Comparing the impact of two occupational therapy interventions on academic learning outcomes for children with Human Immunodeficiency Virus

By Pam Gretschel
What this paper adds

This paper adds to an emerging body of evidence aiming to demonstrate the effect of occupational therapy interventions on occupational outcomes for children with perinatal HIV infection. The paper presents a detailed overview of the conceptualisation of learning as an occupational outcome. The paper presents further consideration of the practical challenges linked to the implementation of, adherence to and sustainability of rehabilitation interventions in low to middle income countries.
ABSTRACT

The strong association between perinatal HIV infection and poor performance in academic learning is further challenged by various barriers to learning in the [removed for blind review] context of basic education. This study investigated the efficacy of a novel play-informed, caregiver-implemented, home-based intervention (PICHIBI) for improving academic learning in HIV positive children. A single-blinded, randomised comparison group design was selected to compare PICHIBI with conventional one-on-one occupational therapy interventions. Children with HIV aged 5 to 8 year olds on ART and their primary caregiver (N=23) were randomly allocated to an intervention group. The primary outcome of academic learning was measured using the Griffiths Mental Developmental Scales-Extended Revised and the short form Beery-Buktenica Visual Motor Integration test, 5th edition at baseline, mid (5 months) and post intervention (after 10 months). At baseline the total sample (n=23) presented with below average performance in all assessed academic learning outcomes. Between-group differences for all academic learning outcomes were not significant at mid or post test assessment points. A statistically significant within-group change in visual motor integration was noted in the PICHIBI from baseline to mid test (p=.019). In the conventional group there were statistically significant changes in visual perception from baseline to mid (p=.001) and baseline to post-test (p=.009). Performance in the conventional group improved significantly from baseline to mid test (p=.027). While improvements were noted, children in both groups continued to present with academic learning concerns at post-test. These concerns motivate the need for continued monitoring and further investigation into the feasibility and effectiveness of occupational therapy interventions targeting the academic learning challenges of this population.

(263 words)

KEY WORDS: occupational therapy intervention; HIV positive children; academic learning
MAIN TEXT

Prevention of mother-to-child transmission programmes (PMTCT)\textsuperscript{1} have led to the wider provision of antiretroviral therapy (ART) and as a result more children with Human Immunodeficiency Virus (HIV) are reaching school-going age\textsuperscript{2}. In [removed for blind review] an estimated 260,000 children (aged 0 to 14) live with HIV\textsuperscript{3}. Their academic learning success is negatively impacted on by delays in their motor and neuro-cognitive functioning\textsuperscript{4,5,6,7,8}.

Studies comparing the HIV-infected child’s functional and intellectual abilities to their HIV-uninfected peers\textsuperscript{9,10,11} support the call for children with HIV to receive intervention \textsuperscript{12,13}. HIV is particularly prominent in low-income countries like [removed for blind review], where its’ negative effect on neuro-cognition and visual perceptual skills is undoubtedly exacerbated by contextual barriers to learning\textsuperscript{14}. Despite this, at the time of this study, only one intervention study focused on promoting development in an HIV-infected paediatric population in [removed for blind review] could be sourced. In this study a home stimulation programme taught to the child’s caregiver significantly improved the developmental progression of children less than 2 years 6 months infected with HIV\textsuperscript{15}. Occupational therapists promote a child’s ability to engage in the academic learning, often using play as a means to address barriers related to the academic learning of children\textsuperscript{16}. Descriptions of, and studies exploring the effectiveness of occupational therapy interventions for HIV positive children are scant. This paper presents the results of a postgraduate study\textsuperscript{1} investigating and comparing the effect of two occupational therapy interventions on the academic learning of HIV-infected children. The hypothesis for the study was that HIV positive children on ART aged 5-8 years children taking part in the novel play-informed caregiver-implemented home-based intervention (PICHIBI) would demonstrate more improvement in their academic learning outcomes then those children receiving conventional one-on-one occupational therapy intervention. The conceptualization of academic learning outcomes to guide the development of the PICHIBI is presented in Figure 1.

\[\text{[Insert Figure 1]}\]

\textsuperscript{1} This study is one of various four postgraduate masters studies nested in a larger project comparing the impact of occupational therapy interventions on the play, learning and development of children infected with HIV.
Materials and methods

Design
Drawing on the CONSORT statement, a single-blinded, randomised comparison group design\(^7\) was used to report the effectiveness of the novel PICHIKI. Ethical approval for the study was obtained from the University of [removed for blind review] Human Research Ethics Committee (HREC/REF: 772/2014). The study was a sub-study nested in a larger study registered with the [removed for blind review] National Clinical Trial Registry through the National Health Research Ethics Council (Trial number: DOH-27-0115-4892).

