An assessment of WISC-III^{UK} on children with HIV infection

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Abstract

The Wechsler Intelligence Scale for Children – Third Edition UK test was administered to groups of children between the ages of 6 and 12 years with vertically transmitted HIV infection ($n=70$) and a control group who were not infected by the virus ($n=70$). The study was conducted in India. The two groups were matched for general verbal abilities, age and gender. The children were assessed for Verbal IQ, Performance IQ and Full-Scale IQ. The Verbal Comprehension Index, Perceptual Organization Index and Freedom from Distractibility Index were also obtained. A three-factor analysis of variance disclosed that school-age children with vertically transmitted HIV infection notched below in the areas of Verbal IQ, Performance IQ, Full-Scale IQ, Verbal Comprehension Index, Perceptual Organization Index and Freedom from Distractibility Index when collated with normal uninfected cohorts. Findings are discussed in the light of both theoretical and clinical implications.

Keywords

HIV infection, intellectual ability, neuropsychological effects, Wechsler Intelligence Scale for Children – Third Edition UK

Introduction

Most children suffer from HIV disease unknowingly, involuntarily or due to circumstances. Children with HIV have been infected through mother-to-infant (vertical transmission) or through contaminated blood or blood products (horizontal transmission) and sometimes with no specific risk factors. The term vertical transmission refers to infection of children from the mother, which happens either in uterus, during the birth process, or through breastfeeding.

According to the Global Action Programme (GAP) report (UNAIDS, 2014), an estimated 3.2 million children in 2013 were living with HIV infection worldwide, most of these children having acquired it through vertical transmission. The World Health Organization (WHO)/Joint

United Nations Programme for HIV/AIDS (UNAIDS)/United Nations Children's Fund (UNICEF) (2011) quoted that an estimated 390,000 children became newly infected with HIV in 2010. Most children live with HIV/AIDS – almost 9 in 10 – live in sub-Saharan Africa, the region of the world where AIDS has taken its greatest toll.

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India has the third largest number of people in the world living with HIV/AIDS, totalling 2.3 million adults and 115,000 children. In most recent reports, the National AIDS Control Organization (NACO) estimates that about 57,000 children are infected each year with HIV/AIDS; however, 64,000 children living with HIV/AIDS are registered and 22,837 are on antiretroviral therapy (ART), and the high prevalence states are concentrated in the south of India, namely, Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra and the north-eastern states of Nagaland and Manipur (United States Agency for International Development (USAID, 2012).

The detrimental effects of children suffering from HIV infection have impeded normal development. Children with HIV infection have displayed delays in cognition and performance as compared to their normal cohorts (Mellins and Ehrhardt, 1994; Nozyce et al., 1994). The frequency and spectrum of neurologic impairment are greater in children than those reported for adults. In a study conducted by Pearson et al. (2000), 722 ART-naïve children with symptomatic HIV infection were assessed at study entry and at later intervals. Assessments included neuro-developmental testing, neuro-radiologic imaging and neurological examination of motor function. CD4 cell count and plasma RNA viral load were also measured (Centers for Disease Control, 1994). The results showed that children with the lowest neuropsychological functioning ($IQ < 70$) at baseline had the highest risk of later HIV disease progression (56%), compared with those with borderline/low ($IQ = 70-89$) functioning (26%) or with average or above ($IQ > 90$) functioning (18%). Motor dysfunction (especially reduced muscle mass) at entry also predicted disease progression. These findings have important implications for predicting long-term outcomes (e.g. longevity) in paediatric patients. The main neurological condition related to HIV infection in childhood is HIV-associated progressive encephalopathy, which may be the initial presenting condition for AIDS in 18 per cent of cases, affecting 30 per cent to 60 per cent of

seropositive infants, children and adolescents at any time of their disease. HIV-associated progressive encephalopathy causes neuropsychological deficits involving a wide variety of domains, such as speed and language, memory, learning, information processing and motor functioning. They may negatively affect children's normal development and school achievement (Millana-Cuevas et al., 2007).

