

**NEUROPSYCHOLOGICAL FUNCTIONING AMONG PAEDIATRIC HIV PATIENTS
RECEIVING HIGHLY ACTIVE ANTIRETROVIRAL THERAPY**

BY

YASMIN MOHAMMED

10104752



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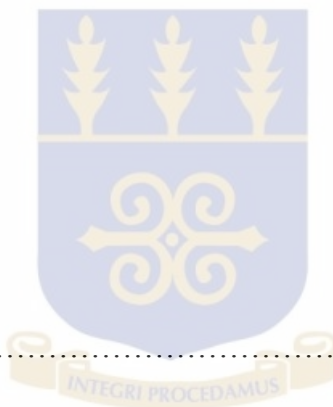
JUNE, 2014

DECLARATION

This is to certify that this thesis is the result of research undertaken by Yasmin Mohammed under supervision towards the award of Master of Philosophy in Clinical psychology Degree in the University of Ghana, Legon.

.....
Yasmin Mohammed
(Student)

.....
Date



.....
Dr. Adote Anum

(Principal Supervisor)

Date.....

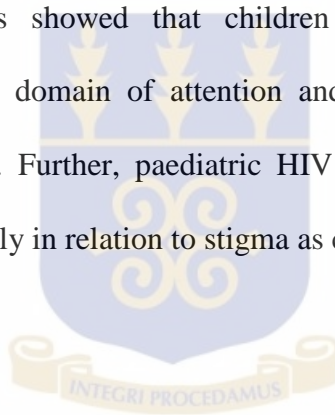
.....
Dr. Kingsley Nyarko

(Co-Supervisor)

Date.....

ABSTRACT

HIV/Aids as a retroviral infection exposes patients to both medical complications and psychosocial difficulties. The aim of this study was to determine the pattern of neuropsychological and psychosocial problems experienced by paediatric HIV outpatients on highly active antiretroviral therapy at the Korle-Bu Teaching Hospital, Accra-Ghana. Forty-two participants comprising twenty HIV infected children on HAART and twenty-two healthy controls from a school based population matched on age, socioeconomic status and education were recruited. Using a battery of neuropsychological tests and measures of psychosocial functioning, data was collected at the Special Clinic, Korle-Bu teaching Hospital and the Sackey-Odoi Basic School. The results showed that children living with HIV infection had neurocognitive impairment in the domain of attention and information processing speed as compared to the healthy controls. Further, paediatric HIV patients had more problems with psychosocial functioning particularly in relation to stigma as compared to their healthy controls.



DEDICATION

To all individuals and their families across all age groups all over the world who struggle every day as a result of living with HIV infection.



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Praise be to Almighty God whose enduring Grace and Mercy has brought me this far. I wish to express my heartfelt gratitude to my Supervisors, Dr. Adote Anum and Dr. Kingsley Nyarko and the Head of Department, Prof. C.C. Mate-Kole for their guidance and patience in helping me make this dream a reality. I also cannot forget the integral role played by the Noguchi Memorial Institute for Medical Research (NMIMR) and all the lecturers at the Department of Psychology towards the completion of this thesis. Their corrections and recommendations are well appreciated. May the Almighty God bless them in due season.

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TABLE OF CONTENTS

Content	Page
DECLARATION	i
ABSTRACT.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS.....	v
LIST OF TABLES	viii
LIST OF FIGURES	x
LIST OF ABBREVIATIONS.....	xi
CHAPTER ONE	1
INTRODUCTION	1
Background to the study	1
Statement of the problem	9
Aims of the study	11
Relevance of research	11
CHAPTER TWO	13
LITERATURE REVIEW	13
Theoretical framework.....	13
Review of related studies	21
Rationale of the study	35
Statement of Hypotheses.....	36
Operational definition of key terms:	38

CHAPTER THREE	39
METHODOLOGY	39
Population and sample size	39
Sample size justification	39
Procedure	48
Design	49
CHAPTER FOUR.....	50
Data analysis	50
Summary of findings:	77
CHAPTER FIVE	79
DISCUSSION, RECOMMENDATIONS AND CONCLUSION DISCUSSION	79
Limitations of the current study	83
Recommendations for Clinical practice	84
Directions for future research	86
Directions for future research	86
Conclusion	87
REFERENCES	89

APPENDICES	105
Appendix I: Ethical Clearance by NMIMR	105
Appendix II: Introductory letter by the Department of Psychology	106
Appendix III: Consent form of the study	107
Appendix IV: Assent form of the study	108
Appendix V: Case Record Form.....	109

LIST OF TABLES

TABLE 1. Demographic characteristics of the study sample.....	51
TABLE 2 . Cronbach alphas of individual measures.....	52
TABLE 3: Ages and Duration of receiving HAART of HIV infected children.....	52
TABLE 4 Means, Standard Deviations, Skewness & Kurtosis Of Measures.....	53
TABLE 5 . Means, Standard deviations, skewness, kurtoses of measures by groups.....	55
TABLE 6 Summary Table of the three way ANOVA comparing HIV infected children and healthy controls on Information Processing Speed.....	57
TABLE 7 Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Attention.....	58
TABLE 8. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Memory.....	59
TABLE 9. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Visual Ability.....	60
TABLE 10 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Spatial task.....	61
TABLE 11. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on School performance.....	61
TABLE 12 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Emotional Problems.....	63
TABLE 13 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on conduct/behavioural problems.....	65
TABLE 14 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on attention/hyperactivity problems.....	66
TABLE 15. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on peer relationship problems.....	67
TABLE 16 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on prosocial behaviour.....	68
TABLE 17 . Summary Table of three way ANOVA comparing HIV infected Children and healthy Controls on the SDQ's total difficulty score.....	69

TABLE 18 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on stigma (fear of contagion/resulting avoidance).....	70
TABLE 19. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on stigma (negative judgments about PLWHA).....	71
TABLE 20. Summary table showing Correlation Matrices between CD4 Count, HAART duration and the Measures.....	73

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LIST OF FIGURES

Figure 1: Proposed Conceptual Framework.....40

LIST OF ABBREVIATIONS

APA	American Psychiatric Association
CDC	Centre for disease control and prevention
CT	Computerized tomography
DSM IV-TR	Diagnostic and statistical manual for mental disorders Fourth Edition text revised
GAC	Ghana Aids Commission
HIV	Human Immuno-deficiency Virus
MOH	Ministry of Health
MRI	Magnetic Resonance Imaging
NMIMR	Noguchi Memorial Institute for Medical Research
PLWHA	People living with HIV/Aids
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION

Background to the study

Childhood HIV infection that is not treated or managed has been linked to impairment in language, motor, cognitive and psychological functions (Pollack, Kuchuk, Cowan, Glasberg, David, Krasuki et al, 1996; Smith, Malee, Leighty, Brouwers, Mellins, Hittelman et al, 2005). These impairments in development are attributed to the involvement of central nervous system disease that may include HIV-related neuroimaging abnormalities. Often times, mental and motor developmental delays may start when a child is 4 months old, and may be experienced as global or selective delays of neurodevelopment (Nozyce, Lee, Wiznia, Nachman, Mofensin, Smith, Yogev et al, 2006). Further, the magnitude/extent of the resulting neuropsychological impairments have been associated with the extent of abnormalities found during neuroimaging (Chiriboga, Fleishman, Champion, Gaye-Robinson, Abrams et al, 2004; Knight, Mellins, Levenson, Arpadi, Kariam et al, 2000; Portegies, Berger, 2000; Van Rie, Harrington, Dow, Robinson et al, 2007).

Since the introduction of new and improved antiretroviral therapies (ARTs), there have been marked improvements regarding the survival and the resulting quality of life of HIV seropositive children [Hellenic centre for infectious diseases control; Hoffman, Tabrizian, Wolff, Eggers, Stoehr, Plattenberg, Bukh et al, 2001; UNAIDS, 2004).

Despite these advances, the progression of HIV disease more often than not affects behavioral, motor and cognitive function of those living with the disease. Affected patients often present with a conspicuous onset of reduced work productivity, reduction in their ability to concentrate,

forgetfulness and slowing of their mental abilities. In some cases, a loss of interest in and withdrawal from hobbies or social activities are not uncommon (Niranjan, Singh, Roos, Varpetian, Greenfield, Sahai-Srivastava et al, 2011). Other rare features that could also be present include sleep disturbances, psychosis (with mania), and seizures. Motor problems include weakness, clumsiness and imbalance.

In the beginning, signs and symptoms are subtle and may be overlooked. Owing to this, cognitive screening tests are part of the routine care of HIV-infected patients, especially those who are at high risk, by an indication of high plasma HIV ribonucleic acid (RNA) levels, low CD4⁺ cell counts, hepatitis C, older age and poor baseline cognitive status (Niranjan et al, 2011). Typical features include intellectual and motor milestone declines in infants. In young children, the rate of acquisition of new skills is reduced and fine motor ability and dexterity may also become affected. Feeding difficulties may also develop. In older children and adolescents, the presentation is similar to that of the symptoms of the Aids Dementia Complex in adults.

Even though effective HAART management of paediatric HIV patients enhances their survival, paediatric HIV patients like children with other chronic conditions such as epilepsy, seizure disorder and Diabetes) may nonetheless experience social, physical, and psychological challenges which adversely affect their development (Tate, Flanigan, Tashima, Walsh, Boland, Cohen et al, 2003; Capaldini, 1999).

Further, it is thought that both the occurrence and magnitude of such problems may be most conspicuous among those children who develop HIV-related complications with time. (Mellins, Smith, O'Driscoll, Magder, Brouwers, Chase, Blasini, Hittelman et al, 2003; Szatmari, 1992) as cited in (Thomadis, Bertou, Ctritseles, Vassiliki, Spoulou et al, 2010). The reason being that the

virus (HIV) finds its way into the structures of the central nervous system early in the course of the infection and is responsible for the altering of several important CNS functions as the disease progresses (Goodkin, Aronow, Baldwin, Molona, Zheng et al, 2008). During the acute face of HIV syndrome, patients may present with symptoms of HIV encephalopathy. HIV-associated progressive encephalopathy (HPE) is a syndrome complex in children that affects their cognition, motor abilities and behavioral functions (Bradley, Daroff, Fenichel, 2004).

Owing to this, pediatric patients living with the disease may have an increased risk of presenting with psychosocial problems of social maladjustment and conduct which are not different from those observed among other chronically ill pediatric patients (Nozyce et al, 2006; Van Rie et al, 2007).

Epidemiology

In 2006, the Centre for disease control and prevention (CDC), estimated that the human immunodeficiency virus (HIV) affects nearly 33 million people world-wide (United Nations, 2007). In developed countries like the U.SA and Canada, survival rates associated with HIV infection have improved dramatically since the introduction of combination antiretroviral therapies (cART) in 1996, that are to reduce the viral burden, raising cluster of differentiation (CD4) cell counts, reducing opportunistic infections and improving health-related quality of life (Powderly, 2002). Despite these remarkable improvements in immune health outcomes, HIV-associated neurocognitive disorders (HAND) are still prevalent. Although neurocognitive impairments are not universal among HIV infected persons, clinically obvious signs and symptoms of at least mild neurologic disease are present in approximately 30% of persons with

asymptomatic HIV infection and about 50% of individuals with the acquired immunodeficiency syndrome (Heaton et al. 1995). Although, the occurrence of severe form of HAND, HIV-associated dementia (HAD), has declined in the era of cART (Sacktor, Lyles & Skolasky, 2001), the incidence and prevalence of milder forms of HAND have been relatively stable (McArthur, 2004) and these may have even multiplied in individuals who are not immunosuppressed (Grant, 2005). There has been no change in the incidence of HIV-1 encephalopathy which has been increasing in the HAART era, and its prevalence is now increasing; the cumulative incidence is 25-38%, and the prevalence is around 37%. In addition, 30-40% of patients are affected by HAND.

A geographic difference in how AIDS dementia complex (ADC) and other associated neurocognitive disorders presents now exists with the changing face of the manifestation of HAND. In developed countries such as the United States on one hand, HIV-infected patients rarely present for the first time with a full-blown picture; whereas in regions of Africa where HAART is not readily available, this scenario is still the same.

HIV and developmental decline

Decline in developmental milestones is closely associated with the deterioration of the central nervous system caused by human immunodeficiency virus (HIV) type 1 infection in infants, children and adolescents. Further, neuropsychological performance in these pediatric patients has been directly linked to degree of encephalopathy (Belman, 1990; Brouwers, Civitello, Moss, Wolters, Pizzo et al, 1995)).

Poor neurocognitive functioning has also been related to surrogate markers of HIV disease, such as low CD4 lymphocyte count percentages (Brouwers, Tudor-Williams, DeCarli et al, 1990).

In turn, markers such as a low CD4 count and a high HIV RNA level are associated with diffuse reduction in cortical functioning (Mitchell, Nelson, Contant et al; 1996), disease progression and a higher risk of death. (Blatt, McCarthy, Bucko-Krasiuka et al, 1995; Bamji, Thea, Weedon et al, 1996; Palembo, Raskino, Ficus et al, 1998). Thus, neuropsychological and neurological variables are closely linked with measures of HIV disease progression in infants, children and adolescents.

While multiple factors, such as prematurity, age at which HIV infection occurs, poor nutrition, socioeconomic status, prenatal exposure to toxic substances and treatment compliance also affect development in children with HIV infection (Ultman, Belman, Ruff et al,1985; Ultman, Diamond, Ruff et al,1987; Nozyce, Hoberman, Arpadi et al, 1994; Walker,1995 ; Darby, Ewart, Giangrande, Spoorer, Rizza, 1996; Touloni, Krafolidou, Giakeki et al, 1998), certain patterns of development have been specifically linked to pediatric HIV infection (Aylward, Butz, Hutton, Joyner,Vogelhurt , 1992).

One prominent pattern seen is decline in both fine and gross motor skills. This pattern of deterioration can be either a failure to acquire new motor skills or a loss of previously acquired milestones. (Belman, 1990; Epstein, Sharer, Goudsnit & Olofsson, 1989; Hittelman, 1990; Boiven, Green, Davies, Gurdani, Mikili, Cutting et al; 1995). Motor dysfunction may be expressed as an inability to move the muscles of the body in infants, whereas in children who are older, it might be experienced as a change in gait or refusal to walk.

Cognitive impairment or deterioration is another central characteristic of HIV infection in children (Belman, 1990; Hittelman, 1990; Chase, Vibbert, Pelton, Coulter & Cabral, 1995; Drotar, Olness, Witnitzer et al, 1997).