Participants
All children aged between 5 years 0 months and 8 years 0 months and their caregivers attending the monthly outpatient paediatric anti-retroviral (ARV) clinic at [removed for blind review] hospital, a tertiary hospital based in [removed for blind review] were considered eligible to participate in the study. Caregiver participants were those persons who spent no less than seven hours of direct contact time a week with the child, and who were able to attend at least five out of the ten intervention sessions. All child participants were from low-income areas and were HIV positive following vertical transmission. The clinic database consisted of 60 participants who met these criteria. A translator fluent in isiXhosa assisted in contacting the participants.

Sample size and power
A convenient sample of 27 dyads (caregiver and child) was arrived at to align with 90% power at a non-inferiority difference of 6 points between groups with a standard deviation of 10. This power was retained even after a 15% loss to follow-up, reducing the chance of a Type II error.

Randomization
Using a random sequence generator, participants were assigned to treatment groups. Randomisation was completed after the participants had consented to participate and conducted their baseline assessments. All researchers and assessors were blinded to the allocation process.

Measures (Instrumentation)
A background information questionnaire completed by caregivers collected data relating to caregiver and child socio-demographics, their developmental history, overview of medical and rehabilitation interventions, ART treatment regime, schooling, play, and television viewing
habits. Caregivers were asked to comment on their child’s learning and bring copies of their school reports to provide information about their academic learning progress in context.

The Griffiths Mental Development Scale-Extended Revised (GMDS-ER) version for children aged 2-8 years consists of six subscales. Four of the six subscales were used in this study; language (subscale C), eye hand co-ordination (subscale D), performance (subscale E) and practical reasoning (subscale F). Functional age in each subscale can be obtained through computation and developmental quotients for each subscale can be calculated by dividing the functional age of the child with their chronological age at the time of testing. The GMDS-ER is used in [removed for blind review] as well as internationally and is considered to be a valid and reliable tool to use with diverse populations.

The Beery-Buktenica Developmental Test of Visual Motor Integration 5th edition (DTVMI) was used to assess the child’s ability to coordinate their visual perception and motor abilities. The DTVMI is frequently used in [removed for blind review]. The DTVMI has a high reliability and validity across a 3–18-year age range and adequate cross-cultural validity.

Standard scores were calculated from raw scores using USA norms.

Academic learning outcomes were represented by standardized scores with a mean (SD) quotient of 100 (15) for the GMDS-ER and a mean standard score of 100 (15) for the DTVMI. Scores between 90-109 are considered average and <70 as intellectually impaired.

Procedures

A pilot study was conducted prior to baseline to ensure inter-rater reliability. Five assessors, all occupational therapists trained in using the GMDS-ER, assessed sixteen children from a local tertiary children’s hospital and the raw scores of these assessments were correlated with the aim being to achieve a minimum level of 90% agreement. Cronbach alpha coefficients were conducted to ensure internal consistency and the coefficients all exceeded the value of 0.70, the acceptable minimum value of reliability. Raw scores differed by a maximum of two to eight points between any two assessors. There was 100% agreement on the age calculations. The reliability measure between the other GMDS-ER scores (quotient, age-equivalent, z-score, percentile) varied between 0.99 and 1.

Data was collected at three intervals, baseline test (before intervention had started), mid test (at five months) and post-test (at ten months). The caregivers completed the background
information questionnaire at baseline assessment. Data were also collected on intervention session attendance rates and participant dropout rates for both intervention groups.

Therapists and the researchers, met monthly throughout the intervention period for group meetings to ensure the intervention was being carried out as documented. In these spaces the challenges and successes related to designing and implementing this intervention were discussed within the methodology of a cooperative inquiry\(^2\).