Epidemiological research has shown that there are critical differences in disease progression between children and adults. Largely due to the lower efficiency of a child's immature (but developing) immune system, children experience a much more rapid disease progression and a much shorter duration of each stage of HIV disease. In the absence of any intervention, the majority of perinatally HIV-infected children develop HIV-related symptoms by 6 months of age (Spira et al., 1999). Studies in resource-constrained countries indicate that the risk of death in untreated HIV-infected infants is 45 per cent at 2 years and 62 per cent at 5 years (Spira et al., 1999). Delayed diagnosis of HIV infection, poor nutrition and high levels of severe bacterial, respiratory and gastrointestinal tract infections are likely reasons for the higher early mortality (Spira et al., 1999). The developmental delays in HIV-infected children can, however, also be caused by adverse rearing environment (Brown et al., 2000).

Improvements in diagnosis and treatment have extended life spans for children infected with HIV/AIDS early in the epidemic. The introduction of ART has transformed the HIV/AIDS epidemic worldwide. In every setting where ART has been used, death rates have dropped, as well as the incidence of hospitalizations and incidence of opportunistic infections in children (Fassinou et al., 2004; Gortmaker et al., 2001; Puthanakit et al., 2005). The primary goal of ART is to prevent clinical complications of HIV and to prolong the survival of HIV-infected children (Fassinou et al., 2004; Gortmaker et al., 2001; Puthanakit et al., 2005). However, among children and adolescents, a combination of therapies and essential drugs brings down the intermediate-term risk of

death, HIV-related disease progression and neurological impairments (Greenfield et al., 2013). Hence, researches on understanding their intellectual functioning and other abilities will compliment coping with their present lifestyle.

HIV is the ninth leading cause of death in children (Wolters et al., 1995). In India, studies relating to the cognitive development of children with HIV infection are yet limited in number and less well developed than in adult HIV. This research is focussed on the intellectual functioning in children with HIV infection since there is little comprehensive research. The study chose school-age children, as school-age children represent an important age group because, with improvements in ART, children live longer and healthier. Since HIV-infected children are now surviving well in their school age and adolescence, it is important to understand their intellectual functioning to plan for their educational and mental health needs. We chose to measure a broad range of cognitive skills with a comprehensive battery of tests (Wechsler Intelligence Scale for Children – Third Edition UK (WISC-III^{UK}) selected for their utility to help children to be successful at school and thereby improve their quality of life.

Method

Participants

The sample contained two groups, one with 70 children who had vertically transmitted HIV infection ranging between the ages of 6 and 12.11 years (35 males and 35 females) and the other a control group of 70 children (35 males and 35 females) who were not infected by the virus. The study was conducted in India. The primary language used to administer the test was English. The two groups were matched for age, gender and ability to communicate in English language (samples were selected from schools where English was the primary language for communication). At each age level, there were five male participants and five female participants in both the experimental and control groups that served to identify the

gender difference in intellectual functioning. Children with any physical or mental disability were excluded from the study.

Selection criteria

Children may be denied access to normal schools due to fear and stigmatization in the community (Human Rights Watch, 2004). For this reason, most children with HIV infection study in special schools. This study selected at random a sample of 70 children infected with HIV from Sneha Care Home and Shinning Star School, Bangalore, Karnataka. The children were undergoing treatment for HIV infection from Sneha Care Hospital, Bangalore. After checking medical reports, children with vertically transmitted virus (HIV-positive) were selected from Bangalore because Karnataka is one of the states in India that is worst affected by the spread of HIV with thousands of children infected with the virus. The control group included 70 HIV-negative participants at the same ages, selected at random from schools in Kerala, namely, Carmel Matha School and St Mary's School at Idukki. The normal cohorts (HIV-negative) were selected from Kerala due to time constraints and denial of permission for the study in normal schools at Bangalore. The two groups were matched for age, gender and ability in receptive and expressive communication in English. The groups only differed in their HIV status and any differences in the group in intellectual functioning on the WISC test could be attributed to their differing HIV status. Fear and discrimination in the society affect the quality of education in children with HIV infection. As a result, they were not encouraged to study in schools with normal cohorts. Alongside there is unavailability of teachers to educate these children. Hence, in most of these institutions, social workers take an initiative to educate the children. In most such institutions in Bangalore, children are provided fundamental education. These children do not follow any particular standard high school syllabus such as Indian Certificate of Secondary Education (ICSE), Central Board of

