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The Impact of Perinatal HIV Infection on Older School-Aged Children's and Adolescents' Receptive Language and Word Recognition Skills

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Abstract

Perinatally HIV-infected youths are reaching adolescence in large numbers. Little is known about their cognitive functioning. This study aims to describe and compare the receptive language ability, word recognition skills, and school functioning of older school-aged children and adolescents perinatally HIV infected (HIV-positive) and perinatally HIV-exposed but uninfected (seroreverters; HIV-negative). Participants included 340 youths (206 HIV-positive, 134 HIV-negative), 9–16 years old, and their caregivers. Youths completed the Peabody Picture Vocabulary Test, Third Edition (PPVT-III) and the Reading Subtest of the Wide Range Achievement Test, Third Edition (WRAT-3). Caregivers were interviewed regarding demographic characteristics and school placement of youths. Medical information was abstracted from medical charts. Both groups of youths scored poorly on the PPVT-III and WRAT-3 with about one third of youths scoring in less than the 10th percentile. The HIV-positive youths scored lower than the seroreverters (M = 83.8 versus 87.6, $t = 2.21$, $p = 0.028$) on the PPVT-III and on the WRAT-3 (M = 88.2 versus 93.8, $t = 2.69$, $p = 0.008$). Among the HIV-positive youths, neither $CD4^{+}$ cell count, HIV RNA viral load or Centers for Disease Control and Prevention (CDC) classification were significantly associated with either PPVT-III or WRAT-3 scores. However, youths who were taking antiretroviral medication had lower WRAT-3 scores than youths not taking medication (M = 95.03 versus 86.89, $t = 2.38$, $p = 0.018$). HIV status remained significantly associated with PPVT-III and WRAT-3 standard scores after adjusting for demographic variables. Many youths had been retained in school and attended special education classes. Findings highlight poor language ability among youths infected with and affected by HIV, and the importance of educational interventions that address this emerging need.

Introduction

With the advent of antiretroviral treatment (ART), children living with perinatal HIV infection are reaching adolescence in large numbers. For example, in New York City, more than 67% of living persons diagnosed with HIV infection before 13 years of age are currently 13 years of age or older.[1] These youths are primarily ethnic minorities living in impoverished, urban communities who contend with multiple stressors that place them at risk for poor cognitive functioning (e.g., exposure to substances *in utero*, attendance at schools in "poor performance districts," comorbid behavioral problems, inconsistent school attendance because of poor health or health care appointments). From the beginning of the epidemic, there have been consistent findings of significant neurologic, developmental, cognitive, and language deficits in HIV-infected (HIV-positive) infants and younger children.[2–6] Clinical reports indicate that older school age perinatally HIV-infected children present with significant learning problems affecting their academic performance, developmental milestones, and ability to function independently.[7] However, little is known about the cognitive functioning, reading ability, or school performance of perinatally HIV-infected adolescents. One study by Kullgren and colleagues[8] that included adolescents found cognitive, adaptive, as well as behavioral delays in HIV-positive youths compared to normative samples. Unfortunately, their sample of 67 youths ranged in age from 3–16 years with a mean of 6.7

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years. Similarly, Jeremy and colleagues[8a] found poor neuropsychological functioning in HIV-positive children and adolescents (4 months to 17 years) compared to established norms and that neuropsychological functioning was worse for children with higher viral loads. However, a limitation of the study was the author's inability to look at specific age groups and the lack of an appropriate control group. Bisiacchi and colleagues[8b] compared a sample of 29 perinatally HIV-infected children and adolescents and 13 seroverters (6–15 years), and found significant differences in executive functions in HIV-positive children compared to seroreverters. Also despite the documentation of longer lifespan among perinatally HIV-infected youth, little has been published on the school experiences of older HIV-positive children and adolescents. Mialky and colleagues[8c] found that among 85 school-age children (5–18 years, mean = 9.9 years), 85% were attending public schools, 3% were in private schools, and 2% were home schooled. Five children were attending special education classes at the time of the study, 23.5% had repeated at least one grade, and 52% were receiving some special services in their school such as resource room ($n = 10$), physical therapy ($n = 5$), tutoring ($n = 4$), speech therapy ($n = 3$), and accelerated courses ($n = 2$).