**PICIHBI group: Play informed, caregiver implemented, home based intervention (PICIHBI)**

The intervention design team drew on the National Curriculum Statements\(^3\) to guide the specific academic learning related skills (literacy, numeracy, gross motor, fine motor, and language) to be targeted the intervention sessions. Additionally, research focused on child development and play theory guided how to make optimal use of play as a means to guide the development of the afore-mentioned academic learning skills in the intervention\(^4\). Both the child and the caregiver attended the monthly 90-minute PICIHBI intervention sessions. During the first 45 minutes, while the children were cared for by the clinic appointed child minder, the caregivers engaged with the occupational therapist, and other caregivers learning how to promote their child’s engagement in play, learning and development. The remaining 45 minutes was experiential. Children joined in the sessions and caregivers were guided to apply the knowledge they had learned practically. At the end of each session the dyad was given an item (i.e., crayons, scissors, puzzle etc.) that was used in the session to add to their “Go Box”, a take home tool kit comprising of age-appropriate stimulation items. Each group consisted of approximately five caregiver-child dyads, an occupational therapist, and a translator/facilitator\(^5\). Caregivers were encouraged to implement the weekly group activities at home with their child. At the following group session, feedback from the caregivers was given and then documented, along with attendance, in the therapist’s notes. This feedback was used to inform and build on the design of the intervention manual, which included the intervention sessions and protocols for implementing the intervention.

**Comparison Group: Conventional one-on-one occupational therapy**

Conventional one-on-one occupational therapy intervention was the comparison intervention. In this intervention the child was the direct focus and although not compulsory, caregivers were welcome to sit in on and observe the sessions. Each child was offered ten 45-minute

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\(^2\) A translator was required to assist the occupational therapist with translating the group content into IsiXhosa, the home language of many of the research participants.
sessions. At the end of the ten sessions, once post-test had been completed, the child was issued with a “Go Box” to take home with them.

Data collectors were blinded to the allocation of participants throughout the intervention period. Un-blinding occurred once all post-tests had been completed and all assessments had been scored. The participants and their caregivers were not blinded to the intervention, but to the hypothesis of the study. Codes for each dyad were used to ensure blinding. All assessments were administered outside intervention period one and two.

**Statistical Analysis**

All data was analysed using the Statistical Package for the Social Sciences (SPSS) at a 95% confidence interval and a significant p-value of ≤0.05. Performance below normal functional limits was rated as a score < -2 SD or < 70, for both assessment tools. Univariate (descriptive), bivariate (correlations) and multivariate (regression) analyses took place. As the total sample size was less than 50, (N=23) the Shapiro-Wilk Test of Normality was used to determine the distribution of the sample. The Levene’s Test for equality showed equal variances for all subscales during the test periods. Since there were no statistically significant differences between the groups using the 2-sample t-test (independent t-test), paired t-tests (dependent t-test) were conducted to determine whether any significant within-group changes had occurred. Analysis of Covariance (ANCOVA) was used where indicated, to establish which factors had the greatest relationships on variables of interest. Intention to treat (ITT) analysis was carried out in this study. The participants who did not attend all intervention sessions were still tested at post-test and their results were captured and analysed.

**Results**

The baseline test sample size consisted of 27 dyads (n=27). One participant was transferred to a home of safety, leaving 26 participants who underwent randomisation following baseline assessment. The small sample resulted from dyads not meeting the inclusion criteria, not wanting to participate or not being contactable for assessment dates. Two participants were lost to follow up after the baseline test, and one was transferred to a home of care. The total sample at the end of the study was n=23. Please refer to Figure 2.

[Insert figure 2]

**Baseline demographics**

Baseline demographics are presented in Table 1. Mothers were the main caregivers, with the majority attaining a high school level of education. Participants in both groups generally had
low viral load LDL. The independent t-test showed statistical significance for time which participants had been on ART ($p=0.021$) with the comparison group being on ART longer. The Levene’s Test for equality of variances was used on baseline test demographics to test if both groups had equal variances.

Table 1. Demographics for participants at baseline test (N=26)

