at onset equally and so explain why no significant difference was observed in academic achievement and memory of seizure patients with early and those with later age at onset.
Socio-Economic Status on the Deficits

The study predicted that seizure patients from high socio-economic status will experience lower deficits compared to seizure patients from low socio-economic status. The results indicated that socio-economic status does not affect any of the deficits except memory and academic achievement. This means high socioeconomic status can helps to improve memory and academic achievement of seizure patients.

The insignificant impact of socioeconomic status on attention, language and executive function is incongruent with the study by Austin et al. (1999) which indicated that seizure patients with most neuropsychological problems came from families with low family mastery. The cultural differences in the study by Austin et al. (1999) and the present study could have resulted in the inconsistent findings.

The results also indicated that there was an insignificant difference in anxiety and depression levels between seizure patients with high socioeconomic status and those with low socioeconomic status. No matter the level of socioeconomic status, the social disapproval and stigma associated with seizure affect both seizure patients from high socioeconomic status and those from low socioeconomic status equally. The social disapproval has the propensity to increase the anxiety and depression level of both seizure patients from high socio-economic background and those from low socioeconomic background equally.

The significantly high level of memory and academic achievement among seizure patients from high socioeconomic background compared to those from low socio-economic background can be due to the differences in quality of education the control and the seizure groups receive. In Ghana, there are levels of quality education which may be determined by the level of socio-
economic status. Some people may not be able to offer the quality of education for their seizure patients due to poor socio-economic status. Some patients may also not be able to attend grade A schools, get private teachers for their children etc. all because of poor socio-economic status. All these can have a tremendous negative impact on memory and academic achievement of seizure patients. In some cases of childhood seizures, a special diet that is rich in fat and low in sugar are prescribed to help to reduce the frequency of seizures (Rodenburg, Meijer, Dekovi & Aldenkamp, 2006). Because of the cost involved, the diet can only be offered by those with high socio-economic status. This explains why seizure patients with high socio-economic background had higher memory and academic achievement compared to those from low socio-economic background.

**Sex of the Patient on the Deficits**

The study predicted that male epileptic children will experience more neuropsychological deficits than females but female epileptic children will experience more on the other deficits than males. Contradictory to the predictions, the findings revealed no significant difference in the deficits among males and females with seizure disorder. This finding is not surprising because studies on gender differences in deficits have revealed inconsistent results. Some studies (e.g., Hoie, Sommerfelt, Waaler, Alasker, Skeidavoll & Mykletun, 2006; Koleoso & Uwadiae, 2013) have favoured higher neuropsychological deficits among females with seizure disorder compared to males with seizure disorder while others (e.g., Austin, Harezlak, Dunn, Huster, Rose, & Ambrosius, 2001) have favoured higher level of neuropsychological deficits among males with seizure disorder compared to females with seizure disorder.
Overall, the lack of differences in gender is found in many epileptic studies. As emphasized by Oostrom (2000), the independent risk factors (socio-economic status, age at onset and type of medication) contribute with different prominence to neuropsychological deficits in boys and girls in the epilepsy population. According to Oostrom (2000), the neuropsychological deficits associated with seizure among males and females may depend on independent factors such as socio-economic status, age at onset etc. Therefore if all these factors are similar across both genders, one may not expect any significant difference in neuropsychological deficits among males and females with seizure disorder.

With respect to the lack of significant differences in the deficits associated with males and females with seizure disorder, a possible reason is that seizure effect on the functional organization of the brain among males and females are the same. No matter the sex of the seizure patient, the disruption of the electrical impulses that the brain nerve cells (neurons) use to communicate occurs in both males and females and their severity may not differ between the two sexes. This has the propensity of leading to higher neuropsychological and non-neuropsychological deficits among males and females with seizure disorder.

Additionally, it was found that early diagnosis influence the language ability of females compared to males. Females who were diagnosed with the disorder early were found to experience higher language deficits compared to males who were diagnosed with the disorder early. Females who were also diagnosed with the disorder later were found to have lower language deficits than males diagnosed with the disorder later in life. This means that age at onset of seizure influence language development of females more than that of males.
Language comprehension and production is a function of the left hemisphere and females dominate the functions of the left hemisphere compare to males. This means that the maturity of the left hemisphere has a greater impact on females than in males. According to Stafiniak et al. (1990), early onset patients have not had time for complete lateralization of language to occur. Since the development of the language abilities among females depend much on the complete lateralization of the brain because of their dominancy in the left hemisphere and language comprehension and production, early injury to the left hemispheres is more likely to affect the language development of females compared to the males.