As children transition to early and middle adolescence, it becomes increasingly clear that language and reading skills are the critical building blocks for literacy and future academic success[9–12] with an important transition from "learning to read and reading to learn."[13] Poor educational achievement, including delayed reading and language skills in youth perinatally infected with HIV may have implications for their ability to understand their illness and its treatment, to adhere to complex medication regimens, and to make decisions about sexual and/or drug risk behaviors.[14–16] For example, studies of HIV-positive adults have found that those who were cognitively compromised or had low levels of health literacy had greater difficulty with adherence, particularly when the regimen was complex.[15–16a] As perintally HIV-infected youths age and assume more responsibility for their own health care, they too will require a degree of health literacy that, if not present, may seriously impede their capacity to effectively manage their disease.

In summary, although there are a number of studies demonstrating neurocognitive and language deficits in HIV-positive infants and young children, particularly in the domain of expressive language.[17–19] The data on preadolescents and older adolescents are limited. The few studies that exist cover too large an age range, do not focus on adolescents, or do not have appropriate control groups. Moreover, the language and reading skills of HIV-positive adolescents have not specifically been described. It is unclear whether early discrepancies between HIV-positive and HIV-negative children persists over time or whether they might be diminished with age and improved health. Such information will be helpful to plan psychoeducational interventions for the growing population of older, perinatally HIV-infected youths. Using baseline data from Project CASAH (Child and Adolescent Self-Awareness and Health Study), one of the largest U.S.-based studies of psychosocial determinants of behavior in a sample composed of both perinatally HIV- infected youths and perinatally HIV-exposed, but uninfected youths (seroreverters; HIV-negative) with similar age and demographic backgrounds, the goal of this study is to conduct secondary data analysis using two brief screening tools to describe and compare the receptive vocabulary skills, word decoding ability, and school achievement in both groups.

Methods

Participants and procedures

Participants include 206 perintally HIV-infected older school-aged children and adolescents and 134 seroreverters, and their 340 primary caregivers. Inclusion criteria are (1) ages 9 to 16 years perinatally exposed to HIV, (2) English-speaking, (3) caregivers speak English or Spanish; and (4) caregiver with legal capacity to consent for the child's participation. Both adolescents who had and had not been formally told of their HIV status were included. During the study recruitment period (2003–2007), of 443 eligible participants, 11% refused contact with the research team and 6% could not be contacted by the study coordinators. Of 367 (83% of 443) approached to participate in the study 340 caregiver/youth dyads (93% of 367) enrolled. New York State confidentiality laws preclude data collection on families who refused participation. Participants were recruited from four urban medical centers in New York City. Two sources of data were collected: (1) caregiver and youth interviews and (2) medical chart abstractions for HIV-positive youth. Caregivers and children were interviewed simultaneously but separately during two 60- to 90-minute sessions (approximately 1 month apart). Among the 340 caregiver/youth dyads enrolled, 96% completed both interview sessions. Since the data for this analysis were derived from the second interview session the study cohort included 325 caregiver/youth dyads.

This study received local Institutional Review Board approval and was compliant with the Health Insurance Portability and Accountability Act (HIPAA) of 1996. All caregivers provided written informed consent for themselves and youths and youths provided written assent. Monetary reimbursement for time and transportation was provided.