<table>
<thead>
<tr>
<th>Variable</th>
<th>PICHHBl group (n=13)</th>
<th>Conventional group (n=13)</th>
<th>Total (n=26)</th>
<th>Levene’s Test for equality of variances p-value</th>
<th>2-Sample t-test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (months)</td>
<td>76.5 (4.35)</td>
<td>78.6 (4.39)</td>
<td>155.1 (4.37)</td>
<td>0.206</td>
<td>0.149</td>
</tr>
<tr>
<td>Time on ART (months)</td>
<td>52.8$^*$ (13.4)</td>
<td>67$^*$ (9.9)</td>
<td>120.5$^*$ (13.4)</td>
<td>0.318</td>
<td>0.221</td>
</tr>
<tr>
<td>No. (%)</td>
<td>No. (%)</td>
<td>No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestation (weeks)</td>
<td>0.706</td>
<td>0.969</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24-29</td>
<td>0 (0.0)</td>
<td>1 (8.3)</td>
<td>1 (4.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-36</td>
<td>1 (9.1)</td>
<td>1 (8.3)</td>
<td>2 (8.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37-40</td>
<td>9 (61.8)</td>
<td>8 (66.7)</td>
<td>17 (73.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-41</td>
<td>1 (9.1)</td>
<td>2 (16.7)</td>
<td>3 (13.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11 (100.0)</td>
<td>12 (100.0)</td>
<td>23 (100.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.572</td>
<td>0.267</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>7 (53.8)</td>
<td>5 (38.5)</td>
<td>12 (46.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>6 (46.2)</td>
<td>8 (61.5)</td>
<td>14 (53.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13 (100.0)</td>
<td>13 (100.0)</td>
<td>26 (100.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caregivers</td>
<td>0.142</td>
<td>0.484</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>11 (84.6)</td>
<td>12 (92.3)</td>
<td>23 (88.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granny</td>
<td>1 (7.7)</td>
<td>1 (7.7)</td>
<td>2 (7.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aunty</td>
<td>1 (7.7)</td>
<td>0 (0.0)</td>
<td>1 (3.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13 (100.0)</td>
<td>13 (100.0)</td>
<td>26 (100.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of primary education</td>
<td></td>
<td></td>
<td></td>
<td>0.909</td>
<td>0.351</td>
</tr>
<tr>
<td>Grade R</td>
<td>6 (46.2)</td>
<td>5 (38.5)</td>
<td>11 (42.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td>7 (53.8)</td>
<td>7 (53.8)</td>
<td>14 (53.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 2</td>
<td>0 (0.0)</td>
<td>1 (7.7)</td>
<td>1 (3.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13 (100.0)</td>
<td>13 (100.0)</td>
<td>26 (100.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caregiver’s level of education</td>
<td></td>
<td></td>
<td></td>
<td>0.464</td>
<td>0.687</td>
</tr>
<tr>
<td>Primary School</td>
<td>4 (30.8)</td>
<td>3 (23.1)</td>
<td>7 (28.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>9 (75.0)</td>
<td>8 (61.5)</td>
<td>16 (100.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>2 (15.4)</td>
<td>0 (0.0)</td>
<td>2 (8.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13 (100.0)</td>
<td>12 (100.0)$^*$</td>
<td>25 (100.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viral loads</td>
<td>0.003</td>
<td>0.269</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDL$^3$ (&lt;40)</td>
<td>9 (75.0)</td>
<td>10 (76.9)</td>
<td>19 (73.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^3$ The acronym LDL stands for Lower Detectable Limit. LDL is a term used to describe the amount of HIV in one’s blood, i.e. one’s viral load of the HIV virus. The more HIV virus there is in your blood, the higher one’s viral load will be. [http://www.aidsmap.com/Viral-load]
Comparing the impact of two occupational therapy-based interventions on academic learning outcomes for HIV-positive children submitted 17 June 2022

| 40<VL≤1000 | 3 (25) | 0 (0.0) | 3 (11.5) |
| 1000<VL≤10 000 | 1 (7.7) | 3 (23.1) | 4 (15.4) |
| **Total** | **13 (100.0)** | **13 (100.0)** | **26 (100.0)** |

*Missing data: Time on ART: 2 in PICI/Hi group; 4 in comparison conventional group; Caregiver level of education: 1 in comparison conventional group, **Bold** = statistically significant result

**Intervention attendance**

The session attendance rates varied across the intervention period. Participants reported that transport issues affected their attendance of the intervention sessions.