Infants and children living with the disease have, sometimes, but not always, been found to have deficits in global intellectual functioning. In addition to these estimates of global functioning, more specific areas may be associated with clinical deterioration. The Speed of information processing, (Loveland & Stehbens; 1990), attention, (Hittelman, 1990; Loveland, Stehbens; 1990, Coulter; Chase & Maclean, 1998) and verbal (and, in some cases, nonverbal) memory skills (Boiven et al; 1995, Loveland & Stehbens; 1990) being some of the domains that are usually affected. Deficits have also been found on tasks assessing visual scanning, academic achievement, cognitive flexibility and psychomotor speed in children (Cohen, Mundy, Karassik, Lieb, Ludwig & Ward; 1991). A Slowing in psychomotor functioning has also been reported in adults with HIV infection and has been predictive of dementia, acquired immunodeficiency syndrome, and death (Sacktor, Bacellar, Hooter et al; 1996).

Deficits in language have also been commonly reported in children with HIV infection (Belman, 1990; Ultman, Belman, Ruff et al, 1985; Hittelman, 1990; Wolters, Brouwers, Civitello & Moss, 1997; Caplan, Contello, Cunningham et al, 1998). Language ability is strongly related to academic performance, and these children show declines in academic achievement, especially in mathematics (Loveland & Stehbens, 1990; Wolters, Brouwers & Moss, 1995). Research findings of this nature suggest that the importance of examining performance in specific domains (e.g. language and psychomotor speed) in addition to administering global measures of neuropsychological functioning (e.g., Full-Scale IQ) cannot be overemphasized (Rubinow, Joffe, Brouwers, Squillace, Lane & Mirsky; 1988). According to (Wolters, Brouwers, Civitello & Moss, 1997) global measures of cognitive ability may actually conceal subtle patterns of deterioration in specific brain function.

These findings document the relationship between HIV disease progression (e.g., encephalopathy or death) and neuropsychological and neurological functioning. As these patients are living longer, it is highly desirable to identify clinical measures that could aid in predicting developmental outcomes of the disease's progression.

Effects of HIV infection on the CNS and its structures

The HIV virus does not appear to directly invade nerve cells but it jeopardizes their health and function. The resulting inflammation may damage the brain and spinal cord and cause symptoms such as confusion, forgetfulness and behavioral changes. Cognitive and motor impairment or damage to the peripheral nerves is also common. Research has shown that the HIV infection can significantly alter the size of certain brain structures involved in learning and information processing such as the cerebrum, the Pons, the hippocampus, the basal ganglia and the spinal cord. (National Institute of Neurological Disorders and Stroke).

The cerebrum contains higher centres which regulate levels of cognitive and emotional functions. The upper part of the cerebrum which is the cortex is responsible for planning, complex movements, attention, information processing, speech and perception. The entire surface of the cortex is covered by a mass of neurons, glial cells, neural nets and axons which enable us to perform organized actions, create images, symbols, associations and memories. The Pons connects other parts of the brain with the cerebrum and the cerebellum. Its main functions are to provide pathways for sensory and motor impulses to and from the hemispheres of the cerebrum. The Hippocampus plays a significant role in memory, particularly in the storage of long term information. The Spinal cord acts as a relay center which conducts

impulses/information to and fro in the peripheral nerves. The basal ganglia also play an important role in motor control and cognitive functioning.

Other nervous system complications that occur as a result of the disease or the drugs used to treat it includes seizures, spinal cord problems, lack of coordination and destruction of brain tissue and coma. These symptoms may be mild in the early stages of AIDS but can become progressively severe.

Nervous system complications in children may include developmental delays, loss of previously achieved milestones, brain lesions, smaller than normal skull size and impairment of information processing speed. (National Institute of Neurological Disorders and Stroke).

Thus damage to any of these brain areas may result in deficits in attention, information processing, planning, verbal ability, spatial ability, perception and memory.

Effects of HIV Infection on psychosocial functioning

HIV/AIDS has many physical effects, but perhaps some of its most profound effects are on the psychological and social wellbeing of the HIV-positive person, his or her loved ones and the community.

Human immunodeficiency virus (HIV) is a globally significant health threat to child and adolescent psychology and psychiatry. The rapidly increasing incidence of pediatric acquired immunodeficiency syndrome (AIDS) and HIV documents the consequences of the epidemic in the care and development of children and youth infected by HIV and in the change of risk behavior among both the infected and the affected (Brown & Lourie, 2000).

Stigma and fear have surrounded many of those who live with and die from HIV/AIDS, as well as those who love and care for them since the beginning of the epidemic.

Due to the magnitude of these psychosocial effects, they are central to HIV prevention efforts, care for people with HIV, and how communities respond to the massive losses of people in their most productive years of life. Although clinical reports suggest that children and adolescents with HIV infection are more likely to report limitations that are behavioral and emotional other than physical (Remafedi, 1998), there are few research studies which have focused on the complexity of their difficulties. Moreover, the prevalence rates of psychological/psychiatric disorders in HIV-infected children and adolescents are not known.

Understanding the cause of behavioral problems in HIV-infected children and adolescents is critical for improving their mental health and quality of life. Also, given the evidence that mental health problems are associated with poor medication adherence even in adults, improving the mental health of HIV-infected children and adolescents may positively impact on their overall growth and development and the quality of life of those infected and the entire family (Mellins et al., 1999; Philadelphia, Rabkin and Chesney, 1998).

Statement of the problem

This study seeks to determine the level of neurocognitive and psychosocial functioning of pediatric HIV patients on highly active antiretroviral therapy (HAART).

HAART has been linked with immune function sustenance and HIV viral load reduction in addition to the consequent decrease in opportunistic infections which together contribute to prolonging the survival of patients (Hoffman et al, 2001; Lindsey et al, 2007; Tate et al, 2003).

However, pediatric HIV patients may still have an elevated risk of presenting with psychosocial problems, including problems of social maladjustment and behaviour which are not different from those observed in other chronically ill pediatric patients (Nozyce et al, 2006; Van Rie et al, 2007). Further, several researchers suggest that the incidence and magnitude of such problems may be most evident in children who experience complications related to HIV (Mellins et al, 2003; Szatmari, 1992).

Further, there is a lot of Stigma attached to having a seropositive status in Ghana. This is because our cultural beliefs (norms, moral values and moral judgments) are such that there is a lot of superstition attached to illnesses that are perceived to be as a result of moral delinquency and promiscuity.

Fear of and preoccupation with transmission of HIV through every day casual contact leads directly to stigma which occurs everywhere from within the home, to social gathering places in the neighbourhood, to the market place, health facilities and even places of worship (International Centre for Research on Women – ICRW, 2005). The consequence is poor psychosocial and emotional functioning of those infected with HIV.

Unfortunately, these neurocognitive deficits and psychosocial problems are not identified early in most patients even in the developed countries (CDC, 2008). Hence a study to evaluate the utility of neurocognitive and psychosocial measures as predictors of clinical disease progression in infants, children, and adolescents with HIV infection as well as the emotional, social and behavioural correlates that arise as a result of living with the disease is needed in order to be able to address the above problems and report a better clinical picture.

Aims of the study

The main aim of this thesis is to investigate the neurocognitive and psychosocial functioning of pediatric HIV patients receiving highly active antiretroviral therapy (HAART).

Specific objectives for the study are:

- To examine the effects of HIV infection on cognitive abilities/functioning of affected children receiving highly active antiretroviral Therapy.
- To find out whether there is a direct link between HIV infection and emotional problems.
- To find out whether disclosure or otherwise of HIV seropositive status has an effect on psychological and emotional functioning of HIV positive children.
- To find out whether lower CD4 count status has a greater negative effect on cognitive abilities.
- To find out whether HIV infected children have more social and emotional problems as compared to healthy controls.

Relevance of research

This study seeks to provide the Ministry of Health, the Ghana Aids Commission and other stakeholders in the management of HIV/AIDS like the Ghana Health Service with information about the neuropsychological functioning of affected individuals. The study findings will inform these practitioners of screening, diagnostics, management and referral services when working with patients. Also, this effort will serve as a step in complementing the expensive cost of MRI and other radiologic imaging techniques used in other studies (Thomadis, Bertou, Critseles, Vassiliki, Spoulou et al, 2010) to shown brain damages.

Further, this research seeks to evaluate the utility of neuropsychological and neurological variables as predictors of clinical disease progression in children, and adolescents with HIV infection as well as the emotional, social and behavioural correlates that arise as a result of living with the disease.

Results from this study will also inform practicing neuropsychologists in Sub-Saharan Africa to identify appropriate test batteries not only to screen individuals but to identify specific deficits and also measure progress in management. This is needed in the current practice of clinical neuropsychology in Ghana, as it stands as an emerging field in the management of HIV/Aids across the globe (CDC, 2010). In addition, findings from this study will also make recommendations that will be valuable for future researches on the neuropsychological functioning of paediatric HIV patients. It will also be a valuable enhancement to literature since the study will provide additional data on Ghanaian paediatric patients with living with HIV infection.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents information on the theory, review of literature and related studies of the problem under investigation. The chapter begins with the citation of relevant theories that form the background to this study. This is followed by the review of related studies that have been done on the subject area. The review examined the effects of HIV infection and the disease progression on the neurocognitive functioning of pediatric HIV patients in relation to their emotional and social well-being. The literature review also includes the rationale of the study, statement of hypotheses and operational definition of terms.

Theoretical framework

Luria's working brain model

A widely accepted theory of brain functioning was proposed by Luria in his book, "*The Working Brain*". He outlined "three principal functional units of the brain whose participation is necessary for any type of mental activity" (Luria, 1974, p. 43). These units are responsible for **regulating cortical tone or waking**, for **obtaining, processing, and storing information** arriving from the outside world, and for **programming, regulating, and verifying mental activity** (Luria, 1974: 43).

He also proposed that each of these units is hierarchical in structure and consists of at least three cortical zones built one above the other. A **primary** "projection" area receives impulses from or sends impulses to the periphery. A **secondary** "projection-association" area processes incoming information and programs information for projection to efferent pathways. The **tertiary** "zones

of overlapping" area is last to develop and is responsible for complex forms of mental activity which requires the integrated participation of many cortical structures. These units and zones, when functioning properly, work together to regulate all our behaviors, from waking and sleeping, to hearing and seeing, and thinking and problem solving.

The unit for regulating tone, waking and mental states lies below the cerebral cortex and is commonly known as the reticular activating system (RAS). This unit has a dual relationship with the cortex, in that the RAS both influences the tone of the cortex and also experiences a regulatory influence (Luria, 1974). Through the cells of this unit, excitation spreads gradually, changing their levels little by little. This is in direct contrast to the cells in the cortex which send single impulses along their long axons operating on an "all or nothing" law which states that the cell will store up energy until there is enough to depolarize and send an impulse. Instead, the cells in the RAS form a "nerve net" in which the bodies of cells are connected by relatively short axons. Excitation which gradually spreads through the RAS will ultimately excite the cortex and, according to Luria (1974), modulate the whole state of the nervous system.

The fibers of the RAS form pathways which are both ascending and descending and allow the RAS to have a reciprocal relationship with the cerebral cortex. The ascending pathways of the RAS synapse with higher level structures in the nervous system such as the thalamus, caudate body, and ultimately the neocortex. This ascending pathway gradually spreads excitation upwards to "activate the cortex and regulate the state of its activity" (Luria, 1974, p. 46). The descending pathways of the RAS begin in the higher level structures starting in the neocortex and run to lower structures synapsing ultimately in the brain stem. This descending pathway allows the higher structures to "subordinate these lower structures to the control of programmes

(axons) arising in the cortex and requiring modification and modulation of the state of waking for their performance" (Luria, 1974, p. 46).

So, the first functional unit not only changes the tone of the cortex, but is also under control of the cortex, allowing the RAS to help the nervous system to respond and adapt to perceived changes in the environment. Thus, the hierarchical organization of the nervous system proposed by Luria assumes that higher structures in the system are dependent upon the lower structures for activation as well as regulation and maintenance of the activation. This activation is derived from three sources: metabolic processes, the arrival of stimuli from the outside world activating an "orienting response", and internal plans or goals which evoke the activation of neurons leading to the attainment of the goal. Any disruption in the ascending or descending RAS pathways, or damage to the processes and structures which activate this functional unit, will result in an insufficient state of waking or cortical tone, which in turn results in an organism which can not sufficiently interact with its environment.

The second functional unit is primarily responsible for the reception, analysis, and storage of information. This unit occupies the posterior region of the neocortex, including the occipital, temporal, and parietal lobes, and plays a vital part in bringing visual, auditory, gustatory, olfactory, vestibular, and general sensory information into the cortex (Luria, 1974). The structures comprising this unit consist of isolated groups of neurons in parts of the cortex which receive impulses and relay impulses to other neurons. The primary zones of these structural units employ modality-specific groups of neurons to receive impulses from the sensory organs, while the secondary zones of these structures surround the primary zones with associative neurons which enable incoming excitation to be conveyed to the tertiary zones. These tertiary zones, or

"zones of overlapping", are responsible for integrating and organizing the excitation arriving from the different sensory structures, and converting the successive stimuli into simultaneously processed groups (Luria, 1974). Any damage to the structures forming the second functional unit can result in decreased efferent impulses to orient the first functional unit, or incomplete information being transmitted to the third functional unit.

The third functional unit is responsible for programming, regulating, and verifying conscious activity. Forming plans and intentions, regulating behaviors, monitoring progress towards goals, and correcting mistakes are all activities associated with this third functional unit; located in the regions anterior to the precentral gyrus (Luria, 1974). Neural activity passes through this unit to the primary motor cortex where impulses are transmitted into motor routines and speech patterns. These impulses are projected first to the secondary zone of the third functional unit, incorporated in the premotor areas of the frontal region. It is within this premotor area that neural activity is transmitted to systematically organized movements (such as grasping movements of the hands, turning the head and eyes, or forming words and sentences instead of individualized twitches of muscles) before passing through the structures of the primary motor cortex to the periphery (Luria, 1974). This prefrontal area also connects with lower levels of the brain and is instrumental in modulating the activities in these lower levels. Afferent impulses from all areas of the brain are synthesized in the prefrontal structures and organized for efferent projection, thus inhibiting or activating behaviors controlled by the afferent areas. Damage to the third functional unit can alter this regulatory control by impairing the ability of the prefrontal area to synthesize and organize these impulses, resulting in dissociation between the afferent impulses and the behaviors which arise from the efferent activity. In addition, damage to the prefrontal area can

alter the reciprocal relationship between cortex and the RAS, so that the brain may not be sufficiently aroused for complex behaviors requiring sustained attention.