Secondary Education (CBSE) or State level. The children with HIV infection were not divided into grades according to age, but rather were divided into batches based on their abilities and capabilities. The study chose samples from lower socio-economic status (SES) for both groups, due to the lack of availability of HIV-infected children from a middle SES. Evidence indicates that education typically available with middle/higher SES groups can decrease the risk of acquiring HIV (Goldman and Smith, 2002). Moreover, studies on young HIV groups of children are sparse. The study was designed to understand the difference in intellectual functioning between HIV-positive children and normal cohorts. Furthermore, possible interaction effects of gender, group and age on intellectual functioning were considered.

Materials

The WISC-III^{UK} (Wechsler, 1991) consisting of several subtests, each measuring a different facet of intelligence, was administered to each child. Some subtests require the child to reason abstractly, some focus on the child's memory, some on perceptual skills and so forth. No single subtest is intended to provide an adequate index of intelligent behaviour. Wechsler (1944) insisted that an intelligence scale should sample broadly from the full array of cognitive abilities and thus reflect the multi-faceted characteristics of intellectual ability. The materials used for each subtest are presented in Tables 1 and 2, respectively.

The above subtests yield three composite variables: the Verbal IQ (VIQ), Performance IQ (PIQ) and the Full-Scale IQ (FSIQ).

The factor index scores were used to calculate verbal comprehension (Verbal Comprehension Index (VCI)), perceptual organization (Perceptual Organization Index (POI)) and freedom from distractibility (Freedom from Distractibility Index (FDI)).

Reliability

The reliability of a test refers to its accuracy and consistency of measurement and to the stability

Table 1. Subtests for Verbal and Performance IQ.

Verbal	Performance
Information	Picture completion
Similarities	Coding
Arithmetic	Picture arrangement
Vocabulary	Object assembly
Comprehension	Block design

Table 2. Factor Index.

Factor-1	Factor-2	Factor-3
Information	Picture completion	Arithmetic
Similarities	Picture arrangement	Digit span
Vocabulary	Block design	
Comprehension	Object assembly	

of its scores over time. The test reliabilities ranged from .80 to .97 for VIQ, PIQ, FSIQ and verbal comprehension. Reliability range for performance organization, processing speed and speed from distractibility indices was .56–.89, respectively. Inter-rater reliabilities for verbal subtests were more than .92. The reliability coefficients for the WISC-III subtests, except coding and symbol search, were estimated by the split-half method. The items on each subtest were divided into two half tests that approximated parallel forms with approximately equal variances. Scores on the two half tests were then correlated and the resulting coefficient was corrected by the Spearman–Brown formula. For coding and symbol search subtests, stability coefficients were used as reliability estimates, because measures of internal consistency, such as split-half coefficients, are inappropriate for speeded tests. These stability coefficients were obtained from the test–retest study.

Validity

The manual reports strong correlations between WISC-III metrics and comparable metrics from the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R), Wechsler Intelligence Scale for Children-Revised (WISC-R), Wechsler Adult Intelligence Scale-Revised

(WAIS-R), Otis-Lennon School Ability Test and Differential Ability Scales (*r*s between WISC-III IQs and comparable composites range from .59 to .92). Additionally, independent studies report correlations between WISC-III IQ/Indices and comparable metrics from other batteries that are well within acceptable limits. The WISC-III manual reports appropriate correlations with achievement. Studies published since test publication also report appropriate IQ achievement correlations in children representing normal, referred, learning disabled, severely emotionally disturbed, language/speech impaired and hearing-impaired/deaf clinical categories.