[Insert table 2] Table 2. Intervention attendance per child (N=23)

<table>
<thead>
<tr>
<th>Child</th>
<th>Total amount of sessions attended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PICI/Hi group (n=11) No. (%)</td>
</tr>
<tr>
<td>Child 1</td>
<td>6 (60.0)</td>
</tr>
<tr>
<td>Child 2</td>
<td>2 (20.0)</td>
</tr>
<tr>
<td>Child 3</td>
<td>1 (10.0)</td>
</tr>
<tr>
<td>Child 4</td>
<td>2 (20.0)</td>
</tr>
<tr>
<td>Child 5</td>
<td>4 (40.0)</td>
</tr>
<tr>
<td>Child 6</td>
<td>6 (60.0)</td>
</tr>
<tr>
<td>Child 7</td>
<td>8 (80.0)</td>
</tr>
<tr>
<td>Child 8</td>
<td>3 (30.0)</td>
</tr>
<tr>
<td>Child 9</td>
<td>6 (60.0)</td>
</tr>
<tr>
<td>Child 10</td>
<td>2 (20.0)</td>
</tr>
<tr>
<td>Child 11</td>
<td>2 (20.0)</td>
</tr>
<tr>
<td>Child 12</td>
<td>7 (70.0)</td>
</tr>
</tbody>
</table>

**Aim 1: Academic learning profile of children with HIV**

The academic learning profile of the total sample measured at baseline is presented below in Table 3. The standard means of the DTVMI, and the quotient means of the GMDS-ER showed that the total sample presented with below average scores for all academic learning outcomes measured at baseline. Standard mean and quotient mean scores below 70 indicates the presence of significant challenges. The academic learning outcomes most affected were visual perception, language, and practical reasoning.

[Insert table 3] Table 3. Baseline standard means (DTVMI) and quotient means (GMDS-ER) for total sample (n=23 children)
### Outcome measure and sub scales

<table>
<thead>
<tr>
<th>Measure</th>
<th>Standard mean</th>
<th>Classification scale</th>
<th>Children scoring below 70 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Test of Visual Motor Integration</td>
<td>77.9</td>
<td>Low</td>
<td>3 (13.6)</td>
</tr>
<tr>
<td>Visual motor integration</td>
<td>74.0</td>
<td>Low</td>
<td>9 (40.9)</td>
</tr>
<tr>
<td>Motor coordination</td>
<td>86.3</td>
<td>Below Average</td>
<td>3 (13.0)</td>
</tr>
<tr>
<td>Griffiths Mental Developmental Scales-Extended and Revised</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language</td>
<td>71.6</td>
<td>Borderline delay</td>
<td>16 (69.6)</td>
</tr>
<tr>
<td>Eye hand coordination</td>
<td>80.2</td>
<td>Low average</td>
<td>13 (56.5)</td>
</tr>
<tr>
<td>Performance</td>
<td>81.6</td>
<td>Low average</td>
<td>7 (30.4)</td>
</tr>
<tr>
<td>Practical Reasoning</td>
<td>75.4</td>
<td>Borderline delay</td>
<td>18 (79.3)</td>
</tr>
<tr>
<td>General Quotient</td>
<td>80.3</td>
<td>Low average</td>
<td>15 (68.2)</td>
</tr>
</tbody>
</table>

*Missing data: one child from comparison conventional group missed baseline assessment for these subscales (n=22 children)*
Aim 2: Preliminary effectiveness of the PICHIHBI for improving academic learning

The preliminary effectiveness of the PICHIHBI for improving academic learning is represented by the presentation of tables describing the between group and within group changes in both the PICHIHBI and comparison conventional group for both the DTVMI and GMDS-ER.

[Insert table 4] Table 4. Changes in Beery VMI subtests mean standard scores in both groups over time (N=23)

<table>
<thead>
<tr>
<th>Visual Motor Integration (VMI)</th>
<th>Baseline</th>
<th>Mid-point</th>
<th>Post test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>SD</td>
<td>mean</td>
</tr>
<tr>
<td>PICHIHBI group</td>
<td>81.0</td>
<td>15.86</td>
<td>90.3</td>
</tr>
<tr>
<td>Comparison group</td>
<td>81.8a</td>
<td>14.90</td>
<td>86.1</td>
</tr>
<tr>
<td>Between group differences at each point</td>
<td>p-value (95% CI)</td>
<td>p-value (95% CI)</td>
<td>p-value (95% CI)</td>
</tr>
<tr>
<td>Visual perception (VP)</td>
<td>0.899</td>
<td>-14.1-12.4</td>
<td>0.287</td>
</tr>
<tr>
<td></td>
<td>mean</td>
<td>SD</td>
<td>mean</td>
</tr>
<tr>
<td>PICHIHBI group</td>
<td>85.1</td>
<td>26.15</td>
<td>90</td>
</tr>
<tr>
<td>Comparison group</td>
<td>69.9a</td>
<td>32.41</td>
<td>94.1</td>
</tr>
<tr>
<td>Between group differences at each point</td>
<td>p-value (95% CI)</td>
<td>p-value (95% CI)</td>
<td>p-value (95% CI)</td>
</tr>
<tr>
<td>Motor co-ordination (MC)</td>
<td>0.107</td>
<td>-3.6-34.5</td>
<td>0.591</td>
</tr>
<tr>
<td></td>
<td>mean</td>
<td>SD</td>
<td>mean</td>
</tr>
<tr>
<td>PICHIHBI group</td>
<td>91.1</td>
<td>10.55</td>
<td>91.5</td>
</tr>
<tr>
<td>Comparison group</td>
<td>81.8a</td>
<td>22.24</td>
<td>83.8</td>
</tr>
<tr>
<td>Between group differences at each point</td>
<td>p-value (95% CI)</td>
<td>p-value (95% CI)</td>
<td>p-value (95% CI)</td>
</tr>
</tbody>
</table>