"Each form of conscious activity is always a complex functional system and takes place through the combined working of all three brain units, each making its own contribution" (Luria, 1974, p.99). In order to perform a voluntary movement, according to Luria (1974), the systems of the first unit provide the muscle tone, the systems of the second unit provide afferent feedback as to the status of the movement, while the third unit regulates the movement by synthesizing the neural activity and coordinating and adjusting the movement toward the goal. Similar scripts can be outlined for virtually any act of perception, verbalization, audition, motion, etc. However, when this complex functional system is damaged by injury to any or all of the units, the cohesion of the system is disrupted, resulting in a system which functions in a manner markedly different from before the disruption.

While the HIV virus does not appear to directly invade nerve cells, it jeopardizes their health and function. The resulting inflammation may damage the brain and spinal cord and cause symptoms such as confusion, forgetfulness and behavioral changes. Cognitive and motor impairment or damage to the peripheral nerves is also common. Research has shown that the HIV infection can significantly alter the size of certain brain structures involved in learning and information processing such as the cerebrum, the Pons, the hippocampus, the basal ganglia and the spinal cord. (National Institute of Neurological Disorders and Stroke). Thus damage to any of these brain areas may result in deficits in attention, information processing, planning, verbal ability, spatial ability, perception and memory.

A thorough examination of Luria's working brain model brings to the fore (a) knowledge regarding neural pathways between various cortical and subcortical structures and (b) an indication that preverbal monitoring of how language occurs. In this model, the thalamus plays roles in cortical arousal and activation and in preverbal semantic monitoring. The basal ganglia functions to regulate the degree of excitation conveyed from the thalamus to the cortex and to time the release of formulated language for motor programming. It is also consistent with the classical theories of potential application to other areas in the neurosciences and is specific enough that testable hypotheses can be derived.

Vygotsky's social development theory

Vygotsky's Social Development Theory, also known as the socio-cultural perspective, states that the cognitive development of children and adolescents is enhanced when they work in their Zone of Proximal Development (ZPD). To reach the ZPD, children need the help of adults or more competent individuals to support or scaffold them as they are learning new things. This theory is one of the foundations of constructivism and it asserts three major themes:

Major themes:

1. Social interaction plays a fundamental role in the process of cognitive development. In contrast to Jean Piaget's understanding of child development (in which development necessarily precedes learning), Vygotsky felt social learning precedes development. He stated that every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological) (Vygotsky, 1978).

2. The More Knowledgeable Other (MKO): The MKO refers to anyone who has a better understanding or a higher ability level than the learner, with respect to a particular task, process or concept. The MKO is normally thought of as being a teacher, coach or older adult, but the MKO could also be peers, a younger person or even computers.
3. The Zone of Proximal Development (ZPD). The ZPD is the distance between a student's ability to perform a task under adult guidance and/or with peer collaboration and the student's ability solving the problem independently. According to Vygotsky, learning occurred in this zone.

Vygotsky focused on the connections between people and the sociocultural context in which they act and interact in shared experiences (Crawford, 1996). According to Vygotsky, humans use tools that develop from a culture, such as speech and writing, to mediate their social environments. Initially children develop these tools to serve solely as social functions, ways to communicate needs. Vygotsky believed that the internalization of these tools led to higher thinking skills (cognitive abilities).

A critical examination of Vygotsky's theory brings to one's attention the fact that (1) it does not take into consideration gender differences, (2) it underestimates abilities and ignores the role of an individual, (3) it does not address the issue of how the outer world is connected to the internal mind. Further, its focus on valuing performance children accomplish together may result in children becoming indolent and perpetually calling out for help even when they can take the initiative and follow through with the accomplishment of a task by themselves.

The Link and Pubert stigmatization model

This was proposed by Bruce Link and Jo Pubert (2001). They postulated that stigma exists when four specific components converge. These begin with (1) Individuals differentiating and labeling human variations (2) The prevailing cultural beliefs tie those labels of adverse attributes (3) Labeled individuals are placed in distinguished groups that serve to establish a sense of disconnection between “us” and “them”. (4) Labelled individuals experience “status loss and discrimination” that leads to unequal circumstances.

Thus according to this theory, stigmatization begins with labeling or social cognition. This is the tendency to categorize and group information to form schemas and use them to interpret new and unusual information. This leads us to rely on potentially inaccurate heuristics (shortcuts in memory reasoning) and eventually lead to negative stereotypes and apply them in a discriminatory way.

In relation to HIV/AIDS, inaccurate information, derogatory terms used to describe those infected and negative powerful images painted by world leaders and in the media help in labeling affected individuals as an out-group. This tendency of “us’ and “them” categorization is the underlying theme of social cognition. Misconception leads to prejudice, discrimination and exclusion. Inadequate knowledge leads to careless behavior. Lack of knowledge leads to lack of care for those that are affected and to stigmatization that makes the infected into social outcasts.

Another component of the theory is placing the labeled group in a psychosocial or physical distance that serves to establish a sense of discrimination between “us and “them”. Finally the labeled individuals experience “status loss and discrimination’ that lead to unequal circumstances.

The first factor postulates a relationship between fear and the development of Stigma. This fear of and preoccupation with transmission of HIV through impossible or highly unlikely routes persists across all four countries despite high levels of Knowledge about how HIV is transmitted. In Ghana also, there is a lot of stigma attached to having a seropositive status. This is because our cultural beliefs (norms, moral values and moral judgments) are such that there is a lot of superstition attached to illnesses that are perceived to be as a result of moral delinquency and promiscuity (Battuta, 2010)). Fear of and preoccupation with transmission of HIV through every day casual contact leads directly to stigma. It occurs everywhere from within the home, to social gathering places in the neighbourhood, to the market place, health facilities and even places of worship .The consequence is poor social and emotional functioning of those infected with HV.

Review of related studies

HIV and associated neurocognitive deficits

The survival rates associated with having/living with HIV infection have improved dramatically since the introduction in 1996 of combination antiretroviral therapies (cART), which are capable of decreasing viral burden, increasing cluster of differentiation 4 (CD4) cell counts, diminishing the incidence of opportunistic infections, and improving health-related quality of life (Powderly, 2002).

Notwithstanding, these remarkable improvements in immune health outcomes, HIV-associated neurocognitive disorders (HAND) still pose a significant public health concern. Although neurocognitive impairments are not universal among HIV infected persons, signs and symptoms that are clinically obvious of at least mild neurologic disease are still evident in affected persons (Heaton et al. 1995).

Cysique, Franklin, Morgan, Chuan, Wu, Taylor et al (2010) had examined the neurobehavioural effects of HIV-1 infection in China and the United States among twenty-eight HIV seropositive (HIV+) and twenty-three HIV seronegative (HIV-) individuals with comparable gender, age, and education distributions were recruited in Beijing and a rural province in China. Another, thirty-nine HIV+ and thirty-one HIV- individuals were selected from a larger U.S. cohort, recruited from a Neurobehavioral Research Center to be matched to the Chinese sample for age, disease status, and treatment variables. The neuropsychological (NP) test battery consisted of 14 individual test measures, each assigned to one of seven areas of ability thought to be especially vulnerable to effects of the virus on the brain (i.e., verbal fluency, abstraction/executive function, working memory, information processing speed, learning, delayed recall, and motor function). In order to explore the cross-cultural equivalence and validity of the NP measures, they compared their Chinese and U.S. samples on the individual tests, as well as mean scaled scores for the total battery and seven ability domains. The mean of the Chinese retropositive group on each neuropsychological measure was worse than that of the HIV-group. Highly significant HIV effects on the Global and all domain mean scaled scores was revealed by a 2 by 2 ANOVA. The absence of interactions of HIV-by-Country gave an indication that the NP effects of being HIV positive are similar in the two countries.

Even though, the NP test battery that was selected and adapted for use in this Chinese HIV research appeared to have good cross-cultural equivalence; appropriate Chinese norms were however needed to identify disease-related impairment in individual Chinese people. To be able to inform the development of such norms, a much larger study of demographic effects is needed.

Gonzalez, Jacobus, Amatya, Quartana, Vassileva & Martin (2008) documented that HIV and drugs of abuse affect common neural systems responsible for procedural memory, including the striatum. They had matched and compared performance of 48 HIV seropositive (HIV+) and 48 HIV seronegative (HIV-) participants with history of dependence on cocaine/heroin across multiple Trial Blocks of three procedural learning (PL) tasks: Rotary Pursuit (RPT), Mirror Star Tracing (MST), and Weather Prediction Test (WPT). Both groups were well matched on demographic, psychiatric, and substance use parameters, and had ensured that all participants were abstinent from drugs. Mixed model ANOVAs revealed that the HIV+ group performed more poorly across all tasks, with a significant main effect of HIV seropositive status observed on the MST and a significant trend obtained for the RPT. There were no significant differences observed on the WPT. The groups had both demonstrated significant improvements in performance across all three PL tasks. More noteworthy was the fact that no significant Serostatus X Trial Block interactions were observed on any task. Their findings are consistent with HIV-associated deficits in complex motor skills, but not in procedural learning.

Several investigators have reported that many children and adolescents with HIV have or meet clinical criteria for psychiatric disorder, particularly attention-deficit/hyperactivity disorder (ADHD). For example, Pao et al (2000) reported that 85% of their sample of youths with HIV, who had acquired the infection as a result of risk-taking behavior (n = 34), met diagnostic criteria for at least one primary DSM-IV disorder, and 44% met criteria for current major depression.

This was because these patients were likely to be less inhibited and were more prone to HIV-related risk behavior (eg, unprotected intercourse), and they therefore posed a greater risk of transmission of the virus, because of their neuropsychiatric problems (Niranjan et al, 2011).

Hoare, Fouche, Spottiswoode, Donald, Philipps et al (2012) examined 12 asymptomatic HIV-positive children (8 to 12 years in comparison with matched controls on a neuropsychological test battery in addition to diffusion tensor imaging in a masked region of interest analysis focusing on the corpus callosum, internalcapsule and superior longitudinal fasciculus. The “slowprogressor” group, in comparison to their healthy controls performed significantly worse on the Wechsler Abbreviated Scale of Intelligence Verbal and Performance IQ scales, and on standardised tests of visuospatial processing, visual memory and executive functioning. The “Slow progressors” presented with lower fractional anisotropy (FA), higher mean diffusivity (MD) and radial diffusivity (RD) in the corpus callosum ($p < 0.05$), and increased MD in the superior longitudinal fasciculus, compared to controls. Hoare and her colleagues had found a correlation between poor performance on a test of executive function and a test of attention with corpus callosum FA, and a test of executive function with lowered FA in the superior longitudinal fasciculus. These data suggest that demyelination as reflected by the increase in RD may be a prominent disease process in paediatric HIV infection.

In a study by Royal, Cherner, Carr, Habib, Akomolafe et al (2012), 60 HIV-1 seropositive antiretroviral-naive individuals and 56 seronegative control subjects were administered the International HIV Dementia Scale (IHDS) and assessed for functional impairment using the Karnofsky Performance Status Scale. 15 HIV infected patients and 11 controls were also administered a detailed NP battery. Blood samples from 8 infected subjects, 3 with evidence of NCI, was obtained for molecular analysis of HIV-1 strain. Unadjusted scores on the IHDS showed that, using a recommended total score cutoff of 10, 28.8% of the HIV-1 seropositive and 16.0% of seropositive individuals scored abnormally. The mean Karnofsky score for the HIV seropositive and seronegative groups were, respectively, 90.7 ± 12.2 and 98.8 ± 3.8 ($p < 0.0001$).

Results from testing using the full NP battery showed that overall the HIV seropositive group performed worse than the seronegative group, with effect sizes spanning from small (0.25 on the Trail Making Test A) to large (0.82 on Action Fluency), with an average effect size across the battery of 0.45, which approaches that which has been recorded in other international settings. Finally, sequencing of partial pol amplicons from viral isolates revealed that 2 of 3 patients with NCI were infected with subtype G virus and 1 with the circulating recombinant form (CRF) 02_AG; all 4 individuals without NCI were infected with CRF_02AG.

These studies demonstrate the utility of conducting these studies for establishing the burden of NCI in the population of individuals with HIV-1 infection in Nigeria and for assessing the functional consequences and the virologic correlates of NCI.

It has been suggested by several researchers (Thomadis, Bertou, Critseles, Vassiliki, Spoulou et al, 2010; Battuta, 2009; Bose et al, 1998) that various stressors (biological, societal, and viral) associated with HIV augment the psychosocial stigma of HIV, thereby potentiating the adverse effects of the virus on brain processing and disease.

In these studies, negative life events, such as a family member being hospitalized or dying (which is not uncommon in families with HIV) or loss of wages or housing, play a role in worsening immune suppression, further complicating the effect of virus on the central nervous system. Thus, children with HIV, who have grown up in disadvantaged households and have been exposed to medications potentially toxic to the central nervous system, may be at greater risk than other populations for psychiatric symptoms which are comorbid with medical complications.

Bose et al (1998) compared HIV-infected children (n = 36) with seronegative peers and found higher rates of anxiety, social withdrawal, and underachievement with respect to academic work in the former. They compared the infected children with healthy controls from a school based population on measures assessing psychosocial functioning as well as their performance in academic work.

A preliminary international study suggested that neurocognitive difficulties exist in the early stages of HIV infection including impairments in the speed with which information is processed and verbal fluency (Mandal et al. 2008), and it is recognized that CNS involvement can occur during infection when symptoms are not present and may be evident before other disease manifestations (Grant et al, 1987). Neuroimaging studies have also suggested that there are alterations of the brain structures early in HIV infection (Lentz et al. 2009) and other studies have also suggested that HIV infection may result in early transformation to subcortical regions which subsequently spread to cortical regions.

Robertson, Nakasujja, Wong, Musisi, Sacktor et al (2007) examined the neuropsychological test scores of 110 HIV positive patients which were compared in relation to that of 100 control subjects on measures of attention/concentration, learning/memory, motor functioning and mental flexibility.