**Medication Compliance on the Deficits**

Effective treatment of epilepsy has been found to depend on medication compliance across a lifetime (Fountain, 2000). Based on this, it was predicted that medication compliance will have a significant relationship with the deficits. The findings indicated that there is a significantly positive relationship between medication compliance and attention, language, memory and academic achievement. This means as seizure patients comply with their medication, their level of attention, language, memory and academic abilities improve tremendously. Again the findings indicated that medication compliance has significant negative relationship with executive function, depression and anxiety. With highly scores on executive function, depression and anxiety indicating higher deficits in executive function, depression and anxiety respectively, the findings imply that as seizure patients comply with medication, their level of depression and anxiety reduces and it also improve their executive function abilities.

In a nutshell, the findings indicate that compliance with medication helps to reduce the deficits associated with seizure disorder. According to Nolan, Redoblado, Lah and Sabaz (2003),
medications prescribed by medical doctors have the potential of reducing the seizure frequency which is associated with the deficits. Failure to comply with the medication will reduce the efficacy of the drug in controlling seizure frequency. Complying with the dosage of the medication prescribed has the potential of controlling the frequency of seizure and hence reducing the deficits associated with the disorder.

According to antiepileptic drug (AED) therapy, the mainstay of treatment for most patients, has four goals: to eliminate seizures or reduce their frequency to the maximum degree possible, to evade the adverse effects associated with long-term treatment, and to aid patients in maintaining or restoring their usual psychosocial and vocational activities, and in maintaining a normal lifestyle (Rowland, 2005). These goals can only be achieved if one uses the drug as appropriately prescribed by the medical practitioner. For individuals with epilepsy, adherence to medication is crucial in preventing or minimizing seizures and their cumulative impact on everyday life. Failure to comply with medication may lead to toxicity which will serve as a significant limiting factor in treatment maintenance. When seizure patients fail to comply with medication, the course of treatment becomes difficult (Bootsma, Ricker, Hekster, Hulsman, Lambrechts, Majoie, Schellekens, de Krom & Aldenkamp, 2009). Non-adherence to antiepileptic drugs (AEDs) can result in breakthrough seizures many months or years after a previous episode and can have serious repercussions on an individual’s perceived quality of life (Mitchell et. al., 2000). This explains why compliance with medication was found to minimize the neuro and non-neuropsychological deficits associated with epilepsy.
Maturation Effect on Cognitive and Neuropsychological Deficits

The outcome of the impact of seizure disorder on neuropsychological deficits has been reported by some previous researchers (e.g., Misra 2006; Oguz, Kurul, & Dirik, 2002) to be attributed partly on maturation effect. There was therefore the need to assess the impact of maturational effects on cognitive and neuropsychological deficits among the seizure patients. To assess maturational effect in this study, participants in the seizure group were categorized based on their class of study and their level of cognitive and neuropsychological deficits were compared. The results indicated a significant impact of class of study on all the deficits based on the class of study of participants from the seizure group except on depression and anxiety (results shown on appendix). This means that as seizure patients mature and they attain higher level of study, it decreases their neuro-cognitive deficits (language skills, attention skills, memory skills, executive functions and academic achievement) except on depression and anxiety.

Limitations of the Study

There were some limitations to this study that must be considered in future studies though the results helped in achieving the aims of the study. First, data on depression and anxiety were collected using structured questionnaires which restricted respondents in the responses they gave. Secondly, because the sampling method used was a non-probability one, it failed to ensure that every member of the population will have an equal chance of been selected to take part of the sample, and therefore the interpretation must be done with caution.

The epilepsy group, consisting of 36 children, was rather small for investigating the full effects of age at onset, gender, medication compliance, and socioeconomic status on the deficits and the age range was too wide to deduce precise conclusions in relation to brain development through
the ages. Considering the relative rarity of seizure patients, the number of patients was however just enough for a statistical analysis.

Although both groups were matched on sex, age and class of study, the researcher could not rule out the differences in schooling which might have contributed to the different neuropsychological test results. Most of the seizure patients attended private schools and had part time teachers unlike the healthy control participants who were from public schools. This could have contributed to the findings in memory and academic performance between the control group and the seizure patients. Maturational effect was also not investigated which could have a significant impact on the findings.

Finally, each deficit was assessed using just a single test instead of multiple testing. This was because it involved children whose attention span is limited as compared with adult. This therefore makes conclusions difficult.