Procedure

Tests were administered in a quiet room at school during a single, individual session. In order to avoid biasing of performance in any test from effects of practice or fatigue, the test presentation order was counterbalanced. The verbal and performance subtests were administered in alternating order to make the test session interesting and varied. If the child refused to respond to a particular subtest, it was administered later. In particular, children were presented with a total of 11 subtests: to assess VIQ, PIQ, FSIQ, verbal comprehension (VCI), perceptual organization (POI) and freedom from distractibility (FDI).

The VIQ is the ability to analyse information and solve problems using language-based reasoning and ability to deal with abstract social conventions, rules and expressions. The PIQ measures spatial perception, visual abstract processing, problem-solving abilities and the ability to quickly perceive visual details. The FSIQ assesses a child's ability to reason abstractly given both verbal and visual prompts. The VCI is an overall measure of verbal concept formation, the child's ability to verbally reason, and is also influenced by knowledge learned from the environment. POI measures nonverbal reasoning and inductive reasoning. FDI assesses the child's attention, concentration and working memory.

Scoring procedures

Obtaining scaled scores, IQ scores and index scores

After each WISC-III^{UK} subtest was scored, each child's raw score and scaled subtest scores were obtained. The scaled score was used to calculate the VIQ, PIQ and FSIQ scores. The three-factor-based index scores were also calculated from the scaled scores. The raw score of each subtest was converted to scaled scores using the manual of WISC-III^{UK}. Scaled scores were based on the child's age in years, months and days.

The child's verbal score is the sum of scaled scores on the five regularly administered verbal subtests. The performance score is the sum of scaled scores on the five regularly administered performance subtests. The full scale score is the sum of the verbal and performance scores; hence, it is the sum of 10 subtest scaled scores. Similarly, each factor-based composite score is the sum of the scaled scores of its contributing subtests. Later, the verbal score, performance score and full scale scores were converted to their IQ equivalents. Similarly, the verbal comprehension score, perceptual organization/reasoning score and freedom from distractibility scores were converted to index scores.

Results

Construction of IQ and index scores

The sum of scaled scores (verbal, performance and full scale) were formed by summing each child's actual score on the relevant subtests and obtaining the corresponding scaled scores from the manual for scoring. For each of the seven age groups, the means and standard deviations (SDs) of the three sums of scaled score distributions were calculated. The construction of the three index scores (VCI, POI, FDI) followed the same general procedures. A review of data from age 6 to 12.11 years (both male and female) indicates higher scores for VIQ, PIQ, FSIQ, VCI, POI and FDI in normal children

Table 3. Mean and SD of the IQ and index scores of the HIV-positive and HIV-negative (normal) children.

	Female	Children	Male	Children	Total	Children
	Mean	SD	Mean	SD	Mean	SD
Verbal IQ						
HIV +tve	67.6	12.9	66.2	8.6	66.89	10.9
HIV -tve	96	8.7	101.66	6.8	98.8	8.2
PIQ						
HIV +tve	56	6.8	56.6	6.6	56	6.7
HIV -tve	76.8	4.5	76.4	5.5	76.6	5.4
FSI						
HIV +tve	58.8	9.9	59.1	8.6	59	9.2
HIV -tve	86	6.1	88.3	5.2	87.8	5.8
VCI						
HIV +tve	65.9	12.3	65.6	8.2	65.7	10.4
HIV -tve	98.2	5.6	103.2	4.1	100.7	5
POI						
HIV +tve	57.1	6.9	57.8	5.2	57.4	7
HIV -tve	76.4	5.7	103.2	4.1	100.7	5
FDI						
HIV +tve	76.2	12.1	76.2	12.7	76.2	12.3
HIV -tve	84.1	6.5	86.6	5.6	85.4	6.5

SD: standard deviation; PIQ: Performance IQ; FSI: Full-Scale IQ; VCI: Verbal Comprehension Index; POI: Perceptual Organization Index; FDI: Freedom from Distractibility Index.

(HIV negative) as compared to children with HIV infection. The study used WISC-III norms for the assessment.