Analysis of covariance (ANCOVA) established significant group differences on the measures of verbal learning and memory, speed of information processing, attention and executive functioning between the retropositive and retronegative subjects after an adjustment was made for education. The retropositive patients showed relative deficits on measures of verbal learning and memory, speed of information processing, attention and executive functioning compared to

the retronegative controls. They also found out that neuropsychological deficits are likely to affect the patient activities of daily living and ability to retain their employment although initiation of antiretroviral therapy has been found to improve these deficits in some patients.

The researchers however did not examine the relationship between the neurocognitive deficits and the emotional and social functioning of the study participants.

Puthanakit, Aupibul, Louthrenoo, Tapaya, Nadsasran et al (2010) also carried out a study that was aimed at assessing cognitive functioning in school-aged HIV-infected children and the change after receiving antiretroviral therapy (ART). They conducted a prospective cohort study of retropositive children from 6–12 years of age compared with HIV-affected (children of HIV-positive mothers who were not infected with HIV), and retronegative control groups. The WISC-III was used in assessing the children at enrollment and reassessed after being followed-up for 30 months. Semistructured interviews of primary caregivers were also performed. 121 children had been enrolled; 39 HIV-infected, 40 HIV-affected, and 42 control children with a median age of 9.3 years. The HIV-infected group had a mean (standard deviation [SD]) CD4 percentage of 13.8% (5.3), 87% of whom had been receiving ART for a median of 35 weeks. At the first cognitive assessment, the mean (SD) of full-scale intelligence quotient (FSIQ) was 79 (13) and 88 (10) among HIV-infected and HIV-affected children, which was statistically lower than that of the control group at 96 (13; $p < 0.01$). The proportion of children with average intelligence level (FSIQ > 90) among 3 groups were 21%, 49%, and 76%, respectively ($p < 0.01$). At 30 months of follow-up, the HIV-infected group had a mean (SD) CD4 percentage of 25.6% (5.6); 77% had undetectable viral load. The mean (SD) FSIQ of children among three groups were 75 (12), 85 (12), and 91 (12), respectively.

Compared with the baseline assessment, the verbal scale score significantly decreased in all groups, including the controls, on the other hand, the performance scales were not altered. The researchers had drawn the conclusion that school-aged retropositive children have lower cognitive function than HIV-affected and retronegative children and cognitive ability was not ameliorated after receiving ART.

However, the retropositive children in this study were born when antiretroviral therapy was not widely available in Thailand. Therefore, they had advanced disease, more than half of the sample had experienced clinical category B and C symptoms and had very low percentage of CD4 prior to receiving treatment thus the findings might be somewhat biased towards severely poor cognitive functioning status.

Further studies are therefore needed to address whether early ART can preserve cognitive functioning among HIV-infected children. The researchers were also not able to collect information on school performance and social functioning because the families of the infected children needed to maintain confidentiality about participating in the study which could have given insight into whether any social difficulties were present. .

Lawler, Jeremiah, Mosepele, Ratcliffe, Cherry et al (2011) explored the prevalence and features of HIV-associated neurocognitive disorders (HANDS) in Botswana. It was a cross sectional study of 60 HIV-positive individuals, all receiving highly active antiretroviral therapy (HAART), and 80 demographically matched HIV-seronegative control subjects. The researchers had administered a comprehensive neuropsychological test battery and structured psychiatric interview. The lowest 10th percentile of results achieved by control subjects was used to set the lower limit of normal performance on the measures of cognition. Any participants who scored

abnormal on three or more measures were classified as cognitively impaired. In determining the clinical significance of any cognitive impairment, they looked at medication adherence, employment, and independence in activities of daily living (ADL). The retropositive subjects were impaired for all cognitive-motor ability areas compared with matched, uninfected control subjects. Thirty seven percent of the retropositive individuals met criteria for cognitive impairment.

The findings indicated that neurocognitive impairment is likely to be an important feature of HIV infection in resource-limited countries; emphasizing the need to develop effective treatments for subjects with, or at risk of developing, cognitive impairment.

A study carried out by Moore, Letendre, Morris, Umlauf, Deutsch, Smith et al (2011) also examined neurocognitive functioning among persons with acute or early HIV infection (AEH) that is people who have been diagnosed with HIV infection for less than a year and hypothesized that the neurocognitive performance of AEH individuals would be intermediate between HIV seronegatives (HIV⁻) and those with chronic HIV infection. Comprehensive neurocognitive testing was carried out with 39 AEH, 63 chronically HIV infected, and 38 HIV⁻ participants. All AEH participants were HIV infected for less than 1 year. Average domain deficit scores were calculated in seven neurocognitive domains. HIV⁻, AEH, and chronically HIV infected groups were ranked from best (rank of 1) to worst (rank of 3) in each domain. All participants had received detailed substance use, neuromedical, and psychiatric evaluations and HIV infected persons provided information on antiretroviral treatment and completed lab evaluations. Test results using ranks of average scores in the seven neurocognitive domains revealed a significant monotonic trend with the best neurocognitive functioning in the seronegative group(mean rank

= 1.43), intermediate neurocognitive functioning in the AEH group (mean rank = 1.71) and the worst in the chronic seropositive group (mean rank = 2.86).

While, this study confirmed that HIV positive persons perform worse than their seronegative peers on neuropsychological measures and showed more emotional symptoms (depression/mood disorder), the researchers failed to examine the social effects (particularly stigma) with respect to having an HIV seropositive status.

Mellins, Brackis-Cott, Cheng-Shiun, Elkington, Dolezal, Wiznia et al (2009) also examined 1) the prevalence of psychiatric and substance use disorders in perinatally HIV-infected (HIV+) adolescents and 2) the association between HIV infection and these mental health outcomes by comparing HIV+ youths to HIV exposed but uninfected youths (HIV-) from similar communities.

For this paper, data had come from the baseline interview of a longitudinal study of mental health outcomes in 9-16 year old perinatally HIV-exposed youths (61% HIV+) and their caregivers. Three hundred and forty youths and their primary adult caregivers were recruited from four medical centers and participated in separate individual interviews. Psychiatric disorder of youth was assessed using the caregiver and youth versions of The Diagnostic Interview Schedule for Children (DISC-IV). From the caregiver or youth report, a high percentage of seropositive and seronegative youths met criteria for a non-substance use psychiatric disorder, with significantly higher rates among the HIV+ youths. Anxiety disorders (46% for total sample) were the most prevalent disorders for them which included social phobia, separation anxiety, agoraphobia, generalized anxiety disorder, panic disorder, obsessive-compulsive disorder, and specific phobias. One quarter of the sample met criteria for a behavioral disorder (ADHD,

conduct disorders, and oppositional defiant disorders), with ADHD being most prevalent. Seropositive youths had significantly higher rates of ADHD). Only 7% of the control youths met criteria for a mood disorder and 4% for a substance abuse disorder as compared to their seropositive peers. Several caregiver variables (caregiver type and HIV status) were also associated with both child HIV status and mental health outcomes. Mellins et al (2009) concluded that HIV+ youths are at high risk for mental health disorders as compared to seronegative youths.

In this study, the researchers were able to establish the link between HIV seropositive status and the prevalence of emotional and conduct problems however they neglected the social component (particularly stigma) and how that may have contributed to the mental health disorders.

Further longitudinal research is also necessary to understand the etiology, as well as potential protective factors, in order to inform efficacy-based interventions.

HIV and Psychosocial Functioning

Thomadis, Bertou, Critselis, Vassiliki, Spoulou et al (2010) investigated the cognitive and psychosocial development of retropositive children. The children in the case group (n = 20) were aged 3-18 years and receiving HAART had been matched with two randomly selected healthy controls from a school-based population each. They had also included neuroimaging of HIV-related abnormalities as part of their data collection. The third edition of the Wechsler Intelligence Scale and Griffiths Mental Abilities Scales were applied to assess cognitive abilities of the children. Their emotional adjustment and social skills of both the infected children and the controls was also assessed by the use of the age specific strengths and difficulties questionnaire (SDQ). The two groups of children were compared by means of the Fisher's exact test, student's t-test, and Wilcoxon rank sum test on categorical, continuous, and ordinal scores, respectively of

the scales. The retropositive children without neuroimaging abnormalities did not differ from those who showed neuroimaging abnormalities with respect to either age at HAART initiation or months of HAART treatment. Although, the retropositive children without neuroimaging abnormalities had similar cognitive development with their healthy peers, the retropositive children with neuroimaging abnormalities had lower means for practical and general Intelligence Quotient scores. Further, the retropositive children who had no neuroimaging abnormalities had an elevated risk of both hyperactivity and abnormal emotional problems scores. This was in contrast to sepositive children with neuroimaging abnormalities, who rather showed an elevated risk of presenting with peer problems that are abnormal.

Eventhough, this study established a link between neurocognitive deficits and psychosocial functioning, the researchers did not examine how stigma could affect or contribute to poor social functioning of HIV positive children. The sample size was also too small to make generalizations to larger cohorts. Thus, a longitudinal study is necessary in order to assess whether the emotional and psychosocial characteristics of pediatric HIV patients in adulthood may vary.

A prospective study conducted by Banerjee, Pensi, Lohia & Gurprit (2007) examined the unique and combined influences of HIV infection and socio-demographic variables on the behaviour of 441 children (140 infected and 301 age and income matched controls) in the 4-16 year age group. The random sampling approach was used in this study. The Child Behavior Check List was applied in assessing behavior patterns in each child. Multivariate analyses comparing children and adolescents with retro-infection with their uninfected peers from similar backgrounds showed more subjective distress in the retro-infected children. 80.7% of the retro-infected children had behavioral problems as reported by their primary caregivers as compared to

18.3% of healthy control group. Another finding was that psychiatric behavior in HIV-infected children as risk factor for retro-infection was also identified in significant proportions for this particular study. The researchers had examined the extent to which psychosocial and demographic factors were involved in causation and exacerbation of behavior problems in HIV-infected children by behavioural analysis.

Further, Salama, Morris, Armistead, Koenig et al (2012) investigated whether coping skills and executive functioning interact in their association with psychological adjustment in HIV-positive youth. Data came from the Project, Adolescents Living with HIV/AIDS (ALPHA), a study to examine psychosocial, behavioral and neuropsychological functioning of youth with behaviorally acquired HIV was used. Fifty-nine of the participants aged 14-23, had been diagnosed with HIV prior to age 20 and receiving care in one of two HIV clinics in Atlanta or New York City, were recruited, consented and enrolled. All participants completed measures of depressive symptoms (Beck Depression Inventory), conduct disorder (Adolescent Symptom Index), and use of positive and negative coping strategies (Kidcope). The Wisconsin Card Sorting Test (WCST) assessed abstract reasoning (categories completed) and cognitive inflexibility (perseverative errors). In this sample of HIV-positive youth, depressive symptoms were best predicted by an interactive combination of negative coping skills and poor neuropsychological functioning. Neuropsychological functioning (cognitive inflexibility) and negative coping skills were directly associated with conduct disorder symptoms. The results of this study also highlighted the importance of including neuropsychological assessment in the evaluation of HIV-positive youth, particularly those with emotional or behavioral problems.

Prevalence of HIV related stigma

People are stigmatized when they are viewed as possessing characteristics that contribute a basis for avoiding them resulting in interpersonal dissociation (Leary and Scheindorfer, 1998). According to Leary and Scheindorfer, the basis of this social exclusion can fall under four categories that are as follows:

1. Poses a threat to other's health and safety.
2. Deviate excessively from group standards.
3. Fail adequately to contribute to society.
4. Create negative emotional reactions in others.

HIV/AIDS meets all these criteria. People living with HIV/AIDS are seen as an “infectious” group of people on a steep road to weakness, dependence and death and therefore of no use to society. This creates a negative emotional reaction of discrimination against people living with HIV/AIDS (PLWHA).

Greene and Bannerjee (2006) examined Disease related stigma by comparing predictors of AIDS and Cancer Stigma in a quasi-experimental survey design (n=485) to examine attitudes towards people living with AIDS and Cancer. Results showed that people with HIV/AIDS experience more stigma than those with Cancer.

Holzemer et al (2009) conducted a cross – sectional study exploring the contribution of demographic variables, symptoms and stigma to quality of life. This study empirically documented that perceived HIV stigma had a significantly negative impact on the quality of life for a broad sample of people living with HIV Infection.

Rationale of the study

Almost all of the data in this area comes from studies conducted in the United States (Dawes, Suarez, Casey, Cherner & Marcotte, 2008; Heaton, Franklin, Clifford, Woods & Rivera, 2009), Europe (Bhaskaran, Mussini, Antinori, Walker & Dorucci, 2008) and the pacific region/Australia (Wright, Brew, Arayawichanon, Robertson, Samintharapanya et al, 2005). Less is known about the prevalence and characteristics of neuropsychological complications of HIV in developing African countries like Ghana, which carry the burden of the epidemic (Sacktor, Wong, Nakasujja, Skolasky, Selnes et al, 2005; Clifford, Mitike, Mekonnen, Zhang, Zenek et al, 2007; Wong, Robertson, Nakasujja, Skolasky, Musisi et al, 2007; Kanmogne, Kuate, Cysique, Fensah, Eta et al, 2010; Nakasujja, Wong, Robertson, MacArthur & Sacktor, 2004) as cited in (Lawler, Kealeboga, Mosepele, Ratcliffe, Cherry et al, 2011). The assumption cannot therefore be made that HIV positive patients in Africa exhibit the same declines as patients in high resource settings like the USA and Canada since there are disparities that may influence cognitive functioning including nutrition, history of concomitant disease and varying HIV strains among other possibilities.