**Recommendations and Practical Implications**

The implication of the study is that seizure disorder is associated with severe deficits. The study also implies that socio-economic status of the family helps to ameliorate the deficits associated with epilepsy. Complying with medication was found to reduce the deficits associated with seizure disorder. The implication of the findings is that epileptic patients suffer from various degrees of neuropsychological problems, which if could be recognized early and intervened in time can further reduce the disability among these children’s and will lower the psychosocial impact of epilepsy at large.

The ability of the socioeconomic status to ameliorate the deficits means that parental financial investment plays a major role in reducing the deficits. On the basis of this parents are encouraged to invest financially towards the treatment of patients with seizure disorder. It is also hoped that
these findings will serve as resource materials for the health practitioners to ensure an effective management of seizure among epileptic children. Seizure patients must also comply with medication as means of reducing the deficits associated with disorders.

Even though the study had some limitations, it invariably yielded reliable results as it supported most of the studies conducted previously and added to the literature on the field of neuro and non-neuropsychological deficits associated with epilepsy. The key finding of this study is undoubtedly that seizure patients experience higher deficits in language skills, attention skills and executive functioning, depression and anxiety compared to healthy control group. Academic achievement and memory were the only deficits that significant differences were not observed between the seizure group and the healthy control group. Thus seizure patients can develop normal intelligence and memory with good measures in place.

Even though, the study has these unique contributions to the health service, expansion on the present study would allow greater knowledge into the factors that influence the deficits associated with epilepsy. Future investigations should increase the sample size and match the groups in terms of socioeconomic status and type of school attended. This study reinforces the importance of a thorough neuropsychological examination of children with epilepsy. Further research should continue to examine other personal and seizure variables that influence the deficits. To be able to extends the findings of this study, several areas for further research are recommended below:

a) Firstly, future research should investigate the neuropsychological deficits among seizure patients by comparing them with other neurological diseases to find out whether the deficits are associated with all neurological diseases.

b) Secondly, future research should engage in more eclectic approach by concurrently assessing numerous personal and seizure variables such as type of medication, duration of
treatment, age, and school attended in a single study. This will help to better explain the predictive relationships.

c) Moreover, despite the robustness of the findings over one sample and time periods, statements about generalizability must await the results of research in additional settings.

d) Again, to fully pinpoint causality, an ideal study might sample new seizure patients and track their onset of the disorder over a long period. This will help to know the course of the disorder on the deficits.

e) Finally, future research should use at least two or three tests for each deficit in order to draw conclusions to all situations.

In assessing these areas, the methodological limitations encountered in the present study need to be addressed. Future researches with these same variables and also exploring the areas recommended should employ either qualitative research approaches or both qualitative and quantitative approaches, for a better understanding of the interaction effects of all the variables in the study. Qualitative research should be considered because during data collection, the researcher realized participants were eager to explain their feelings further. A longitudinal design can also be adopted over the cross-sectional design, for a better understanding of the long term effect of the variables investigated in this study.

Summary and Conclusion

Throughout the previous chapters, the study has been looking at the deficits associated with seizure patients. The study has also been assessing the factors that influence seizure patients to experience high deficits using seizure patients at Korle Bu Teaching Hospital and Healthy control participants from West African Basic School. The entire research centered on two
objectives: To determine the neuropsychological deficits in selected cognitive abilities (language skills, attention skills, memory skills, executive functions), and other deficits (academic achievement, depression and anxiety) of people with seizure disorders and to assess whether the deficits associated with seizure disorders would be predicted by factors such as age at onset, socio-economic status, compliance with medication and sex of the patient.

In fulfilling the objectives, a number of literatures on factors influencing neuropsychological deficits among the seizure patients were reviewed. A total of 36 seizure patients and 36 healthy control participants took part in the study. Questionnaires and neuropsychological tests were answered by respondents anonymously. In analyzing the data, the predicted hypotheses were analyzed using the Pearson Product Moment Correlation Coefficients and the ANOVA.

The results of the study showed that seizure patients experience significantly higher deficits in language skills, attention skills, executive functioning, anxiety and depression than the healthy control group. There was no significant deficit in memory and academic achievement among seizure patients when compared to the healthy control. There was no difference between males and females on language skills, attention skills, memory, executive functioning, academic achievement, depression and anxiety of seizure male and female patients. There was also difference among the different socioeconomic groups, however, seizure patients from low socio-economic background were found to experience significantly higher memory deficits and academic underachievement than those from high socio-economic background. Early diagnosis of seizure disorder led to higher deficits in language skills, attention skills and executive functioning than late diagnosis. Age of diagnosis did not however have any significant impact on memory, academic achievement, depress and anxiety of seizure patients. Finally, there was a significant relationship between medication compliance and the deficits assessed.
References


Against Epilepsy (ILAE) and the International Bureau for Epilepsy (IBE). *Epilepsia*, 46(4):470-2.