Assessments

Child receptive language ability and word recognition skills. The Peabody Picture Vocabulary Test (PPVT-III), is a widely used, well-validated test of receptive language abilities.[20] The examiner reads each word aloud; the child chooses which of four pictures best illustrates the word. Standard scores range from 40–160. Research shows a strong correlation between the total score of the PPVT-III and the Full Scale IQ ($r = 0.90$) and Verbal IQ scores ($r = 0.91$) from the Wechsler Intelligence Scale for Children.[20] The PPVT-III was also validated using the Kaufman Adolescent and Adult Intelligence Test.[20] The Wide Range Achievement Test (WRAT-3)[21] measures the development of reading, spelling, and arithmetic skills for individuals ages 5–75 years. For this study, we used the reading subtest of the WRAT-3, which focuses on specific coding skills: Reading—recognizing and naming letters and pronouncing printed words. The child is asked to read up to 42 words aloud. Standard scores range from 45–155. The information presented in the technical manual provides adequate psychometric properties of the WRAT-3.[21]

Demographics. Caregivers were asked about child and caregiver age, gender, ethnic identity, education, work status of caregiver, as well as family income.

TABLE 1. CHARACTERISTICS OF YOUTHS AND THEIR PRIMARY CAREGIVERS BY CHILD HIV STATUS

	Total Sample n *(% of 325)*	*HIV-positive* n *(% of 196)*	*Seroreverters* n *(% of 129)*
Child Variables			
Race/Ethnicity			
African American	180 (55)	114 (58)	66 (51)
Latino	96 (30)	58 (30)	38 (30)
Age			
9–10	100 (31)	51 (26)	49 (38)
11–12	77 (24)	50 (26)	27 (21)
13–14	90 (28)	58 (30)	32 (25)
15–16	58 (18)	37 (19)	21 (16)
Female	164 (51)	99 (51)	65 (50)
Current grade in school			
2nd–4th	75 (23)	38 (19)	37 (29)
5th–6th	86 (27)	55 (28)	31 (24)
7th–8th	90 (28)	58 (30)	32 (25)
9th–12th	73 (23)	44 (22)	29 (23)
Caregiver Variables			
Relationship to child[a]			
Biologic parent	160 (49)	70 (36)	90 (70)
Relative caregiver	73 (23)	53 (27)	20 (16)
Nonrelative caregiver	92 (28)	73 (37)	19 (15)
HIV infected[a]	149 (46)	61 (31)	88 (68)
Race/Ethnicity			
African American	167 (51)	101 (52)	66 (51)
Latino	116 (36)	72 (37)	44 (34)
Age[b]			
19–29	13 (4)	7 (4)	6 (5)
30–39	68 (21)	30 (15)	38 (30)
40–49	114 (35)	67 (34)	47 (36)
50–59	61 (19)	47 (24)	14 (11)
60–82	69 (21)	45 (23)	24 (19)
Female	284 (87)	170 (87)	114 (88)
Education			
0–9th grade	64 (20)	34 (17)	30 (23)
10th–12th grade	84 (26)	52 (27)	32 (25)
>High school	175 (54)	109 (56)	66 (52)

HIV-positive vs. HIV-negative [a]$p < 0.001$; [b]$p < 0.05$.
Due to missing data, some values do not sum to the total *N*s listed. Due to rounding, percentages may not sum to 100.

School-related characteristics. Caregivers were asked about school placement of youth (regular education class versus special education class), and whether the youth had ever skipped a grade, been held back, suspended or expelled.

Child health status. $CD4^+$ lymphocyte count (cells/mm^3), HIV RNA viral load (copies per milliliter), and clinical disease category according to CDC classification system for the closest date to the research interview were obtained through medical record abstraction for the HIV-positive youths. Based on variation in assay methodology all viral load 100,000 or more copies per milliliter were coded as 100,000 copies per milliliter and all values 400 or less copies per milliliter were coded as undetectable. In addition, caregivers of HIV-positive youths were asked whether their child was taking antiretroviral therapy.

Data analyses

HIV-positive youths and seroreverters were compared on demographic variables, PPVT-III, WRAT-3, and school-related characteristics. χ^2 tests were used for dichotomous and categorical variables, and t tests were used for continuous variables. Variables such as age and education have been categorized for presentation in the tables, but were retained in their original continuous form for t test analyses. In addition, multivariate regression analyses were conducted to test the association between HIV status and PPVT-III/-WRAT-3 standard scores while adjusting for demographic variables.