The results are presented according to the various IQ and index scores. The means and SDs of the HIV-infected and normal children are presented in Table 3. The means indicate that the normal HIV-negative children performed better than the HIV-positive children on all the subtests and have higher scores on the FSIQ than the HIV-positive children.

VIQ. Figure 1 shows the performance of the children on the VIQ test.

The average VIQ scores of children aged 6, 7, 8, 9, 10, 11 and 12 years with HIV infection were 73.9, 66.1, 71.7, 63.6, 61.6, 69.2 and 62.1, respectively, whereas the corresponding figures for the normal cohorts were 97.6, 95, 97, 98.4, 99.1, 97.3 and 98.83, respectively.

The means indicate that the HIV-positive children scored significantly lower than normal cohorts on all the verbal tests except arithmetic.

Figure 1. Comparison of means of scaled scores in verbal intelligence quotient

Analysis of variance (ANOVA) computed with (2) group $\times$ (7) age $\times$ (2) gender indicates that the main effect of group was significant ($F(1, 140) = 321.171, p < .000$) revealing that HIV-positive children scored less than HIV-negative children. The interaction effect of group and age was also significant ($F(6, 140) = .993,$

Figure 2. Comparison of means of scaled scores in performance intelligence quotient.

$p < .019$). Post hoc Scheffe's test showed that the HIV-infected group has lower scores than the normal group at all ages ($p < .05$).

PIQ. Figure 2 shows the performance of the children on the PIQ test.

The average scores on PIQ for children aged 6, 7, 8, 9, 10, 11 and 12 years with HIV infection were 61.1, 55.5, 59, 54.2, 53, 57.9 and 53.4, respectively, whereas the corresponding figures for the normal cohorts were 84, 74.1, 79.4, 71.7, 76.9, 73.8 and 76.3, respectively.

The PIQ scores indicate that the HIV-positive children scored significantly lower than that of the normal children in all areas of the performance test.

ANOVA indicates that the main effect of group was significant ($F(1, 140) = 277.845$, $p < .000$) showing HIV-positive children scored less than HIV-negative children. The main effect of age was significant ($F(6, 140) = 4.168$, $p < .001$), indicating ages 6 and 9 years differed from the other age groups. The interaction of group, gender and age was also significant ($F(6, 140) = 2.404$, $p < .032$), indicating ages 6 and 9 years scored lower in the HIV group. Post hoc Scheffe's test showed that ages 6 and 9 years differ ($p < .05$).

FSIQ score. The average scores on FSIQ for children aged 6, 7, 8, 9, 10, 11 and 12 years with HIV infection were 67.8, 57.8, 62.4, 55.8, 53.9,

Figure 3. Comparison of means of scaled scores in test of verbal comprehension.

60.5 and 54.5, respectively, whereas the corresponding figures for the normal cohorts were 90.2, 83, 87.5, 86.6, 86.8, 84.2 and 91.9, respectively.

ANOVA indicates that the main effect of group was significant ($F(1, 140) = 320.867$, $p < .000$) revealing HIV-positive children scored less than HIV-negative children. The main effect of age was significant ($F(6, 140) = 2.198$, $p < .048$). Post hoc Scheffe's test showed that the HIV-infected group has lower scores than the normal group at all ages.

VCI. Figure 3 shows the performance of the children on the VCI.

The average scores on VCI for children aged 6, 7, 8, 9, 10, 11 and 12 years with HIV infection were 73.1, 64.7, 70.8, 63.8, 59.8, 67.9, 59.9 and 65.7, respectively, whereas the corresponding figures for the normal cohorts were 102.9, 99.3, 101.5, 97.7, 97.8, 96.7 and 108.8, respectively. The means indicate that the HIV children scored much lower than that of the normal children in verbal comprehension.

ANOVA indicates that the main effect of group was significant ($F(1, 140) = 421.380$, $p < .000$), showing HIV-positive children scored less than HIV-negative children. The interaction of group and age was significant ($F(6, 140) = 2.361$, $p < .035$). Post hoc Scheffe's test showed that the HIV-infected group has lower scores than the normal group at all ages ($p < .05$).