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**UNIVERSITY OF GHANA**

**OFFICE OF RESEARCH, INNOVATION AND DEVELOPMENT**

*Ethics Committee for Humanities (ECH)*

**PROTOCOL CONSENT FORM**

**Section A - BACKGROUND INFORMATION**

<table>
<thead>
<tr>
<th>Title of Study:</th>
<th>Neuropsychological Deficits In Children With Seizure Disorders in Ghana. A study at Korle-Bu Teaching Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal Investigator:</td>
<td>Rona Bioh</td>
</tr>
<tr>
<td>Certified Protocol Number</td>
<td></td>
</tr>
</tbody>
</table>

**Section B–CONSENT TO PARTICIPATE IN RESEARCH**
General Information about Research

Dear,

The title of the study in which you are being invited to participate is a “Neuropsychological Deficits in Children with Seizure Disorders in Ghana - A study at Korle-Bu Teaching Hospital”. This study is being carried out to achieve two main aims that are: to assess the neuropsychological deficits in selective cognitive abilities and academic performance of people with seizure disorders and to determine whether the neuropsychological deficits associated with seizure disorders would be predicted by factors such as age at onset, compliance with medication, socioeconomic status, etc. The study is for academic purpose only. Attached are the psychological tests and some questionnaire that you will be asked to respond to.

Benefits/Risk of the study

Possible risks: There is no risk you will encounter due to your participation in the present study. You may experience fatigue as a result of the long time needed to complete the psychological tests and questionnaires. You will however be given enough time in the form of a break to prevent fatigue during the session. You are encouraged to complete all the questions on the psychological tests as they apply to you.

Possible Benefits: The overall importance of this study is to generate knowledge about Seizure disorders. The disease is not new in Ghana and this study will provide a better understanding of the deficits associated with it in order to help alleviate some of the assumptions that people have about the causes of the disorder which in a way will help minimize the stigma associated with it.

Confidentiality
In this study, you are instructed to write your name but your name would not be associated to your test results to enhance anonymity. The data collected for the research will be stored and handled in a professional manner in order not to identify you or any other information that could lead to identifying you in the discussion of the research results. Only the researcher and supervisors will have access to the individual data you will provide.

**Compensation**

No incentives will be provided. There will not be any compensation associated with your participation in this study. Only verbal appreciation will be involved as means of thanking you for your participation.

**Withdrawal from Study**

Your participation in this study is voluntary (not compulsory), which means you may choose to participate or not. In the course of participation, you have the right to withdraw from the study at any point in time and also refuse to respond to any question you may feel uncomfortable with, in which case there will be absolutely no negative consequences to you. In the course of completing the questionnaires as well as the psychological tests, you may also choose to stop participation at any time without any negative consequences to you.

Thank you for your valuable effort and time. Below is a consent form, please sign to indicate your acceptance to take part in the study.

**Contact for Additional Information**

The following numbers can be contacted in case of any discomfort, explanation or further information.

Student researcher: Rona Bioh (# 024 9823882)
Section C - VOLUNTEER AGREEMENT

"I have read or have had someone read all of the above, asked questions, received answers regarding participation in this study, and am willing to give consent for me, my child/ward to participate in this study. I will not have waived any of my rights by signing this consent form. Upon signing this consent form, I will receive a copy for my personal records."

________________________________________________
Name of Volunteer

________________________________________________
Signature or mark of volunteer  Date

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

________________________________________________
Name of witness

________________________________________________
Signature of witness  Date

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

________________________________________________
Name of Person who Obtained Consent
NEW PROTOCOL SUBMISSION FORM

Requirements:

i. A new protocol must be submitted to the ECH at least five weeks before the proposed commencement date of the research.

ii. All sections of the form must be completed before protocol can be considered for review.

iii. 11 hard copies of proposal must be submitted to the ECH in addition to other documentations as spelt out in the SOP. A soft copy of proposal and other documentations should also be emailed to ech@isser.edu.gh/dopaitetteh@ug.edu.gh

Section A – Background Information
1. Project Title: **NEUROPSYCHOLOGICAL DEFICITS IN CHILDREN WITH SEIZURE DISORDERS IN GHANA – A STUDY AT KORLE-BU TEACHING HOSPITAL**