Results

The vast majority of demographic variables were similar between HIV-positive youths and seroreverters including child race/ethnicity, age, gender, and grade in school (Table 1). Significantly fewer HIV-positive youths were living with a birth parent (36% versus 70%; $\chi^2 = 36.9$, $p < 0.001$), and thus, by definition, an HIV-positive caregiver (31% versus 69%; $\chi^2 = 42.9$, $p < 0.001$). Also, HIV-positive youths had older caregivers than seroreverters ($t = -2.54$, $p = 0.01$).

Among the HIV-positive youths, the mean $CD4^+$ cell count was 602 (median = 572, standard deviation [SD] = 317) and only 10% had $CD4^+$ less than 200 cells/mm^3. The median HIV RNA viral load was 3150 copies per milliliter (mean = 14,722; SD = 25,516); 34% had undetectable viral loads ($\leq$400 copies per milliliter) and only 5% had viral load values 100,000 or more copies per milliliter. The majority of HIV-positive youths were taking antiretroviral medications (84%).

Receptive language ability

Among the total sample, the mean PPVT-III standard score was 85.3 (Table 2). PPVT-III percentile scores ranged from less than 1st to 96th percentile; 60% of all youths scored below average (<25th percentile) and 37% scored less than 10th percentile. Among the HIV-positive youths, the mean standard score was 83.9 and PPVT-III percentile scores ranged from less than 1st to 96th percentile. Sixty-two percent scored below average (<25th percentile) and 39% scored less than 10th percentile. Among the seroreverters, the mean PPVT-III standard score was 87.5 and PPVT-III percentile scores ranged from less than 1st to 86th percentile. Fifty-six percent of the seroreverters scored below average (<25th percentile) and a third (34%) scored less than 10th percentile. The HIV-positive youths scored significantly lower (M = 83.8) than the seroreverters (M = 87.6) on the PPVT-III ($t = 2.21$, $p = 0.028$).

Word recognition

Among the full sample, the mean WRAT-3 score was 90.5 and WRAT-3 percentile scores ranged from less than 1st to100th percentile. Half of youths (49%) scored below average (<25th percentile) and 28% scored less than 10th percentile. Among HIV-positive youths, the mean WRAT-3 score was 88.3 and WRAT-3 percentile scores ranged from less than 1st to 97th percentile. Half of the HIV-positive youths (54%) scored below average (<25th percentile) and a third (33%) scored less than 10th percentile. Among the seroreverters, the mean WRAT-3 score was 93.8 and WRAT-3 percentile scores ranged from less than 1st to 100th percentile. Forty percent

Table 2. PPVT and WRAT Scores by Child HIV Status

Child variables	*Total sample* n = *322*[a]	*HIV-positive* n = *196*	*Seroreverters* n = *129*
PPVT			
Mean standard score (SD)[b]	85.30 (14.39)	83.82 (14.81)	87.55 (13.47)
Range	22–127	22–127	59–116
Mean percentile score (SD)	24.08 (22.44)	22.09 (21.16)	27.10 (24.03)
Range	0–96	0–96	0–86
WRAT-3			
Mean standard score (SD)[c]	90.44 (18.02)	88.23 (17.92)	93.77 (17.72)
Range	44–139	44–128	44–139
Mean percentile score (SD)[c]	34.30 (30.08)	30.54 (29.66)	39.97 (29.93)
Range	0–100	0–97	0–100

[a]Note. 2 youths refused to complete the WRAT-3.
HIV-positive vs. Seroreverters; [b]$p < 0.05$; [c]$p < 0.01$.
PPVT, Peabody Picture Vocabulary Test; WRAT-3, Wide Range Achievement Test, Third Edition; SD, standard deviation.

scored below average (<25th percentile) and 21% scored less than 10th percentile. The HIV-positive youths scored significantly lower (M = 88.2) than the seroreverters (M = 93.8) on the WRAT-3 ($t = 2.69$, $p = 0.008$). For both the PPVT-III and the WRAT-3, the full range of scores was represented and normally distributed with no extreme outliers.