Missing data:

*Two children from the PICHIHBI group for VMI at post-test (n=9)

*One child from the comparison conventional group for VMI and VP at baseline (n=11)

Overall change in DTVMI scores over time

There were no statistically significant between group differences at any time point in the intervention (p>0.05). Statistically significant within group changes were noted. In the PICHIHBI group VMI improved from baseline to mid test (p= .019). In the comparison conventional group there was a statistically significant improvement in VP from baseline to mid test (p= .001). While the mean VP standard score decreased from mid test to post test (88.7), the overall change in VP from baseline to post-test remained significant (p= .009). The only decrease in mean standard scores from baseline to post-test was seen in the PICHIHBI group for motor co-ordination. In the other subtests, both groups, improved throughout the intervention period.
These changes were not statistically significant. None of the children in the PICIHBI scored <70 (severe delay) at post test.

[Insert table 5] Table 5. Changes in GMDS-ER mean quotient scores for both groups over time (N=23)

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<thead>
<tr>
<th>GMDS-ER subscale</th>
<th>Quotient Mean (SD)</th>
<th>Number of children with z-score below -2 (%)</th>
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<tr>
<td></td>
<td>Baseline</td>
<td>Mid</td>
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<tr>
<td>PICIHBI (n=11)</td>
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<tr>
<td>Language</td>
<td>70 (10.27)</td>
<td>76.6  (10.18)</td>
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<tr>
<td>Eye hand co-ordination</td>
<td>82.3 (15.74)</td>
<td>80.2 (8.22)</td>
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<tr>
<td>Performance</td>
<td>86.5 (23.10)</td>
<td>90.7 (^{a}) (21.23)</td>
</tr>
<tr>
<td>Practical reasoning</td>
<td>75.1 (10.11)</td>
<td>75.3 (7.05)</td>
</tr>
<tr>
<td>General Quotient*</td>
<td>80.3 (9.76)</td>
<td>83.3 (7.51)</td>
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</table>

Comparison conventional (n=12)

<table>
<thead>
<tr>
<th>GMDS-ER subscale</th>
<th>Quotient Mean (SD)</th>
<th>Number of children with z-score below -2 (%)</th>
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<tr>
<td></td>
<td>Baseline</td>
<td>Mid</td>
</tr>
<tr>
<td>Language</td>
<td>73.2 (10.73)</td>
<td>68.4  (12.90)</td>
</tr>
<tr>
<td>Eye hand co-ordination</td>
<td>78.4 (11.53)</td>
<td>80.5 (16.63)</td>
</tr>
<tr>
<td>Performance</td>
<td>77.1 (21.64)</td>
<td>90.1  (19.95)</td>
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<tr>
<td>Practical reasoning</td>
<td>75.7 (8.36)</td>
<td>72.1  (10.64)</td>
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<tr>
<td>General Quotient*</td>
<td>80.3 (11.14)</td>
<td>79.8  (14.19)</td>
</tr>
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</table>

*Missing data: One child from the PICIHBI group GQ, at post test (n=10)

\(^{a}\)Statistically significant change (p<0.005)

Overall change in GMDS-ER scores over time

No statistically significant between group differences were found for any of the GMDS-ER outcomes at any time point (p>0.05). One within group change was noted. A statistically significant improvement in performance was observed for the conventional group from baseline to mid test (p=.027). While not statistically significant, changes were noted within the two groups. Except for language and practical reasoning in the conventional group, all post test assessment scores were higher than the baseline assessment scores in both groups. Scores generally improved from baseline to mid test except for eye hand coordination in the PICIHBI group and language, practical reasoning, and general quotient in the comparison
conventional group. Eye hand coordination and general quotient improved at post test and was higher than the baseline assessment, while language and practical reasoning continued to decline and post test scores were lower than baseline.