2. Proposed Date of Commencement: **18TH MAY, 2014**

3. Principal Investigator (Name, Title, Qualifications, Postal Address, Institution/Department, Phone number, Email address)

   **RONA BIOH**  
   **BACHELOR OF ARTS PSYCHOLOGY WITH RELIGION**  
   **UNIVERSITY OF GHANA**  
   **PSYCHOLOGY DEPARTMENT, TEL: 0249823882, E-MAIL: rbioh@yahoo.com**

4. Co-Investigator(s) (Name; Title; Qualifications; Postal Address; Institution/Department; Phone number; Email address)

5. Student Investigator(s) (Name; Title; Qualifications; Postal Address; Institution/Department; Phone number; Email address; Supervisors name, Title and Contact)

   **RONA BIOH**  
   **BACHELOR OF ARTS PSYCHOLOGY WITH RELIGION**  
   **UNIVERSITY OF GHANA**  
   **PSYCHOLOGY DEPARTMENT, TEL: 0249823882, E-MAIL: rbioh@yahoo.com**  
   **MASTERS LEVEL**

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**Section B – Project Information**

1. Proposed Project Duration - From: (dd/mm/yy)  
   18/5/2014 To 6/2015

2. Collaborating Institution (if applicable)-**NOT APPLICABLE**

3. Funding Status of Project? **FUNDED**

   - Funding pending  
   - Funded  
   - Not funded  
   - Other

4. Source of funding (Name and Address) - **PERSONAL**

5. Research Location(s)- **KORLE BU TEACHING HOSPITAL, AND WEST AFRICAN BASIC SCHOOL (ADENTA)**

6. Data Collection Instruments – **PSYCHOLOGICAL TESTS AND QUESTIONNAIRE**
### Section C – Ethical Survey

1. Will the study involve participants who are particularly vulnerable or unable to give informed consent? (e.g. people under the age of 18, people with learning disabilities, students you teach or assess, etc.) **YES**

2. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? **NO**

3. Will the study involve any audio or visual recording of people in public places? **NO**

4. Will the study involve the discussion of sensitive topics? (e.g. sexual activity, illegal drug use, illegal activities, death, whistleblowing) **NO**

5. Will the study involve invasive, intrusive or potentially harmful procedures of any kind? **NO**

6. Is physical pain or psychological stress from the proposed project likely to cause harm or negative consequences beyond the risks in normal life? **NO**

7. Will financial inducements (other than expenses) be offered to any of the participants? **NO**
Section D – Signature

Name of person completing the form: RONA BIOH

Role on the study: STUDENT INVESTIGATOR

Signature: ________________________________________________________________________

Date: ____________________________________________________________________________

For all student projects:

__________________                        _________                       __________________                ___________
Student Investigator                            Date                                  Supervisors Signature                Date

Note:

As the Principal Investigator/Student Investigator on this project, my signature confirms that:
(i) I will ensure that all procedures performed under the study will be conducted in accordance with UG –
wide policy statement on ethical conduct of research involving human subjects as well as the Standard
Operating Procedure of ECH.
(ii) I understand that if there is any change from the project as originally approved, I must submit an
amendment to the ECH for review and approval prior to its implementation. Where I fail to do so, the
amended aspect of the study is invalid.
(iii) I understand that I will report all serious adverse events associated with the study within seven days
verbally and fourteen days in writing.
(iv) I understand that I will submit progress reports each year for review and renewal. Where I fail to do so,
the ECH is mandated to terminate the study upon expiry.
(v) I agree that I will submit a final report to the ECH at the end of the study.
QUESTIONNAIRE

This questionnaire is part of a study about neuropsychological deficits associated with seizure patients in Ghana. The results of this research, based on your responses will be presented to the School of Graduate Studies, University of Ghana. Thus, if you agree with the terms of this survey, please give accurate responses to the questionnaire below (You do not have to write your Name). Thank you for your help.

Demographic Variables
Age:                     Sex:                   Age at onset:

Type of education:       Number of seizures:    Duration of treatment:

Socioeconomic status of parents/ caregiver

a. Educational background of parents/caregivers

b. occupation: ..............................................................