Associations between demographics, health status, and ability

Correlations, *t* tests, and analyses of variance (ANOVAs) assessed the associations between PPVT-III and WRAT-3 standard scores and all demographic variables in Table 1. Males and youths in higher grades had higher PPVT-III scores; younger youths had higher scores on the WRAT-3. All other analyses were not statistically significant. Among HIV-positive youths, none of the health status variables obtained from medical charts ($CD4^+$ count, viral load, CDC classification) were significantly associated with either PPVT-III or WRAT-3 scores; all correlation coefficients were close to zero. However, youths who were taking antiretroviral medication had lower WRAT-3 scores than youths not taking medication (M = 95.03 versus 86.89, $t = 2.38$, $p = 0.018$). In regression analyses, HIV status remained significantly associated with PPVT-III and WRAT-3 standard scores after adjusting for child's gender, household income, caregiver education, child race/ethnicity, and whether the caregiver was the child's biologic parent (Table 3).

School-related characteristics

Over a third of the youths (35%) in both groups (37% of HIV-positive, 32% of HIV-negative) had been retained in school, 33% were currently attending special education classes (37% of HIV-positive versus 28% of HIV-negative) and 47% had a history of special education placement (52% HIV-positive, 39% HIV-negative, $\chi^2 = 4.77$, $p < 0.05$; Table 4). Across groups, special education placement was most frequently attributed to problems with reading or math.

Discussion

Our sample of perinatally HIV-infected and exposed youths scored poorly on measures of language functioning: 37% scored less 10th percentile on the PPVT-III and 28% scored less than 10th percentile on the WRAT-3. Poor scores are suggestive of poor verbal ability including limited vocabulary and lack of basic skills needed for reading. In addition, large numbers of youths were academically retained (35%) and placed in special education classes (47%). Overall,

Table 3. Multivariate Regression Models Predicting Cognitive Functioning among HIV-Positive and HIV-Negative Adolescents

	PPVT - III		*WRAT - 3*	
	b (SE)	p	*b (SE)*	p
Gender (1 = male, 2 = female)	−4.31 (1.65)	**0.009**	−2.01 (2.06)	0.331
Income (categories)	0.70 (0.33)	**0.034**	0.95 (0.41)	**0.021**
Caregiver years of education	0.14 (0.28)	0.622	0.02 (0.35)	0.950
Race/ethnicity: Latino[a]	−1.98 (1.95)	0.312	−1.47 (2.44)	0.548
Race/ethnicity: Other[a]	−2.32 (2.44)	0.342	−5.40 (3.07)	0.079
Caregiver is biologic parent (0 = no, 1 = yes)	1.18 (1.89)	0.533	4.57 (2.36)	**0.054**
Child HIV status (0 = HIV-negative, 1 = HIV-positive)	−4.18 (1.79)	**0.020**	−5.04 (2.23)	**0.024**

[a]Reference category = African American.
PPVT, Peabody Picture Vocabulary Test; WRAT-3, Wide Range Achievement Test, Third Edition; SE, standard error.

Table 4. School-Related Characteristics for HIV Infected and Uninfected Youth

School-related characteristics	*Total sample* n *(% of 325)*	*HIV-positive* n *(% of 196)*	*Seroreverters* n *(% of 129)*
Currently in school (yes)	324 (99)	195 (99)	129 (100)
Ever held back in school (yes)	112 (35)	72 (37)	40 (31)
Currently in special education class	109 (34)	73 (37)	36 (28)
Ever attended special education class (yes)[a]	154 (47)	102 (52)	52 (40)
Reason for special education placement ever	n *(% of 153)*	n *(% of 101)*	n *(% of 52)*
Reading problems	95 (62)	64 (63)	31 (60)
Math problems	84 (55)	56 (55)	28 (54)
Attention problems	58 (40)	38 (38)	20 (39)
Discipline problems	35 (23)	25 (25)	10 (19)

HIV-positive vs. HIV-negative; [a]$p < 0.05$.

the performance of this cohort of perinatally HIV-exposed youths was well below age expectations. HIV-positive youths' performance was statistically worse as compared to the seroreverters on both measures of reading and language ability and the HIV-positive youths were more likely to have attended special education classes. Our data suggest that infected youths continue to have learning problems at higher than expected rates as they age and enter adolescence.