**Aim 3: Grade progression**

The third objective was to track the grade progression of the children in each group. Only one child in the comparison conventional group repeated a grade, grade one, the second year of formal schooling in [removed for blind review].

**Adverse Effects**

No adverse effects were noted or documented.

**Discussion**

At the time, this study was novel in its exploration of the impact of an occupational therapy intervention on the academic learning outcomes of the HIV-infected child on ART. Baseline results showed that the total sample all performed below average on all academic learning outcomes as measured by the DTVMI and the GMDS-ER. The academic learning outcomes most affected were visual perception, language and practical reasoning. For visual perception, 40.9% of the total sample scored <70 at baseline. The high percentage of children experiencing difficulties with visual perception correlates with the results of a study by Laughton et al. showing the negative impact on HIV on visual perception, regardless of the ART regime provided. Visual perceptual difficulties are a concern as a visual learning approach is dominant in many school environments. For practical reasoning and language, 78.3% and 69.6% respectively of the children scored <2 z-scores, which was also consistent with prior studies describing neurodevelopment in HIV children.

Between-group analysis showed that there were no statistically significance differences in the performance of the groups at all measurement points for all academic learning outcomes. This showed that PICHIBI had equivalent effects on the academic learning outcomes for HIV positive children aged 5 – 8 years, on ART and living in low SES families, when compared to the comparison conventional group.

Within-group analysis showed some statistically significant results. PICHIBI was significantly more effective (p=.019) in improving visual motor integration over a five-month intervention period, from baseline to mid test. The positive change in a group format intervention over a five-month period is encouraging as well-developed visual motor integration skills have been linked to the development of effective handwriting in children and high levels of academic
performance\textsuperscript{25}. The conventional intervention was significantly beneficial in improving visual perception over a five- and ten-month intervention period, which could possibly be linked to the more intensive focus placed on specific visual perceptual skills within the format of the individual conventional intervention approach. A statistically significant improvement in performance was observed for the comparison conventional group (\(p=.027\)) from baseline to mid test. While there were decreases and increases in other academic learning outcomes, between assessment points for each group, none of these changes were statistically significant which support that specific time points were not more viable to effect changes in these outcomes. While there was a decrease in the number of children scoring <70 seen from baseline to post test in both groups, children continued to present with difficulties in academic learning outcomes at post test.

Limitations
A small sample size (\(n=23\)) resulted in wider confidence intervals effecting the generalizability of the results. No follow up assessments were conducted. This limited the researcher’s discernment if the improvements or digression in scores in the various academic learning outcomes, were purely due to intervention or in addition to the natural maturation of a child over time. Not all variances measured in the two groups were equal and this may have affected a Type I error rate. Attaining participant’s recent school reports would have allowed for further comparisons to be made between academic learning outcomes assessed in the intervention and in the classroom.

Conclusion
This article highlighted the deficits in various academic learning outcomes of HIV positive children. These results assist in informing occupational therapy practice protocols, policies and legislations, specifically relating to academic learning for children with HIV on ART in [removed for blind review]. Deficits in the areas of language and practical reasoning should urge occupational therapists to partner with communication science therapists and educational specialists to design intervention which support the academic progress of children with HIV living in the multi-lingual context of [removed for blind review]. Rehabilitation in [removed for blind review] continues to be undermined by staffing constraints limiting the reach of services. The group format of the PICHBI holds the potential to have a greater reach when compared to conventional one-on-one intervention\textsuperscript{25}. Attendance was however problematic with a slightly higher level of attendance in the comparison control group. Further investigation into the feasibility and effect of PICHBI within a larger multi-site study, drawing on mechanisms to build on attendance, is thus recommended.
Comparing the impact of two occupational therapy-based interventions on academic learning outcomes for HIV-positive children submitted 17 June 2022
References


Comparing the impact of two occupational therapy based interventions on academic learning outcomes for HIV positive children. Submitted 17 June 2022.
Figure 1: Conceptual map of the targeted academic learning outcomes informing the development of the content of the PICIHB1
Figure 2. Participant Flowchart
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