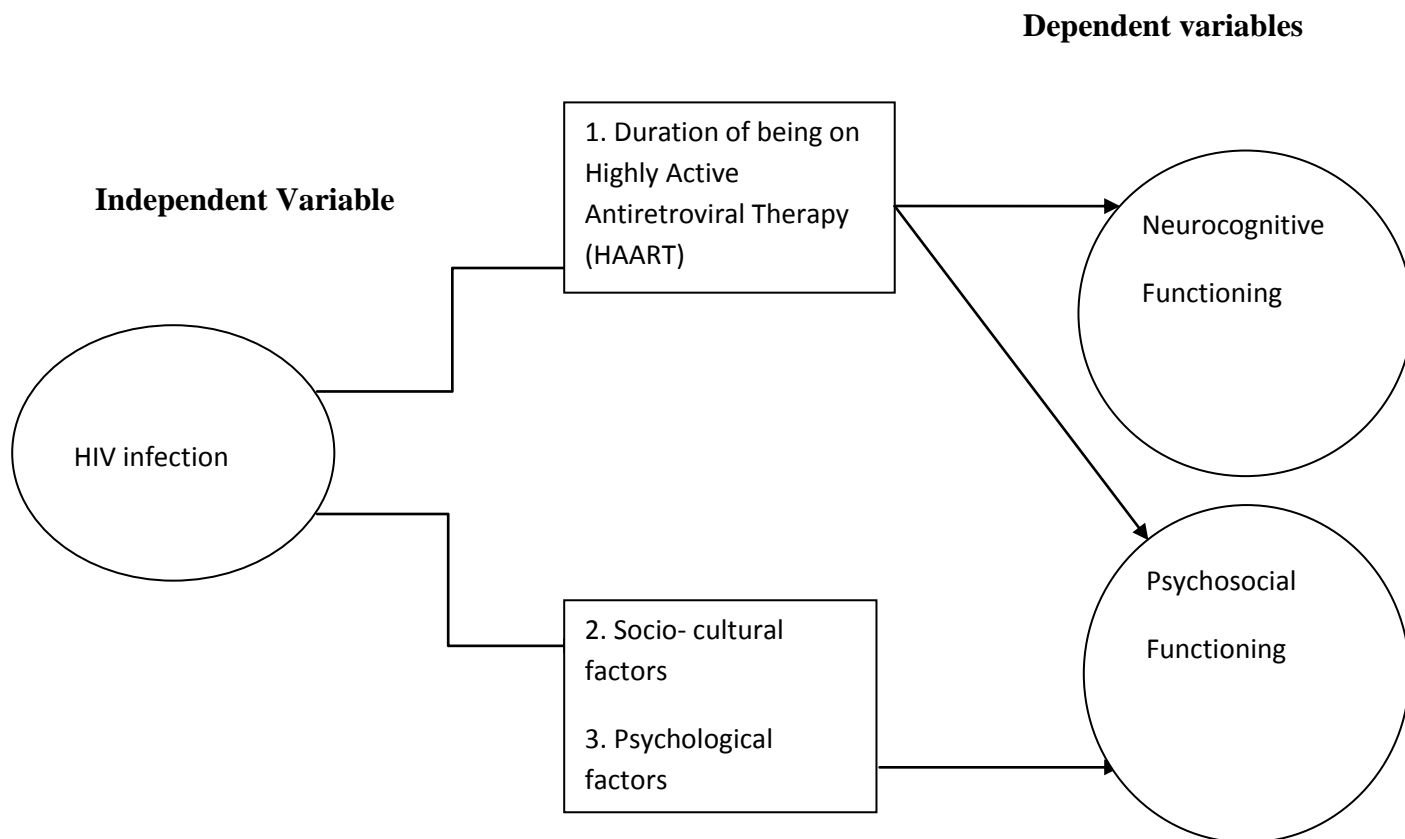
Further, most of the researches (Lawler et al, 2011; Moore et al, 2011; Puthanakit et al, 2010; Moore et al, 2011; Cysique et al, 2010; Gonzalez et al, 2008; Robertson et al, 2007) that have been done have focused solely on the neurocognitive deficits that arise as a result of HIV infection for a number of reasons. Neuropsychological functioning is easy to identify and measure and as well there are developmental markers that provide easy identifiable milestones in development. The same cannot be said of psychosocial development that is influenced by several factors and for which the manifestations might vary between individuals and between cultures.

In the present study, I intend to evaluate the psychosocial adjustment including emotional and social skills of infected HIV paediatric patients receiving Highly Active Antiretroviral Therapy (HAART) in Ghana. I will also assess whether adverse selective and/or global aspects of social and emotional functions are differentially associated with the duration of living with HIV infection.

To the best of the Researcher's knowledge, there is virtually no study relating stigma to psychosocial functions and neurocognitive deficits in children with HIV infection in Ghana.

Statement of Hypotheses

1. HIV infected children will perform poorer as compared to healthy controls with respect to neurocognitive functioning.
2. HIV infected children will perform poorer as compared to healthy controls with respect to psychosocial functioning.
- 3A. There will be a significant positive relationship between CD4 count and neurocognitive functioning.
- 3B. There will be a significant positive relationship between CD4 count and psychosocial functioning.
- 4A. There will be a significant negative relationship between duration of HAART and neurocognitive deficits.
- 4B. There will be a significant negative relationship between duration of HAART and psychosocial difficulties.

Figure1: Conceptual framework

Operational definition of key terms:

HAART (Highly Active Antiretroviral Therapy) are a group of drugs used in managing HIV/AIDS. They are capable of reducing viral burden, raising cluster of differentiation 4 (CD4) cell counts, reducing opportunistic infections, and improving health-related quality of life.

Neucognitive deficits: Impairments in Cognitive and motor functions associated with HIV infection.

Psychosocial Functioning: The ability to respond appropriately in social interactions with other people, behave in socially acceptable ways and to be able to control maladaptive patterns of thought and behaviour.

CHAPTER THREE

METHODOLOGY

Population and sample size

The Study population comprised of all outpatients HIV infected children at the Korle-Bu teaching Hospital between the ages of 6 and 17. From this population, a sample of twenty (20) children was recruited by seeking the assent of the children and the consent of their parents. Another twenty-two (22) children were recruited from a school based population who were matched with the infected children to serve as controls making the total sample size of forty-two (42). The total study sample of 42 children was made up of 21 males and 21 twenty females. All children whose parents declined excluded from the study.

Sample size justification

Sample size calculation based on Krejcie and Morgan (1970)

Krejcie and Morgan (1970) used the following formula to determine sampling size:

$$S = X^2NP(1-P) / d^2(N-1) + X^2P(1-P)$$

S = required sample size

X^2 = the table value of chi-square for one degree of freedom at the desired

confidence level

N = the population size

P = the population proportion (assumed to be .50 since this would provide the maximum sample size)

d = the degree of accuracy expressed as a proportion (.05)

For the present study, the values of the parameters are as follows:

N (Population of children attending the HIV clinic) = 597

$X^2 = 2.71$ (1 degree of freedom at 95% confidence level)

$P = 0.50$

$d = 0.05$

$s = 81.2$ which would be rounded up to 80.

Instruments/measures

Wechsler Intelligence Scale for Children Fourth Edition (WISC IV)

In this research, five of the fifteen subtests (at least one under each of the four main indices) of the WISC IV were used to assess attention, speed of information processing, planning, verbal ability, spatial ability, perception and memory. The WISC IV is administered to ages 6-16. It contains 10 core tests and 5 additional subtests. These are summed to four indices (the verbal comprehension index (VCI), the perceptual reasoning index (PRI), the working memory index (WMI) and the processing speed index (PSI) and one full scale IQ (FSIQ). The subtests are given for additional examination of processing abilities. The Indices have composites with a cronbach alpha which ranges from 0.88 for processing speed to 0.97 for full scale IQ.

WISC IV provides essential information and critical clinical insights into a child's cognitive functioning. It also integrates current conceptualizations and research to provide the most

essential information about a child's strengths and weaknesses. It is concluded to represent significant advances in the understanding of cognitive abilities. The four main indices of the WISC and what they measure are described below:

Verbal Comprehension Index (VCI)

This index measures verbal concept formation. Its core tests include Similarities, Vocabulary and Comprehension and the optional tests are Information and Word Reasoning. It assesses children's ability to listen to a question, draw upon learned information from both formal and informal education, reason through an answer, and express their thoughts aloud. It can tap preferences for verbal information, a difficulty with novel and unexpected situations, or a desire for more time to process information rather than decide "on the spot."

In this research, Similarities will be used to assess attention, information processing and verbal ability.

Perceptual Reasoning Index (PRI)

The PRI measures Non-verbal and fluid reasoning. Its core tests include Block Design, Picture Concepts and Matrix Reasoning and the optional test is Picture Completion.

It assesses children's ability to examine a problem, draw upon visual-motor and visual-spatial skills, organize their thoughts, create solutions and then test them. It can also tap preferences for visual information, comfort with novel and unexpected situations, or a preference to learn by doing.

In this research, picture concepts and matrix reasoning would be used to assess visual and spatial ability.

Working Memory Index (WMI)

The WMI measures Working memory. Its core tests include Digit Span and Letter-Number Sequencing and the optional test is Arithmetic.

It assesses children's ability to memorize new information, hold it in short-term memory, concentrate, and manipulate that information to produce some result or reasoning processes. It is important in higher-order thinking, learning, and achievement. It can tap concentration, planning ability, cognitive flexibility and sequencing skill, but is sensitive to anxiety too. It is an important component of learning and achievement and ability to work effectively with ideas as they are presented in classroom situations.

In this research, Letter Number sequencing would be used to assess attention, concentration and memory.

Processing Speed Index (PSI)

The PSI index measures the speed of Information Processing. The core tests include Coding and Symbol Search and the Optional test is Cancellation.

It assesses children's abilities to focus attention and quickly scan, discriminate between and sequentially order visual information. It requires persistence and planning ability, but is sensitive to motivation, difficulty working under time pressure and motor coordination too. Cultural factors seem to have little impact on it. It is related to reading performance and development too.

It is also related to Working Memory in that increased processing speed can decrease the amount of information a child must "hold" in working memory. On the other hand, lower processing

speed can impair the effectiveness of working memory by requiring the child to "hold" in working memory more information than the child can effectively process at a given time. Cancellation will be used to assess the speed of information processing in this study.

Matrix Reasoning

Matrix reasoning is a measure of fluid intelligence and is a reliable estimate of general intellectual ability. The child is presented with a partially filled grid and asked to select the item that properly completes the matrix. The test measures fluid reasoning. Fluid reasoning describes a child's skill at grasping nonverbal concepts (i.e., shapes, designs, visuospatial patterns) such that s/he can identify missing or incorrect aspects of those concepts and complete or correct them. The cronbach alpha observed for matrix reasoning in this study was 0.84.

Picture Concepts

Picture concepts is also a measure of fluid intelligence and a reliable estimate of general intellectual ability.

It assesses fluid reasoning, perceptual organization (i.e. the ability to organize nonverbal concepts in a way that they can be processed most quickly and accurately), and categorization (i.e. skill at recognizing the common features of nonverbal concepts). From each of two or three rows of objects, the child selects objects that go together based on an underlying concept. The cronbach alpha obtained for Picture Concepts was 0.83.

Letter-Number Sequencing (LNS)

Letter number sequencing is a test that assesses working memory. It shows a child's skill at organizing and manipulating two or more somewhat different concepts quickly and accurately. The child is presented a mixed series of numbers and letters and rearranges them such that numbers come first, from lowest to highest; then letters are next, in alphabetical order. The child also receives full credit if s/he organizes letters followed by numbers, if the letters and numbers are correctly ordered. To perform LNS well, one must be able to remember the numbers and letters then rearrange them in several rapid steps while remembering them. The cronbach alpha obtained for LNS was 0.77.

Cancellation

Cancellation measures processing speed using random and structured animal target forms (foils are common non-animal objects e.g. fruits, flowers and plants). The child is asked to place a strike through selected targets interspersed among a much larger group of targets. The child has 45 seconds to place a strike through as many of the target animals as possible on first the sheet with the random animal target forms and then the structured animal target forms. The cronbach alpha obtained for cancellation in this study was 0.79.

Similarities

Similarities measure a child's skill in comparative reasoning. This is one's skill in recognizing the similarities (and, by extension, the differences) between verbal ideas.

The test is made up of items requiring the child to describe how two given things presented are alike. The score on each item varies according to the degree to which the response describes a

general property primarily pertinent to both items in the pair. The cronbach alpha obtained for similarities in this research was 0.81.

People Search

People search is an attention test which also reflects frontal lobe function. The child is required to identify fully formed stick persons as targets among a grid of both complete and incomplete stick persons. It has 2 different levels of increasing difficulty. The cronbach alpha observed for people search was 0.76.

Literacy and Numeracy

Literacy is a test that was developed to measure school achievement based on the academic curriculum for basic schools in Ghana.

It involves English letter recognition, word reading, true sentence recognition, comprehension and paragraph expression and writing short stories. There are six levels.

Numeracy is a series of arithmetic problems that measure school achievement also based on the Ghanaian academic curriculum for Basic Schools. It involves number recognition, computation, addition, subtraction, multiplication, written maths 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 progressing to the next level.

The Age Specific Strengths and Difficulties Questionnaire (SDQ)

The Age specific Strengths and difficulties Questionnaire (Goodman, 2002) is an emotional and behavioural screening questionnaire for 4 -16 year olds. There are versions for the parent/carer to complete, the child/young person and the school to complete. It is concise and easy to use. It gives a score which indicates when difficulties may be present. Research has shown that it is a reliable and valid tool. Goodman, Ford, Simmons, Gatward & Meltzer (2000) carried out testing in a community sample to assess the strengths and difficulties Questionnaire (SDQ) as a potential means for improving the detection of psychological/psychiatric problems in the community. In the study, SDQ predictions and independent psychiatric diagnoses were compared in a sample of 7984, 5 to 15 year olds for the 1999 British Child Mental Health Survey. Multi-informant (parents, teachers, older children) SDQs identified individuals with a psychiatric diagnosis with a specificity of 94.6% (95% CI 94.1 – 95.1%) and a sensitivity of 63.3% (59.7% - 66.9%). The questionnaires identified over 70% of individuals with conduct, hyperactivity, depressive and anxiety disorders thus the researchers had concluded that community screening programmes based on SDQs could potentially increase the detection of child psychiatric disorders.

The SDQ has five separate subscales for different aspects of problems or behaviours, some positive others negative: Emotional problems, Conduct/behaviour problems, Inattention/hyperactivity Relationship with peers and Pro-social behavior. The five subscales include (1) Emotional Symptoms Score (Normal: 0-5; Borderline: 6; Abnormal: 7-10); (2) Conduct Problems Score (Normal: 0-3; Borderline: 4; Abnormal: 5-10); (3) Hyperactivity Scale (Normal: 0-5; Borderline: 6; Abnormal: 7-10); (4) Peer Problems Scale (Normal: 0-3; Borderline: 4-5; Abnormal: 6-10); and (5) Prosocial Scale (Normal: 6-10; Borderline: 5;

Abnormal: 0-4). The scores are added together to produce a total overall stress score. The questionnaire then asks for the impact of the behaviour to be rated to determine whether it is chronic, how much distress it causes, the level of social impairment and the burden to others. It has a cronbach alpha of 0.70 for the teacher administered version and 0.77 for the parent administered version.