Because HIV remains a stigmatized disease and teachers are rarely disclosed to about a child's status, it will be important for medical doctors working with this population to be aware of how HIV influences youths' ability to function in school. The stress of living with a chronic stigmatized illness coupled with a sense of educational failure places youths with HIV at further risk for behavioral and health problems. For example, poor language skills may limit youths' ability to understand their illness and compromise their ability to adhere to challenging medication regimens.[15,16] Conversely, better cognitive functioning, particularly in the verbal domain, may operate as a protective factor against early sexual activity during adolescence, whereas lower intelligence may be a risk factor.[14] Furthermore, our school-based findings that large number of these youths are being retained in school and attending special education classes further demonstrates how these perinatally HIV infected and affected youths are struggling.

It is noteworthy to report that, among the HIV-positive youths, delays were not associated with most recent CD4$^+$ count or viral load. Previous studies that found viral load to be unrelated to cognitive test scores, speculated that the lack of association with viral load might be due to the fact that viral load values can fluctuate with changes in adherence.[22–24] These biomedical markers only reflect current health status and do not necessarily represent past medical history which may have included long periods of illness, immune suppression and active viremia. Furthermore, cognitive functioning may be indirectly related to disease severity, for example with increased number of absences from school among sicker children. Our finding that youths who were currently taking antiretroviral therapy had lower scores on the WRAT-3 could be explained by sicker children being more likely to be prescribed medication or conversely could be related to side effects of the medications.[25] This finding needs more thorough analysis and assessment to fully understand the association, however, such analysis is beyond the scope of this investigation.

Although HIV-positive youths had significantly lower scores on both measures of language and reading ability, it is important to note that 34% of seroreverters scored less than 10th percentile on the PPVT-III and 21% scored less than 10th percentile on the WRAT-3. By definition, these youths are living with an HIV-positive parent or have already lost a parent to death. In addition to dealing with the stressors of inner city living, these youths are often caretakers for their parents and isolated due to their "family secret," often leading to behavior problems or symptoms of anxiety or depression.[26–30] Similar to the HIV-positive youths, seroreverters are living in impoverished, urban communities in poor performance school districts. Unfortunately, HIV-exposed but uninfected youths are often difficult to identify, as they are typically not followed in specialized HIV care clinics. HIV-positive youths are more likely to have regular contact with medical, mental health, and social service providers to help families navigate systems to get the services they need, but HIV-negative youths are less likely to benefit from such services. There is no sign that the numbers of uninfected, but HIV-affected children are diminishing, as HIV disease continues to spread in women of child-bearing age. Our data suggest that seroreverters may be at risk for poor outcomes given the association between cognitive functioning and risk behaviors[31,32] that can in turn lead to sexually transmitted diseases (STDs), pregnancy, and behaviorally acquired HIV disease. Medical providers treating seroreverters may be in a unique position to identify youths who are struggling and make the appropriate mental health and social service referrals.