Figure 4. Comparison of mean of scaled scores in test of perceptual organization.

POI. Figure 4 shows the performance of the children on the POI.

The average scores on POI for children aged 6, 7, 8, 9, 10, 11 and 12 years with HIV infection were 63.8, 58.3, 58.2, 53.6, 52.9, 59.6 and 55.5, respectively, whereas the corresponding figures for the normal cohorts were 88, 78.9, 77.2, 70.8, 74, 72.7 and 77.7, respectively.

The means show that the HIV-positive children scored less than that of normal children in the area of POI.

ANOVA indicates that the main effect of group was significant ($F(1, 140)=206.902$, $p<.000$), showing that HIV-positive children scored less than HIV-negative children. The main effect of age was also significant ($F(6, 140)=6.056$, $p<.000$). Post hoc Scheffe's test showed that the HIV-infected group has lower scores than the normal group at all ages ($p<.05$).

FDI. Figure 5 shows the performance of the children on the FDI.

The average scores on FDI for children aged 6, 7, 8, 9, 10, 11 and 12 years with HIV infection were 76.7, 75.3, 81.4, 72.4, 75.3, 81.1 and 71.2, respectively, whereas the corresponding scores for the normal cohorts were 70.7, 75.3, 77.1, 86.3, 87.7, 101.4 and 99, respectively.

The statistics show that the HIV-positive children scored lower than that of the normal children in the area of FDI.

Figure 5. Comparison of means of scaled scores in test of freedom from distractibility.

ANOVA indicates that the main effect of group was significant ($F(1, 140)=25.994$, $p<.000$) showing HIV-positive children scored less than normal children. The main effect of age was significant ($F(6, 140)=6.299$, $p<.000$), indicating differences between ages 6, 7 and 11 years. Post hoc Scheffe's test showed that the HIV children have lower scores than the normal at ages 6, 7 and 11 years ($p<.05$).

Discussion

To date, there has been a dearth of studies using WISC to assess children with HIV infection in India. The findings of this study indicate that HIV-positive children scored less in all the subtests of the WISC-III^{UK} as compared to HIV-negative children. The results are discussed according to the factors in the test. Some of the factors that may play a vital role in the poor intellectual functioning of children with HIV-positive children are explained herewith. Stigma may prevent HIV-infected children from access to proper education, well-being, treatment and care both directly (through abuse, denial, loss of inheritance, etc.) and indirectly if the child avoids potentially stigmatizing situations such as social interaction or educational opportunities from internalizing stigma (Strode and Barrett-Grant, 2001). Second, women contact HIV through intravenous drug use or have

partners with histories of drug use, and children with HIV are at increased risk of prenatal drug and alcohol exposure and premature birth, both of which have been associated with poor cognitive outcome (Henry et al., 1996; Loebstein and Koren, 1997). At the same time, maternal illness may compromise parenting (Kotchick et al., 1997), which, in turn, can negatively affect the child's intellectual functioning. But, to the best of our knowledge, there have been no studies reflecting a detailed statistical analysis on comparison of intellectual ability in this clinical and normal child population.

This study characterizes a detailed analysis of intellectual ability between HIV-positive children and normal cohorts, focussing mainly on the areas of VIQ, PIQ, FSIQ, VCI, POI and FDI. The descriptive statistics of VIQ portrays that the ability to analyse information, solve problems using language-based reasoning and ability to deal with abstract social conventions, rules and expressions are lower in HIV-positive school-age children when compared with normal cohorts. Studies that may compliment the findings are outlined. For example, Bisiacchi et al. (2000) found that on a series of memory tests, HIV-infected youth scored significantly lower than sero-reverters including a digit span task, but again, treatment regimens were not described. Language impairments were usually found in HIV-infected children, particularly in expressive language, the presence of both expressive and receptive language dysfunction in them suggests a more fundamental impairment (Moss et al., 1998).