The SDQ was used in this study because research has found that children who suffer from a chronic illness in this case HIV infection also present with emotional, social and conduct problems as sequelae of the disease due to perceived and/or actual stigmatization they may experience because of their seropositive status.

HIV-Related Stigma Survey Module (2008)

The HIV-related stigma survey module assesses four key dimensions of stigma: inappropriate fear of contagion, negative judgments about people living with HIV (PLWH), enacted stigma/discrimination against PWLH and compounded Stigma. Stigmatization whether perceived or actual has also been found to have negative effects of the psychosocial functioning/quality of life of persons living with HIV/Aids. (Holzemer et al, 2009; Greene and Bannerjee,2006). It was administered to the children in the absence of their parents/ legal guardians (the parents/ guardians were asked to excuse the children for a few minutes) to assess perceived and/or actual stigma in the study sample. e.gs of statements on the survey include: people think a person who has HIV is disgusting, other people think getting HIV is what I deserve for the way I have lived my life.

Coefficient alphas between .90 and .93 for subscales and .96 for the 26-item instrument provide evidence of internal consistency and reliability.

Procedure

The purposive sampling Technique was used in this ascases were available at only the fevers unit of the study site (Korle-Bu Teaching Hospital). Paediatric HIV outpatients on HAART were approached when they came for their reviews at the HIV Clinic.

The aims and purpose of the study were explained thoroughly to the care givers and the children themselves to enable them make an informed decision about participating in the study or otherwise.

They were also assured of the right to withdraw without being penalized or their decision to withdraw not affecting the way they had been receiving treatment at the facility.

We also assured them that we would try to minimize any risks or inconvenience that participants may go through as a result of participating in the research.

Testing was carried out in one of the consulting rooms at the pediatric clinic free from intrusion and distractions. The room was quiet and well lit with comfortable furniture for the children to sit on during the testing. On the average, it took about 2 hours 15 minutes to administer the battery of tests and questionnaires to each child. When they got tired during the administration of the tests and questionnaires, they were allowed to take a break and rest and then the testing continued after the break..

They were also given compensation for the time that they are required to spend in taking the tests and filling out the questionnaires. It was a snack and a small token (a set of colour pencils or an exercise book) depending on the age of the child.

All the participants were then assessed using Cancellation to measure speed of information processing, Letter Number Sequencing to measure working memory, Matrix reasoning to measure visuospatial ability etc. the WISC IV. Their parents /teachers were asked to fill the SDQ in order to find out whether any problems exist in the social and emotional functioning.

Design

A matched study design was conducted. The case group consisted of children infected with HIV (aged 6 -17 years). Each case was matched with randomly selected healthy controls from a school based population. This was done by first recruiting the cases at the HIV clinic and then finding seronegative peers with the same demographic variables in terms of age, education, economic status etc from the Sackey Odoi Basic and Junior High schools.

CHAPTER FOUR

RESULTS

Data analysis

The hypotheses formulated for this study were tested using the statistical package for the social sciences (SPSS) version 20.0 for windows (IBM Corporation, 2011).

The data was screened for possible missing data and outliers. In addition, other data transformations which included the creation of categories were done for some of the variables including age, groups and duration of being on HAART etc before continuing with hypothesis testing. Frontal lobe function was measured by the use of people search, speed of information processing was measured by the use of cancellation, memory was measured by use of letter number sequencing, visual ability was measured by picture concepts, spatial ability was measured by matrix reasoning, and school performance was measured by literacy and numeracy. The demographics of the study sample and the means, variances and cronbach alphas obtained for the various measures of neurocognitive and psychosocial measures are shown in tables A and B respectively. The means , standard deviations, skewness and kurtosis of each of the neurocognitive and psychosocial measures used in testing both HIV infected children (cases) and children chosen from a school based population (healthy controls) are also shown in Table 1.

The three way ANOVA was used to establish the difference between the HIV infected children and the healthy controls on Frontal lobe function, attention, memory, visual ability, spatial ability, information processing speed with respect to neurocognitive functioning and emotional problems, conduct/behavioural problems, attention/hyperactivity problems, peer relationship problems, prosocial behaviour and stigma with regards to psychosocial functioning. For each

analysis, the factors were age (categorized into ages 6- 10 (child group) and ages 11-17 (adolescent group), sex (male and female), and group (HIV infected children and healthy controls). Pearson's product moment correlation was used to establish the relationships between CD4 count value and duration of being on HAART in relation to neurocognitive and psychosocial functioning. Raw scores were used for both the analysis of variance and correlations.

Preliminary analysis

TABLE 1. Demographic characteristics of the study sample

Variable	Groups	
	HIV + (n=20)	HIV – (n =22)
Age	10.76 (2.22)	11.23 (3.05)
sex	12 females, 8 males	9 females, 13 males
Class	4.12 (2.28)	4.13 (2. 09)
HAART	6 years (3.25)	0
Duration		
School type	14 private, 6 public	22 public

TABLE 2 . Cronbach alphas of individual measures

Measures	Cronbach's Alpha
Fronta Lobe Function	.802
Attention	.719
Information Processing Speed	.779
Memory	.705
Visual Ability	.737
Spatial Ability	.736
School Performance	.758
SDQ emotional problems	.680
SDQ conduct and behavioural problems	.674
SDQ hyperactivity problems	.683
SDQ relationship with peers	.678
SDQ prosocial behaviour	.734

TABLE 3: Ages and Duration of receiving HAART of HIV infected children

Participant code	Age	Duration of receiving HAART
CS01	13	6
CS02	12	10
CS03	13	2
CS04	13	6
CS05	8	4
CS06	12	8
CS07	8	7
CS08	8	7
CS09	11	6
CS10	8	3
CS11	11	10
CS12	14	4

CS13	9	1
CS14	6	5
CS15	12	9
CS16	6	6
CS17	12	1
CS18	14	2
CS19	6	5
CS20	9	3

Presentation of Results

TABLE 4 MEANS, STANDARD DEVIATIONS, SKEWNESS & KURTOSIS OF MEASURES

Source of Variation	Mean	SD	SE	Min	Max	Skewness	Kurtosis	Cronbach alphas
Frontal Lobe Function	100.03	0.16	0.00	100.01	100.07	0.097	1.02	0.80
Information Processing Speed	7.02	3.15	0.04	1.00	14.00	0.11	-0.55	0.71
Attention	6.11	2.46	0.37	2.00	14.00	0.89	1.41	0.78
Memory	5.31	3.12	0.48	1.00	12.00	0.16	-0.98	0.74
Visual Ability	4.26	2.15	0.33	1.00	9.00	0.15	-0.40	0.74

Spatial Ability	5.00	2.46	0.38	2.00	12.00	0.77	0.31	0.76
School Performance	8.20	2.32	0.35	5.00	12.00	0.27	-1.06	0.68
Emotional Problems	1.52	2.08	0.32	0.00	5.00	0.67	-1.52	0.68
Conduct/Behavioural Problems	1.26	1.65	0.25	0.00	4.00	0.61	-1.54	0.67
Attention Problems/Hyperactivity	1.35	2.63	0.40	0.00	7.00	1.47	0.22	0.68
Peer Relationship Problems	1.02	1.56	0.24	0.00	4.00	0.95	-0.98	0.68
Prosocial Behaviour	4.97	2.08	0.32	0.00	6.00	-1.98	2.26	0.73
TOTAL Difficulties(SDQ)	11.95	6.88	1.06	0.00	17.00	-1.14	-0.52	
Inappropriate fear of contagion	4.16	1.88	0.29	0.00	5.00	-1.85	1.51	0.74
Negative judgments about PLWHA	5.57	1.56	0.24	0.00	6.00	-3.45	0.41	0.76

Enacted	6.66	4.77	0.73	0.00	10.00	-0.73	-1.53	0.71
Stigma/Discrimination								

The means, standard deviations, skewness and kurtosis of the measures used by groups are also shown in table 4.

TABLE 5 . Means, Standard deviations, skewness, kurtoses of measures by groups

Source of Variation (cases)	Mean	SD	SE	Min	Max	Skewness	Kurtosis
Frontal Lobe Function	100.03	0.06	0.00	100.01	100.07	0.97	1.02
Information Processing Speed	5.65	2.71	0.60	2.00	10.00	0.272	-1.31
Attention	5.650	2.08	0.46	2.00	10.00	0.48	-0.15
Memory	4.45	2.85	0.63	1.00	9.00	0.17	-1.50
Visual Ability	3.70	2.40	0.53	1.00	9.00	0.51	-0.50
Spatial Ability	4.70	2.31	0.51	2.00	10.00	0.71	-0.35
School Performance	7.50	2.60	0.58	5.00	12.00	0.73	-0.87
Total	14.85	5.19	1.16	17.00	63.00	-2.67	6.14
Difficulties(SDQ)							
Inappropriate fear of contagion	3.25	2.44	0.54	4.00	9.00	-0.68	-1.71

Negative judgments about PLWHA	5.10	2.19	0.49	5.00	12.00	-2.12	2.77
Enacted Stigma/Discrimination	3.00	4.70	1.05	9.00	63.00	0.94	-1.24
<hr/>							
(Controls)							
<hr/>							
Frontal Lobe Function							
Information Processing Speed	100.03	0.01	00.00	100.01	100.07	0.97	1.02
Attention	8.27	3.04	0.64	1.00	14.00	-0.18	0.13
Memory	6.54	2.73	0.58	2.00	14.00	0.92	1.47
Visual Ability	6.22	3.17	0.67	1.00	12.00	0.04	-0.90
Spatial Ability	4.77	1.79	0.38	1.00	9.00	0.15	0.54
School Performance	5.27	2.62	0.55	2.00	12.00	0.80	0.74
Total Difficulties Score	8.72	1.92	0.41	5.00	12.00	0.39	-1.02
Inappropriate fear of Contagion	9.31	7.27	1.55	17.00	63.00	-0.54	-1.76
Negative Judgments about PLWHA	5.00	0.00	0.00	0.00	0.00	-	-
Enacted Stigma/Discrimination	6.00	0.00	0.00	0.00	0.00	-	-
	10.00	0.00	0.00	0.00	0.00	-	-

Testing of Hypotheses

Test of Hypothesis 1

In the first analysis, we tested the hypothesis that HIV infected children will perform poorer as compared to healthy controls on measures of neurocognitive functioning. To test this hypothesis, the three way analysis of variance was used to assess the effect of HIV infection on frontal lobe function, information processing speed, attention, memory, , visual ability, spatial ability, and school performance. For each analysis, the factors were age (categorized into ages 6- 10(child group) and 11-14(adolescent group), sex (male and female), and group (HIV infected children and healthy controls). The results of three way ANOVA tables are summarized as follows:

TABLE 6 Summary Table of the three way ANOVA comparing HIV infected children and healthy controls on Information Processing Speed

variable	df	Mean Square	F	ρ
Age	1	17.25	2.17	0.15
Group	1	43.12	5.43	0.02
Age* sex	1	5.49	0.69	0.41
Age *group	1	0.03	0.00	0.94
Age*sex*group	1	17.87	2.25	0.98

The first three-way ANOVA was computed for speed of information processing. As stated previously, this was measured by the Cancellation subtest of the WISC IV. The analysis showed that a significant difference existed between the two groups (HIV infected children and the healthy controls) on information processing speed; [$F(1, 41) = 5.430, p < 0.02$]. Thus the hypothesis was supported for attention and information processing speed (Results are shown in table 6).

Table 7 Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Attention

variable	df	Mean Square	F	ρ
Age	1	3.14	0.50	0.84
Sex	1	1.45	0.21	0.64
Group	1	6.79	1.00	0.32
Age* sex	1	0.30	0.44	0.83
Age *group	1	0.04	0.00	0.93

Age*sex*group	1	1.66	0.24	0.62
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The second three way analysis of variance was computed for Attention. As was mentioned earlier, this was measured by means of the Similarities subtest of the WISC IV. The hypothesis had stated that HIV infected children would perform poorer as compared to the healthy children with respect to Attention. The results of the he analysis showed that no significant difference existed between the two groups [$F(1, 41) = 1.00, p < 0.05$]. Thus the hypothesis that HIV infected children will perform poorer than healthy controls with respect to their ability to attend information and produce a response was not supported. (Results are shown in table 7)

Table 8. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Memory

variable	df	Mean Square	F	ρ
Age	1	0.03	0.00	0.95
Sex	1	0.12	0.00	0.97
Group	1	5.31	0.55	0.46
Age* sex	1	3.36	3.16	0.08
Age *group	1	1.03	0.10	0.74
Age*sex*group	1	2.74	0.02	0.59

In the computation of third three way analysis of variance, the letter number sequencing subtest of the WISC IV was used. The hypothesis had stated that HIV infected children would perform poorer as compared to their healthy controls with respect to Memory. Results of the analysis had shown that the infected children did not differ significantly from the healthy controls in terms of their ability to memorize information presented to them [$F(1, 41) = 0.55, p < 0.46$]. Thus the hypothesis was not supported for memory (Results are shown in Table 8).

Table 9. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Visual Ability

variable	Df	Mean Square	F	ρ
Age	1	0.04	0.01	0.92
Sex	1	8.43	1.96	0.17
Group	1	3.93	0.91	0.34
Age* sex	1	4.56	1.06	0.31
Age *group	1	0.50	0.11	0.73
Sex*group	1	7.64	1.78	0.19
Age*sex*group	1	0.94	0.22	0.64

In testing the hypothesis that HIV infected children will perform poorer in comparison to healthy controls with regards to visual ability, the picture concepts subtest of the WISC IV was used.

The analysis showed that there was no significant difference between the HIV infected children and the healthy controls with respect to visual ability, [$F(1,41)=0.91, \rho <0.34$]. In effect, the HIV infected children did not perform poorer as compared to the healthy controls therefore the hypothesis was not supported for visual ability (Results are shown in Table 9).