There are a number of limitations to this study that should be considered when interpreting our results. Participants were recruited from HIV primary care clinics in New York City and findings may not generalize to perinatally HIV-exposed youths in other settings. Also, although we attempted to recruit both groups from similar communities based on the demographics of pediatric HIV disease, other factors (e.g., differential rates of study refusal or access to services) may have altered the group effects. Due to issues of confidentiality and HIPAA, no data were collected on participants who refused to participate or who were not approached. Nor were data collected to assess whether children were bilingual or their level of acculturation in general, all of which could account for some of the findings. In addition, Project CASAH is study of psychosocial determinants of youth risk and resilience, with a particular interest in mental health and thus included limited measurement of cognitive or academic functioning that could be administered in a short time. The WRAT-3 has limited validity when it comes to predicting actual academic achievement as there is a difference between one's ability to successfully decode words and comprehend text. It also remains to be seen how well suited the PPVT-III, while highly correlated with overall IQ in typically developing children, is as a proxy for overall IQ or general verbal ability in those with learning difficulties or general developmental delays. More thorough evaluation of cognitive functioning would be helpful in strengthening our findings. Notwithstanding these limitations, this study demonstrates poor verbal and reading ability among youths infected with and affected by HIV, and highlights the importance of educational interventions that address this emerging need. As this population ages, further research should continue to examine the relationship between markers of disease severity, related psychosocial factors, and cognitive functioning and attempt to clarify specific cognitive domains that may be more sensitive to effects of HIV among adolescents including motor functioning, executive skills, and information processing speed,[33] so that appropriate educational or remedial programs can be developed and incorporated into ongoing care for this population.

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References

1. NYC DOHMH Pediatric & Adolescent HIV AIDS Surveillance Update New York City: Semiannual Report. December 2007, p. 5.
2. Belman AL, Muenz LR, Marcus JC, et al. Neurologic status of human immunodeficiency virus 1-infected infants and their controls: A prospective study from birth to 2 years. Pediatrics 1996;98(6 Pt 1):1109–1118.
3. Coplan J, Contello KA, Cunningham CK, et al. Early language development in children exposed to or infected with human immunodeficiency virus. Pediatrics 1998;102:8.
4. Epstein LG, Sharer LR, Goudsmit J. Neurological and neuropathological features of human immunodeficiency virus infection in children. Ann Neurol 1988;23:S19–S23.
5. Mellins CA, Levenson RL, Zawadzki R, Kairam R, Weston M. Effects of pediatric HIV-infection and pre-natal drug exposure on mental and psychomotor development. J Pediatr Psychol 1994;19:617–628.
6. Willen EJ. Neurocognitive outcomes in pediatric HIV. Ment Retard Dev Disabil Res Rev 2006;12:223–228.
7. Wolters PL, Brouwers P, Moss HA. Pediatric HIV disease: Effect on cognition, learning, and behavior. Sch Psychol Q 1995;10:305–328.
8. Kullgren KA, Morris MK, Bachanas PJ, Jones JS. Prediction of cognitive, adaptive, and behavioral functioning in preschool and school-age children with HIV. Child Health Care 2004;33:241–256.
8a. Jeremy RJ, Kim S, Nozyce M, et al. Neuropsycholgical functioning and viral load in stable antiretroviral therapy-experienced HIV-infected children. Pediatrics 2005;115: 380–387.
8b. Bisiacchi PS, Suppiej A, Laverda A. Neuropsychological evaluation of neurologically asymptomatic HIV-infected children. Brain Cogn 2000;43:49–52.
8c. Mialky E, Vagnoni J, Rutstein R. School-age children wtih perinatally acquired HIV infection: Medical and psychosocial issues in a Philadelphia cohort. AIDS Patient Care STDs 2001;15:575–579.
9. Denti L, Guerin G. Confronting the problem of poor literacy: Recognition and action. Reading Writing Q 2004;20: 113–122.
10. Durham RE, Farkas G. The importance of early language skills: An explanation for social class. Presented at the annual meeting of the American Sociological Association, San Francisco, CA. www.allacademic.com/meta/p109174_index.html (Last accessed March 26, 2009).
11. Ippolito J, Steele JL, Samson JF. Introduction: Why Adolescent literacy matters now. Harvard Educ Rev 2008;78:1–6.
12. Shapiro ES. From research to practice: Promoting academic competence for underserved students. School Psych Rev 2008;37:46–51.
13. Chall JS. The Academic Achievement Challenge: What Really Works in the Classroom? New York: Guilford Press, 2000.
14. Halpern CT, Joyner K, Udry R, Suchindran C. Smart teens don't have sex (or kiss much either). J Adolesc Health 2000;26:213–225.
15. Hinkin CH, Castellon SA, Durvasula RS, et al. Medication adherence among HIV+ adults: Effects of cognitive dysfunction and regimen complexity. Neurology 2002;59:1944–1950.
16. Wagner GJ. Predictors of antiretroviral adherence as measured by self-report, electronic monitoring, and medication diaries. AIDS Patient Care STDs 2002;16:599–608.
16a. Kalichman SA, Rompa D. Functional health literacy is associated with health status and health-related knowledge in people living with HIV-AIDS. J Acquir Immune Defic Syndr 2000;25:337–344.
17. Coppan J, Contello K, Cunningham CK, et al. Early language development in children exposed to or infected with human immunodeficiency virus. Pediatrics 1998;102:1–4.
18. Epstein LG, Sharer LR, Loeske JM, et al. Neurologic manifestations of human immunodeficiency virus in children. Pediatrics 1986;78:678–687.
19. Wolters PL, Brouwers P, Civitello L, Moss HA. Receptive and expressive language function of children with symptomatic HIV infection and relationship with disease parameters: A longitudinal 24-month follow-up study. AIDS 1997;11:1135–1144.
20. Dunn L, Dunn L. Peabody Picture Vocabulary Test: Examiner's Manual, 3rd ed. Circle Pines, MN: American Guidance Service, 1997.
21. Wilkinson GS. Wide Range Achievement Test, 3rd ed. Lutz, FL: PAR/Psychological Assessment Resources, Inc., 1993.
22. Martin SC, Wolters P, Toledo-Tamula MA, et al. Cognitive functioning in school-aged children with vertically acquired HIV infection being treated with highly active antiretroviral therapy (HAART). Dev Neuropsychol 2006;30:633–657.