Similarly, HIV-positive children scored less in PIQ when matched with HIV-negative cohorts, which, in turn, illustrates that the spatial perception, visual abstract processing, problem-solving abilities and the ability to quickly perceive visual details dwindle in HIV-positive children. The interpretation of FSIQ score reflects that the HIV-negative children have a higher IQ score when compared to HIV-positive children. Evidence revealed that failure to provide items such as toys geared to teaching about shapes and colours has been shown to be associated with reduced IQ scores in children (Bradley et al., 1989). The impact of deficits in neuronal growth can also be a causal factor.

Furthermore, detailed analyses of VCI exhibited that HIV-positive children scored less as compared to normal cohorts. The HIV-positive individuals, regardless of their stages of infection, reportedly have more frequent cognitive complaints than do HIV-negative individuals (Hinkin et al., 1998). Children with HIV infection scored lower in VCI because of their lack of ability to verbally reason which, in turn, may be a consequence of an unhealthy environment. Most of the HIV-infected children were staying in care homes. Several studies suggest that in some cases of extremely adverse rearing circumstances, well-functioning child care institutions may offer children a better rearing environment than their own dysfunctional families (e.g. Miller et al., 2007). But for healthy emotional, cognitive and even physical development of children, long-term institutional care is actually inappropriate for infants and young children because they require at least one consistent and loving caregiver with whom they can form a bond (United States Agency for International Development, 2004).

Moreover, the analysis of POI indicates that HIV-positive children scored less when compared with normal cohorts. This test measures nonverbal reasoning and inductive reasoning. HIV in children has long been associated with subtle and more specific cognitive impairments, including visuo-spatial and motor integration deficits (Fundaro et al., 1998). In WISC-III, freedom from distractibility measures concentration and attention of children. The results illustrate that the HIV-positive children scored below par in FDI when examined alongside the control group. Attention dysregulation is one among major problems faced by children with HIV infection (Brouwers et al., 1994; Lindsey et al., 2007). Analysis of FDI indicates that HIV-negative children have higher scores as compared to children with HIV infection. The causal factor for cognitive issues in HIV-infected children may be due to the effects of extreme poverty and lack of opportunity for stimulation during sensitive periods of development, prenatal drug exposure, malnutrition, family stress associated with death or illness of the primary caregiver, prematurity and other

developmental disabilities unrelated to HIV (Coscia et al., 2001).

Neuropsychological impairments are more common, progress more quickly and may entail greater damage in children than in adults with HIV infection (Wachsler-Felder and Golden, 2002). However, since the introduction of combination therapies, children vertically infected with HIV have shown markedly improved immune function, appearing to exhibit global cognitive functioning comparable to their uninfected peers (Blanchette et al., 2002; Tardieu, 1998). Researchers had begun to evaluate the longitudinal efficacy of these new treatments on cognitive functioning of HIV-positive children (Gortmaker et al., 2001). Moreover, stigmatization and psychosocial distress experienced during childhood not only affect HIV-infected children's ability to capitalize on occupational and social opportunities for their own survival as adults but also have implications for their ability to contribute to national development (Sarada and Udumala, 2009).

In summary, the findings indicate that HIV-positive children scored less in intellectual functioning as compared to normal children of the same age. This investigation addresses general intellectual functioning, language functioning, spatial perception, visual abstract processing, problem-solving abilities, the ability to quickly perceive visual details, the child's ability to reason abstractly, verbal concept formation, nonverbal and inductive reasoning, concentration and working memory in HIV-positive children. This study helps future researches to identify the educational and vocational needs of children with HIV infection to bring about remedial and preventive processes.

By figuring out more precisely which cognitive ability or motor skills are most closely associated with disease progression, is helpful in making efficient use of time and resources. Since HIV-infected children live longer and develop normally like the normal children (Bisiacchi et al., 2000), reflecting on the multifaceted characteristics of intellectual ability in HIV-infected children in the study provides an insight to the type of interventions that will

assist HIV-infected children for successful academic careers. The study chose school-age children as they are in the formative stages of their lives, and therefore, understanding their intellectual abilities can assist their future development. A concentrated multidisciplinary approach in diagnosing and treating may enable the HIV-positive children to reach pinnacles of excellence.

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