Table 10 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Spatial task

variable	df	Mean Square	F	ρ
Age	1	7.47	1.12	0.29
Sex	1	0.00	0.00	0.98
Group	1	0.04	0.01	0.93
Age* sex	1	6.73	1.01	0.32
Age *group	1	5.58	0.84	0.36
Age*sex*group	1	0.13	0.02	0.88

In testing the hypothesis that HIV infected children will perform poorer in comparison to healthy controls with respect to spatial ability which was assessed by means of the picture concepts subtest test of the WISC IV, a three way analysis of variance was performed. Results of the analysis showed that there was no significant difference between the HIV infected children and the healthy controls with respect to spatial ability [$F(1,41)=0.01, \rho <0.93$]. In effect, HIV

infected children did not perform poorer than the healthy controls on the spatial task, thus the hypothesis was not supported for spatial ability (Results are shown in table 10).

Table 11. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on School performance

variable	df	Mean Square	F	ρ
Age	1	25.66	6.00	0.02
Sex	1	6.69	1.56	0.21
Group	1	5.37	1.25	0.27
Age* sex	1	0.61	0.44	0.70
Age *group	1	0.43	0.10	0.75
Age*sex*group	1	4.27	1.00	0.32

In testing the hypothesis that HIV infected children would perform poorer in comparison to healthy controls in terms of school performance which was measured by the Literacy and Numeracy test, a three way analysis was performed. Results of the analysis showed no significant difference was between the HIV infected children and the healthy controls with respect to school performance [$F(1,41) = 1.25, \rho < 0.27$]. In effect, the HIV infected children did not perform poorer than the health controls therefore the hypothesis was not supported for school performance. (Results are shown in table 11).

Test of Hypothesis 2

The second major objective in the study was to examine differences between children infected with HIV and healthy controls on psychosocial functioning.

To test this hypothesis, the three way analysis of variance was used to assess the effect of HIV infection on their psychosocial functioning with respect to emotional problems, conduct/behavioural problems, attentional /hyperactivity problems, peer relationship problems, prosocial behaviour and stigma by the use of the Strengths and difficulties Questionnaire (SDQ) to measure emotional and behavioural problems and the HIV stigma survey module (HSSM) to measure HIV-related stigma. The results of three way ANOVA are summarized as follows:

Table 12 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on Emotional Problems

variable	Df	Mean Square	F	ρ
Age	1	0.61	0.14	0.70
Sex	1	0.00	23.64	0.00
Group	1	0.92	0.21	0.64
Age* sex	1	13.19	3.03	0.09

Age *group	1	2.18	0.50	0.48
Sex * group	1	0.11	0.02	0.87
Age*sex*group	1	0.79	0.37	0.65

A three-way ANOVA was conducted to test the effects of age, sex, and HIV status on emotional problems. As stated earlier, emotional problems was measured by the Strengths and Difficulties Questionnaire (SDQ). The major hypothesis was to test the prediction that HIV infected children would score higher on emotional problems than the healthy children. The ANOVA results did not show any significant results [$F(1, 41) = 0.21, p < 0.64$]. The hypothesis that HIV infected children will have more emotional problems as compared to healthy control was therefore not supported (Results for this analysis is presented in Table 12).

Table 13 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on conduct/behavioural problems

variable	df	Mean Square	F	ρ
Age	1	3.89	1.61	0.21
Sex	1	6.49	2.68	0.11
Group	1	2.56	1.06	0.31
Age* sex	1	6.63	2.74	0.11
Age *group	1	2.80	1.16	0.29
Sex*group	1	0.12	0.05	0.82
Age*sex*group	1	0.63	0.26	0.61

In testing the hypothesis that HIV infected children would have more problems in comparison to the healthy controls, a three way analysis of variance was used. Results of the analysis did not show any significant differences between the two groups, $[F(1, 41) = 1.06, \rho < 0.31]$. In effect, the HIV infected children did not have more conduct/behavioural problems as compared to the healthy controls, thus the hypothesis that HIV infected children would have more conduct and behavioural problems as compared to healthy controls was not supported (Results are shown in table 13).

Table 14 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on attention/hyperactivity problems

variable	df	Mean Square	F	ρ
Age	1	0.66	0.08	0.76
Sex	1	4.96	0.65	0.42
Group	1	4.47	0.59	0.44
Age* sex	1	0.08	0.01	0.91
Age *group	1	0.16	0.02	0.88
Sex * group	1	1.00	0.13	0.71
Age*sex*group	1	14.06	1.86	0.10

In testing the hypothesis that HIV infected children would have problems of attention /hyperactivity as compared to healthy controls, a three way analysis of variance was done.

Results of the analysis showed no significant difference was between the HIV infected children and the healthy controls with respect to Attention/Hyperactivity problems, [$F(1, 41) = 0.59, p < 0.44$]. In effect, the HIV infected children did not have more problems of attention/hyperactivity as compared to the healthy controls therefore the hypothesis was not supported for attention/hyperactivity problems. (Results are shown in table 14).

Table 15. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on peer relationship problems

variable	df	Mean Square	F	ρ
Age	1	0.28	0.11	0.74
Sex	1	3.97	1.53	0.22
Group	1	1.93	0.75	0.39
Age* sex	1	0.17	0.06	0.80
Age *group	1	0.11	0.04	0.84
Sex * group	1	0.67	0.26	0.62
Age*sex*group	1	1.53	0.59	0.45

A three way analysis of variance to test the hypothesis that HIV infected children would have more problems with respect to peer relationships in comparison to healthy controls did not show any significant difference . .between the two groups, [$F(1,41) = 0.75, \rho < 0.39$]. In effect, there was not much difference in the ability to relate to peers appropriately between the HIV infected children and healthy controls thus the hypothesis was not supported. (Results of the analyses are shown in Table 15)

Table 16 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on prosocial behaviour

variable	df	Mean Square	F	ρ
Age	1	0.04	0.00	0.92
Sex	1	1.70	0.39	0.53
Group	1	6.07	1.42	0.24
Age* sex	1	10.16	2.38	0.13
Age *group	1	3.09	0.72	0.40
Sex*group	1	1.70	0.39	0.53

Age*sex*group	1	0.94	0.21	0.64
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A three way analysis of variance showed no significant difference between the HIV infected children and the healthy controls with respect to prosocial behaviour, [$F(1, 41) = 1.43, p < 0.24$]. In effect, there was not much difference between the HIV infected children and healthy controls with respect to behaving in a socially acceptable manner thus the hypothesis was not supported for prosocial behaviour (Results are shown in Table 16).

Table 17 . Summary Table of three way ANOVA comparing HIV infected Children and healthy Controls on the SDQ's total difficulty score

variable	df	Mean Square	F	ρ
Age	1	9.60	0.24	0.63
Sex	1	53.38	1.31	0.26
Group	1	62.80	1.54	0.02
Age* sex	1	83.10	2.03	0.16
Age *group	1	77.94	1.91	1.18
Sex*group	1	18.40	0.45	0.51
Age*sex*group	1	24.46	0.60	0.44

A three way analysis of variance revealed that a significant difference existed between the HIV infected children and the healthy controls with respect to their overall burden of difficulties with emotions, concentration, behaviour or being able to get along with other people which was also assessed by summing up all the other five subscales of the SDQ; [$F(1,41)= 1.54, \rho <0.02$]. In effect, the HIV infected children experienced more emotional, behavioural and social difficulties as compared to their healthy controls, therefore the hypothesis was supported for overall burden of difficulties(Results are in Table 17).

Table 18 . Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on stigma (fear of contagion/resulting avoidance)

variable	df	Mean Square	F	ρ
Age	1	3.56	1.18	0.28
Sex	1	1.31	0.43	0.51
Group	1	25.43	8.44	0.00
Age* sex	1	0.34	0.11	0.73
Age *group	1	3.56	1.18	0.28
Sex*group	1	1.31	0.43	0.51

The hypothesis that HIV infected children would experience more stigma involving fear of contagion and resulting avoidance was assessed by means of the HIV Stigma survey module(2008). A three way analysis of variance had revealed a significant difference between the HIV infected children and the healthy controls with respect to stigma (fear of contagion/resulting avoidance), $[F(1,41)= 8.45, \rho <0.05]$. In effect, the HIV infected children experienced of a lot of stigma with respect to other people avoiding them for fear of also getting infected with HIV thus the hypothesis was supported for stigma involving fear of contagion/resulting avoidance (Results are shown in table 18).

Table 19. Summary Table of the three way ANOVA comparing HIV infected Children and healthy Controls on stigma (negative judgments about PLWHA)

variable		df	Mean Square	F	ρ
Age	1.00	1	1.100	0.46	0.50
Sex	1.00	1	1.00	0.46	0.50
Group	4.47	1	4.47	2.06	0.16
Age* sex	1.00	1	1.00	0.46	0.50
Age*group	4.47	1	4.47	2.05	0.16
Sex*group	1.00	1	1.00	0.46	0.50

Age*sex*group	1.00	1	1.00	0.46	0.50
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The hypothesis that HIV infected children would experience more stigma in relation to people passing negative judgments about them was also assessed by means of the HIV stigma survey module (2008). A three way analysis of variance did not show a significant difference between the HIV infected children and the healthy controls with respect to stigma dimension of negative judgments about people living with HIV/Aids, [$F(1,41) = 2.06, p < 0.16$]. In effect, the HIV infected children did not think people were passing negative judgments about their HIV positive status therefore the hypothesis was not supported for stigma involving negative judgments about people living with HIV (Results are shown in table 19).

In testing hypothesis 3A and 3B, we hypothesized that there will be a significant positive relationship between CD4 count and neurocognitive functioning and psychosocial functioning. A correlation matrix was thus drawn to show the relationship between CD4 count and both neurocognitive and psychosocial measures (Results of the correlations are shown in table 20).

Table 20. Summary table showing Correlation Matrices between CD4 Count, HAART duration and the Measures

	1	2	3	4	5	6	7	8	9	10	11	12
CD4												
DH												-0.69**
FLF											-0.18	0.12
IPS									-0.25*	0.25	-0.06	0.37*
A								-0.11	-0.22	-0.16	-0.17	0.03
M								0.25	-0.17	-0.02	-0.11	0.07
VA								-0.30*	-0.08	0.08	-0.53	0.04
SA						-0.29*	0.03	-0.17	-0.31*	-0.07	-0.37**	-0.10
SP						-0.04	0.07	0.01	-0.12	-0.22	-0.18	0.07
EP					-0.04	0.21	0.18	0.34*	0.26	-0.10	-0.20	0.11
C/BP				-0.30*	0.21	0.24	-0.00	0.36*	0.52**	-0.24	0.21	-0.23
A/HP				-0.04	-0.00	0.13	0.10	0.40	0.31*	-0.09	-0.07	-0.27*
PRP			-0.31*	0.21	0.399**	0.36*	0.02	0.36	0.31*	-0.28*	0.00	0.04
PSB			0.18	0.29	-0.12	0.08	0.01	0.34	-0.32*	0.21	0.22	0.19
OBD		-0.26*	0.01	-0.31*	0.26	0.52*	0.31*	*0.14*	0.32	-0.30	-0.21	-0.25
IFC		-0.32	0.15	0.13	-0.10	-0.241	-0.24	-0.28*	-0.30*	0.34	0.37**	0.36**
NJ	-0.05	0.08	-0.22	-0.38**	-0.20	-0.07	-0.07	0.00	0.21	0.37**	0.38	0.39**
ES/D	-0.69*	0.38*	-0.18	0.11	0.11	-0.27	-0.27*	0.04	-0.25	0.36**	0.39**	0.40

*. Correlation is significant at 0.05 level

**. Correlation is significant at 0.01 level

A - Attention

A/HP – Attention/hyperactivity problems

C/BP – Conduct/behavioural problems

CD4 - CD4 count

Correlation matrices abbreviations list:

EP – Emotional problems

FLF – frontal lobe function

HD – Duration of being on HAART

IPS - Information processing speed

M – Memory

OBD – Overall burden of difficulty

PRP – Peer relationship problems

PSB –Prosocial behaviour

SA – Spatial ability

SP – School performance

VA – Visual ability

IFC –Inappropriate fear of contagion/resulting avoidance

NJ –Negative judgments about people living with HIV

ES/D – Enacted Stigma/discrimination

Hypothesis 3A and 3B: In testing hypotheses 3A and 3B, which stated that there will be a significant positive relationship between CD4 count and neurocognitive functioning (for

hypothesis 3A) and CD4 count and psychosocial functioning (hypothesis 3B), Pearson's product moment correlation was used.

There was no significant positive relationship was found between CD4 count and the neurocognitive domains of attention, information processing speed, memory, visual ability, spatial ability, frontal lobe function and school performance, thus the hypothesis was not supported for any of the neurocognitive domains (Results are shown in table 20).

In testing for hypothesis 3B which stated that there will be a significant positive relationship between CD4 count and psychosocial functioning, Pearson's product moment correlation was calculated. The results did not show a significant positive relationship between CD4 count levels and emotional problems, conduct/behavioural problems, attention/hyperactivity symptoms, peer relationship problems, prosocial behaviour, inappropriate fear of contagion/resulting avoidance, negative judgments about people living with HIV/Aids and enacted stigma/ discrimination, therefore the hypothesis was not supported for CD4 count and psychosocial functioning.

However, a significant positive relationship was found between emotional problems and peer relationship problems [$r = 0.339, \rho < 0.05$], conduct/behavioural problems and peer relationship problems [$r = 0.355, \rho < 0.05$], conduct/behavioural problems and overall burden of difficulties [$r = 0.515, \rho < 0.01$], peer relationship problems and overall burden of difficulties [$r = 0.314, \rho < 0.05$], attention/hyperactivity problems and overall burden of difficulties [$r = 0.313, \rho < 0.05$], inappropriate fear of contagion/resulting avoidance and negative judgments about people living with HIV [$r = 0.372, \rho < 0.01$] and finally, between inappropriate fear of contagion/resulting avoidance and enacted stigma/discrimination [$r = 0.361, \rho < 0.01$] (Results are shown in Table 20).

Testing of Hypotheses 4A and 4B: In testing for Hypothesis 4A and 4B which stated that there will be a significant negative relationship between duration of being on HAART and the rate of neurocognitive deficits (for hypothesis 4A) and duration of being on HAART and psychosocial difficulties (hypothesis 4B, Pearson's product moment correlation was calculated.

There was no significant negative relationship found between the duration being on HAART and rate of cognitive deficits for all the neurocognitive domains of frontal lobe function, information processing speed, attention, visual ability, spatial ability and school performance. In effect, the duration of being on HAART did not make a difference between groups therefore the hypothesis was not supported for HAART duration and the rate of neurocognitive decline (Results are shown in Table 20).