23. Haubrich RH, Little SJ, Currier JS, et al. The value of patient-reported adherence to antiretroviral therapy in predicting virologic and immunologic responses. AIDS 1999;13:1099–1107.
24. Van Dyke RB, Lee S, Johnson GM, et al. Reported adherence as a determinant of response to highly active antiretroviral therapy in children who have human immunodeficiency virus infection. Pediatrics 2002;109:E61.
25. Kohler JJ, Lewis W. A brief overview of mechanisms of mitochondrial toxicity from NRTIs. Environ Mol Mutagen 2007;48:166–172.
26. Hough ES, Brumitt G, Templin T, Saltz E, Mood D. A model of mother-child coping and adjustment to HIV. Soc Sci Med 2003;56:643–655.
27. Keigher S, Zabler B, Robinson N, Frenandez A, Stevens PE. Youth caregivers of mothers with HIV: Need for supports. Child Youth Serv Rev 2005;27:881–904.
28. Reyland SA, Higgins-D'Alessandro A, McMahon TJ. Tell them you love them because you never know when things could change: Voices of adolescents living with HIV-positive mothers. AIDS Care 2002;14:285–294.
29. Reyland SA, McMahon TJ, Higgins-D'Alessandro A, Luthar SS. Inner-city children living with an HIV-seropositive mother: Parent-child relationships, perceptions of social support, and psychological disturbance. J Child Fam Stud 2002;11:313–329.
30. Stein JA, Riedel M, Rotherum-Borus MJ. Parentification and its impact on adolescent children of parents with AIDS. Fam Proc 1999;38:193–208.
31. Bogart LM, Collins RL, Ellickson PL, Klein DJ. Adolescent predictors of generalized health risk in young adulthood: A 10-year longitudinal assessment. J Drug Issues 2006;36:571–596.
32. Luster T, Small SA. Factors associated with sexual risk-taking behaviors among adolescents. J Marriage Fam 1994;56: 622–632.
33. Askinazi LA, Grant ML, Legido A, Bagarazzi ML The relationship between performance on neuropsychological test measures and immunologic and virologic markers of disease progression in HIV infected children. Arch Clin Neuropsychol 2000;15:653–654.

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