   4. GH₵ 2000-2999 5. GH₵ 3000-3999 6. GH₵ 4000 or more

d. Place of residence:


Depression scale
Complete the following statements with the options below as they apply to you
Disagree (0)  No idea (1)  Agree (1)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>I do not have any friends</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>I am sure that terrible things will happen to me</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I never have fun at school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I feel alone all the time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I do not want to be with people at all</td>
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<tr>
<td>6</td>
<td>Nobody really loves me.</td>
<td></td>
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<tr>
<td>7</td>
<td>I want to kill myself</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Nothing is fun at all</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I am sad all the time</td>
<td></td>
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<tr>
<td>10</td>
<td>I feel like crying every day</td>
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<tr>
<td>11</td>
<td>Things bother me all the time</td>
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<tr>
<td>12</td>
<td>I have trouble sleeping</td>
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<tr>
<td>13</td>
<td>Most days I do not feel like eating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>I can never be as good as kinds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
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</tr>
<tr>
<td>15 I worry about aches and pains all the time</td>
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<tr>
<td>16 I look ugly</td>
<td></td>
<td></td>
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<tr>
<td>17 I cannot make up my mind about things</td>
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<td></td>
<td></td>
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<tr>
<td>18 I hate myself</td>
<td></td>
<td></td>
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<tr>
<td>19 I do very badly in subjects I used to be good in</td>
<td></td>
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<td></td>
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<tr>
<td>20 Nothing will ever work out for me</td>
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<tr>
<td>21 I have to push myself all the time to do my schoolwork</td>
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</tr>
<tr>
<td>22 I am bad all the time</td>
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<tr>
<td>23 I am tired all the time</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>24 I never do what I am told</td>
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<td></td>
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<tr>
<td>25 All bad things are my fault</td>
<td></td>
<td></td>
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<tr>
<td>26 I get into fights all the time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 I do everything wrong</td>
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<td></td>
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</tr>
</tbody>
</table>

Anxiety scale
Complete the following statements with Never (0), rarely (1), sometimes (2), Always (3) as they apply to you

<table>
<thead>
<tr>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I worry what other people think of me</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 I worry about things</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 I worry that I will do badly at my school work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 I feel afraid if I have to talk in front of my class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 I feel afraid that I will make a fool of myself in front of people</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 I worry that something awful will happen to someone in my family</td>
<td></td>
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<td>7 When I have a problem, I get a funny feeling in my stomach</td>
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<tr>
<td>8 When I have a problem, my heart beats really fast</td>
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<tr>
<td>9 I am scared of insects or spiders</td>
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<tr>
<td>10 I can’t seem to get bad or silly thoughts out of my head</td>
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<tr>
<td>11 I have to keep checking that I have done things right (like the switch is off, or the door is locked)</td>
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<tr>
<td>12 I worry that something bad will happen to me</td>
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<tr>
<td>13 I get bothered by bad or silly thoughts or pictures in my mind</td>
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<td>14 I feel scared when I have to take a test</td>
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<td>15 I am afraid of being in small closed places, like tunnels or small rooms</td>
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<td>16 I am scared of being in high places or lifts (elevators)</td>
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<td>17 I have to do some things over and over again (like washing my hands, cleaning or putting things in a certain order)</td>
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<td>18 When I have a problem, I feel shaky</td>
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<td>19 I am scared of going to the doctors or dentists</td>
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<td>20 I have to do some things in just the right way to stop bad things happening</td>
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<td>21 I suddenly become dizzy or faint when there is no reason for this</td>
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<td>22 I feel afraid if I have to use public toilets or bathrooms</td>
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<td>23 I suddenly start to tremble or shake when there is no reason for this</td>
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<td>24 I worry about being away from my parents</td>
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<td>25 I would feel afraid of being on my own at home</td>
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26 I feel afraid
27 I am scared of the dark
28 I have to think of special thoughts to stop bad things from happening (like numbers or words)
29 My heart suddenly starts to beat too quickly for no reason
30 I worry that I will suddenly get a scared feeling when there is nothing to be afraid of
31 I am scared of dogs
32 I suddenly feel as if I can’t breathe when there is no reason for this
33 All of a sudden I feel really scared for no reason at all
34 I am afraid of being in crowded places (like shopping centres, the movies, buses, busy playgrounds)
35 I have trouble going to school in the mornings because I feel nervous or afraid
36 I feel scared if I have to sleep on my own
37 I would feel scared if I had to stay away from home overnight
38 I feel scared if I have to travel in the car, or on a bus or a train

**Compliance with medication scale**
Never/rarely (0), Once in a while (1), Sometimes (2), Usually (3) and All the time (4).

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### Multiple Comparisons

#### Memory

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#### Academic Performance

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### Multiple Comparisons

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* The mean difference is significant at the 0.05 level.