For hypothesis 4B which stated that there will be a significant negative relationship between the duration of being on HAART and psychosocial difficulties, a significant negative relationship was found between the duration of being on HAART and enacted stigma/discrimination [$r = -0.691, \rho < 0.01$].

However, no significant negative relationship was found between HAART duration and emotional problems, HAART duration and conduct/behavioural problems, HAART duration and attention/hyperactivity problems, HAART duration and peer relationship problems, HAART duration and prosocial behaviour, HAART duration and inappropriate fear of contagion/resulting avoidance and HAART duration and negative judgments about people living with HIV/Aids. Thus, the hypothesis was supported for only the duration of being on HAART and enacted stigma/discrimination as a measure of psychosocial functioning (Results are shown in Table 20).

Summary of findings:

The study tested six main hypotheses to assess the neuropsychological functioning of pediatric HIV patients. The summary of findings are presented below:

Hypothesis 1 which stated that HIV positive will perform poorer as compared to their healthy controls with respect to neurocognitive functioning (attention, speed of information processing, memory, visual ability, verbal ability, and school performance) was partly supported.

HIV infection was found to negatively affect attention and speed of information processing in the affected children.

Hypothesis 2 which stated that HIV positive will perform poorer as compared to their healthy controls with respect to psychosocial functioning (absence of emotional, behavioural problems and exhibition of prosocial behaviour) was also partly supported.

HIV infection was found to have adverse effects on the psychosocial functioning of affected children particularly with respect to the overall burden it places on their emotions, attention and ability to relate to other people more appropriately.

Hypothesis 3 which stated that the CD4 count of affected children will have a significantly positive relationship with neurocognitive functioning was not supported.

The CD4 count of affected children in this sample did not have a significantly positive relationship with their level of neurocognitive functioning .

Hypothesis 4 which stated that the CD4 count of infected children will have a significant negative relationship with the extent of psychosocial difficulties experienced was not supported.

The CD4 count of infected children was not found have a significantly negative relationship with the extent of psychosocial difficulties experienced in this sample.

Hypothesis 5 which stated that the duration of being on HAART will have a significant positive relationship with neurocognitive functioning was not supported.

The duration of being on HAART was not found to have a significantly positive relationship with neurocognitive functioning among this sample.

Hypothesis 6 which stated that the duration of being on HAART will have a significantly negative relationship with the extent of psychosocial difficulties experienced was also partly supported.

The duration of being on highly active antiretroviral therapy was found to have a significant negative relationship with psychosocial difficulties experienced as a result of enacted stigma/discrimination but not the other measures of psychosocial functioning (emotional problems, peer relationship problems, prosocial behaviour etc).

CHAPTER FIVE

DISCUSSION, RECOMMENDATIONS AND CONCLUSION DISCUSSION

This study sought to establish the differences between the HIV infected children and the healthy controls on frontal lobe function, attention, memory, visual ability, spatial ability, information processing speed and school performance with respect to neurocognitive functioning and emotional problems, conduct/behavioural problems, attention/hyperactivity problems, peer relationship problems, prosocial behaviour and stigma with regards to psychosocial functioning. The major findings are discussed as follows:

The relationship between HIV sero-positive status and neurocognitive functioning

When compared with healthy controls, children who are infected with HIV had lower scores on attention and the speed of information processing as compared to the healthy controls. This finding is in line with previous studies which made the assertion that HIV infection impairs attention and information processing speed in affected individuals (Cysique, Franklin, Chuan, Wu, Taylor et al, 2010; Robertson, Nakasujja, Wong, Musisi, Sacktor et al, 2007, Loveland & Stehbens, 1990). A possible explanation for this observation is that the HIV virus does not directly damage the part of the brain (cerebrum) responsible for how information is processed but what it does is to jeopardize the health and function of the nerve cells thus impairing the speed or efficiency with which information presented to the child is processed.

However, no significant differences were found between HIV infected children and healthy controls for the other neurocognitive domains/constructs of memory, visual ability, spatial ability, frontal lobe function and school performance as was found in another study by Puthanakit, Aurpibul, Louthrenoo, Tapaya, Nadsasran et al (2010). Most of the children who

were infected with the HIV had relatively high levels of CD4 count per milliliter of blood and High CD4 count levels as a result of effective HAART management leading to a relatively reduced risk of cognitive deficits. In the research by Puthanakit et al (2010), the HIV infected children were born when antiretroviral therapy was not widely available in Thailand therefore they had advanced disease. More than half had experienced clinical category B and C symptoms and had very low CD4% prior to receiving treatment thus their findings might have been biased towards severely poor neurocognitive functioning status such that the children in the case group showed a lot of deficits on the neuropsychological tests assessing attention, memory, verbal learning and executive functioning in comparison to the healthy controls.

Further, the claim that there will be a significant positive relationship between CD4 count and neurocognitive functioning domains of attention, memory, visual ability, spatial ability, frontal lobe function, information processing speed and school performance could not be found for this study. This was in contradiction to the findings of Puthanakit, Aurpibul, Louthrenoo, Tapaya, Nadsasran et al (2010); Thomadis, Bertou, Critseles, Vassiliki, Spoulou et al (2010) . Possibly, the relatively small sample size that was obtained was the reason why a significant positive relationship was not found for these neurocognitive domains in this present study, because the differences were too small to be noticed.

There was also no significant negative relationship found between the duration of being on HAART and rate of cognitive decline for all the neurocognitive domains of frontal lobe function, information processing speed, attention, visual ability, spatial ability and school performance. The HIV sero-positive children in this current study had been on HAART for an average of five years. Typically, HIV positive children who are not managed on HAART in the early years of infection will show poor cognitive development etc. Most of these pediatric HIV patients had

been on the antiretrovirals for the most part of their life and thus due to the effectiveness of their HAART management and relatively high percentage of CD4 count cells per milliliter of blood, the virus could not significantly affect the parts of the brain responsible for these cognitive domains.

The relationship between HIV sero-positive status and psychosocial functioning:

The claim that HIV infected children would have more problems of psychosocial functioning as compared to the healthy controls was partly supported. This was measured by five subscales of the strengths and difficulties questionnaire (SDQ) on which a total score was obtained for the overall burden of difficulties following aggregation of the subscale scores. We also found a significant difference between the HIV infected children and the healthy controls on stigma regarding fear of contagion/resulting avoidance and enacted stigma/discrimination as measured by the HIV stigma survey module (HSSM) and their overall difficulties with emotions, concentration, behaviour or being able to get on with other people. This is in support of the findings of (Thomadis, Bertou, Critseles, Vassiliki, Spoulou et al, 2010; Battuta, 2009). As compared to their healthy counterparts, the HIV infected individuals had experienced more difficulties with their emotions and peer relationships and had experienced more HIV stigma related strife.

However, on some of the psychosocial subscales of functioning on both the SDQ and HSSM, there was no significant difference between children infected with HIV and healthy controls. These include, conduct and behavioural problems, and attention/hyperactivity problems on the SDQ and negative judgments about people living with HIV on the HSSM (2008). The expectation was that, as children are infected with HIV and continue to live with the illness, they are likely to suffer some challenges with their emotional well-being, attention and ability to

relate to other people in a socially acceptable manner because they may experience HIV related stigma in one form or another. Our findings however did not support this entirely. A number of reasons can be deduced for this unexpected finding. First, children who are infected with HIV may not feel responsible for the illness because they had acquired the infection through no fault of theirs. Most of them had been infected perinatally (acquired it from their mothers through birth).

Thus, a possible explanation for why the HIV infected children did not experience stigma with respect to negative judgments about people living with HIV is that they did not feel responsible for their condition (mode of acquisition of their retropositive status). Secondly, some of them knew that they were sick and had to constantly be on medication but did not really know that they were retro positive (had HIV). For some reason, both parents and medical staff withhold disclosure information from these children ostensibly to protect them from public ridicule and possibly stigmatization. This was especially true for younger participants in the case group.

The claim that there will be a significant positive relationship between CD4 count and psychosocial functioning was also not supported. No significant relationship was found between CD4 count levels and emotional problems, attention/hyperactivity symptoms, prosocial behaviour, inappropriate fear of contagion/resulting avoidance and negative judgments about people living with HIV/Aids

In the present study, a significant negative relationship had been found between the duration of being on HAART and enacted stigma/discrimination. This is in support of the findings of the study by (Thomadis, Bertou, Critseles, Vassiliki, Spoulou et al, 2010; Battuta, 2009).

However, no significant negative relationship was found between the duration of being on HAART and emotional, conduct/behavioural problems, attention/hyperactivity problems, peer relationship problems, prosocial behaviour and negative judgments about people living with HIV/Aids. This was in contradiction to the findings of Cysique, Franklin, Morgan, Chuan, Wu, Taylor et al, (2010) in their study of the neurobehavioural effects of HIV-1 infection in China and the United States. These researchers had found very significant relationships between HAART duration and conduct/behavioural problems, attention/hyperactivity problems, peer relationship problems, prosocial behaviour.

Significant positive relationships were however found between the measures of the psychosocial functioning themselves. The significant positive relationships were found between emotional problems and peer relationship problems, conduct/behavioural problems and peer relationship problems, conduct/behavioural problems and overall burden of difficulties, peer relationship problems and overall burden of difficulties, attention/hyperactivity problems and overall burden of difficulties, inappropriate fear of contagion/resulting avoidance and negative judgments about people living with HIV and finally, between inappropriate fear of contagion/resulting avoidance and enacted stigma/discrimination. This seems to confirm that psychosocial difficulties are interrelated and encompass emotional, behavioural and social functions.

Limitations of the current study

The most significant limitation of this study was the sample size obtained for both cases and controls. The researcher was only able to get just a little above half of the original sample size projected for the data collection. This was due to time constraints and difficulty in getting people to consent to being a part of the study.

Further, the sample size of forty-two (twenty cases and twenty-two controls) which may be justified in the scope of clinical studies reduces the generalizability of the findings. Perhaps a larger sample size would have been able to capture more accurately the scope of neurocognitive and psychological difficulties of pediatric HIV patients receiving HAART.

Another important limitation worth noting is the fact that the study was primarily quantitative. Concepts like stigma, emotional and behavioural difficulties are better understood when patients are allowed to express themselves through the use of the interview method. Future researches can thus employ the mixed method approach (using both quantitative and qualitative data) to be able to assess these concepts more adequately.

Further, there is a need to develop local neuropsychological scales/measures to measure these constructs in the Ghanaian context. All the measures used in the present study are foreign except the literacy and numeracy test.

Notwithstanding all these limitations, this study fills in some research gaps in HIV studies relating stigma to neurocognitive and psychosocial functioning particularly in the case of Ghana and may serve as a good and valid basis for future research.

Recommendations for Clinical practice

The main findings from this study confirm that HIV infection affects attention, speed of information processing and some aspects of psychosocial functioning. Central to these findings are predictors like duration of being on HAART, CD4 count levels, nutrition, adherence to antiretroviral treatment regimens and the availability of psychosocial support from caregivers. Owing to these challenges, effective HAART management and the clinical management skills of

professionals have to be upgraded to include skills required to screen subtle deficits, control these deficits and to be able to manage them effectively in situations in which they have reached significant levels of dysfunction.

Thus it would be useful to add neuropsychological screening tests where available to the routine care of individuals living with HIV/Aids. This integration between medical and neuropsychological care will call for an intensive training and upgrading of technical knowledge among clinicians.

In the same vein, professional bodies and training institutions offering psychology at all levels as well can incorporate and trains students under their tutelage and other researchers on the psychological burden that chronic illness places on the general wellbeing of those affected by them. This to a greater degree will afford future clinicians the need to be well grounded in the scope and expertise for handling all aspects of psychological challenges that patients have to grapple with.

In line with the behavioural and social burden that HIV places on people, clinicians will have to draw up comprehensive management programmes/plans that will include the families of patients. This will not only improve the overall psychosocial functioning of patients but will also help their caregivers to better understand the condition and be more supportive of their relatives living with the condition.

Directions for future research

Based on the findings of the current research;

Brain/imaging scans such as MRI and CT scans can be added as part of data collection process to identify the specific areas of brain damage associated with the neurocognitive deficits.

An additional number of cases with other chronic conditions like Sickle cell and Diabetes can be added so as to be able to make comparisons across different chronic conditions.

Nutritional measures may also be added as part of the data collection instruments as these may be significant in the manifestation of HIV secondary malignancies and complications.

It may also be helpful to recruit only patients that have full disclosure of their HIV seropositive status in order to be able to assess their subjective experience of HIV related stigma.

A critical look at the role spirituality plays in affecting the quality of life and other functioning of people living with HIV can be examined.

Future studies can also take/add a qualitative approach in examining the psychosocial functioning of people living with HIV in addition to the quantitative approach usually employed with the condition especially because it is chronic and lifelong.

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Conclusion

HIV/Aids is one of the most alarming chronic conditions globally, that poses several public health concerns across different age groups. This is especially true of Sub-Saharan-African countries where widespread access to HAART is still a bit of a challenge (CDC, 2008). Although, HIV infection has shown a constant increase over three decades in Ghana (GAC, 2013), little is known about the neuropsychological functioning of pediatric HIV patients in the country. Considering the efforts of the Ghanaian Ministry of Health to provide medical treatment for individuals living with HIV, research into their neuropsychological functioning will increase the effectiveness of HIV health care delivery in Ghana and other Sub-Saharan countries particularly with respect to any emotional, behavioural or social difficulties they may experience as a result of the disease progression.

The present study sought to examine the neurocognitive and psychosocial functioning of pediatric HIV patients in Ghana. Results from the current research showed that HIV infection significantly affects attention and speed of information processing in affected children.

In addition, HIV infection also significantly affected certain aspects of the psychosocial functioning particularly with respect to overall difficulties with stigma in reference to fear of contagion/resulting avoidance and enacted stigma/discrimination and emotional issues, concentration and relating to other people appropriate ways.

Further, the duration of being on HAART was significantly related to the psychosocial functioning of HIV infected children in that the longer the duration of being on HAART, the lesser the difficulties they experienced with respect to psychosocial functioning. Thus, the importance of effective HAART management in pediatric HIV patients cannot be overemphasized.

Despite the fact that this research has some significant limitations, the outcome of the research has implications for both clinical management of those affected and future HIV research.

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APPENDICES

Appendix I: Ethical Clearance by NMIMR

Appendix II: Introductory letter by the Department of Psychology

Appendix III: Consent form of the study

Appendix IV: Assent form of the study

Appendix V: Case Record Form