Article

A Comparison of the Visual Perceptual Processing Skills of Children (6-10 Years Old) with and without Human Immuno-Deficiency Virus (HIV) Using the Test of Visual Perceptual Skills-3rd Edition (TVPS-3) in Harare, Zimbabwe.

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Abstract

Background: Visual perceptual skills are essential for independent participation in self-care tasks, educational, work and leisure time activities. The effect of HIV on the visual perceptual skills is not well understood among children in low resource settings like Zimbabwe.
Methods: A cross sectional comparative study was done with 30 children living with HIV and 30 children living without HIV residing in Harare urban area. The TVPS-3 was used to assess their visual perceptual skills. SPSS version 22, STATISTICA 13 and Microsoft 2016 were used for data analysis.
Results: Both groups of children had mean percentile ranks below 50 on their TVPS-3 scores. Children without HIV generally performed better than those with HIV but the difference was not statistically significant in most cases. Through univariate analysis, only performance on Spatial Relations significantly differed between the two groups. Both groups had lowest scores in Basic visual perceptual skills. Age and school grade were the independent predictors of the children's performances in the study.
Conclusion: There is need for Occupational therapy services in public primary schools and in the pediatric Opportunistic Infections clinics in hospitals to be part of the health team which caters for children with visual perceptual challenges.
Key words: Occupational therapy, visual perceptual skills, Test of Visual Perceptual Skills-3 (TVPS-3), Human Immunodeficiency Virus (HIV).

Abbreviations: Visual Discrimination (VD); Visual Memory (VM); Visual Spatial Relationships (VSR); Visual Form Constancy (VFC); Visual Sequential Memory (VSM); Visual Figure Ground (VFG); Visual Closure (VC); Test of Visual Perceptual Skills 3rd Edition (TVPS-3); Statistical Package for the Social Sciences (SPSS); Highly Active Antiretroviral (HAART); Human Immunodeficiency Virus (HIV).

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1.0 Introduction

The Human Immunodeficiency Virus (HIV) is a virus which leads to Acquired Immunodeficiency Syndrome (AIDS) over time if untreated (AVERT 2017). A report from The Joint United Nations Programme on HIV and AIDS (UNAIDS) of 2016 estimated that by the end of 2015, there were 36.7 million people living with HIV globally and among them, 1.8 million were children under the age of 15. In Sub-Saharan Africa, a study conducted by UNAIDS in 2015 reported that 25.5 million people were living with HIV, accounting for 70% of the global total estimate. The National AIDS Council of Zimbabwe estimated that 1.4 million people were living with HIV including 77 000 children under age of 15 (AVERT 2015). The prevalence rate for children (0-14 years old) was at 1.6% (ZIMPHIA 2016). Since HIV was discovered, researchers have recognized that it can affect the brain (Highleyman 2010). People living with HIV can have some form of cognitive, motor control or psychological impairments (Lowenthal 2014). In a child's first 4 years of life, brain development takes its genesis (Ngoma and Mwaba 2015). During the brain development stages, HIV has been linked to a variety of developmental problems such as activity, language, cranial nerve, gross and fine motor skills, cerebellar, sensory and primitive reflex skills limitations (Ngoma and Mwaba 2015). This may happen because the brain and the central nervous system are viral reservoirs which cause the disease to progress and initiate structural changes to the brain (Van Rie et al. 2007). In a study by Sherr and colleagues in 2017 in Malawi and South Africa, they confirmed that children with HIV had lower performances on the cognitive assessments than their counterparts without HIV (Sherr et al. 2018). Neurological disorders in persons living with HIV are mainly as a result of changes in the brain's chemical environment induced by the virus once it traverses the blood-brain barrier (Bloom and Rausch 1997). The effects of HIV can also destruct neurons in the brain which are related to the visual perceptual processing skills of persons living with HIV especially in children (Lowenthal 2014). The daily functional skills of children living with HIV can be improved when they continue to adhere to medications such as the highly active antiretroviral therapy (HAART) as well the community integrating them in their activities (Ngoma and Mwaba 2015).

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Visual perceptual skills involve receiving, organizing and understanding what is seen in the surroundings of an individual (Cooke et al. 2006). The ability of people to perform optimally in tasks of everyday life depends on their visual perceptual skills and their environmental contexts (Bainbridge 2015). These processing abilities include visual discrimination, visual memory, visual-spatial relationship, visual form constancy, visual figure-ground, visual sequential memory and visual closure (Coté 2015; Bainbridge 2015). Visual perceptual skills are essential in the cognitive growth and handwriting skills of school going age children (Mona et al 2015). Understanding the effects of HIV on visual perception is important in planning Occupational therapy intervention for children who have visual perceptual problems especially when they start going to school, as it affects their learning and play skills (Thomaidis et al 2014). Early identification of visual perceptual problems in children with HIV helps Occupational therapists to craft appropriate interventions and minimize the disabling effects of this life-long ailment on children's functional performance in occupations. Therefore, the aims of the study were to determine the performance of children (6-10 years old) with and without HIV on the Test of Visual Perceptual Skills 3rd edition (TVPS-3), to determine the visual perceptual skills affected in children (6-10 years old) with and without HIV, to determine if there is a statistically significant difference in the visual perceptual skills of children (6-10 years old) with and without HIV as measured by the TVPS-3 percentile rank scores and to determine the independent predictors of the children's performances on the TVPS-3.

2.0 Materials and Methods

2.1 Patient enrolment criteria

This was a descriptive cross-sectional study carried out to determine the differences in the visual perceptual skills of children with HIV who were outpatients at opportunistic infections clinics of two major hospitals and children without HIV who were attending high-density primary schools that surround the hospitals in Harare Zimbabwe. The sample size was based on previous similar studies such as (Menken et al 1987) used 24 participants, (Ahmetoglu 2013) used 30 participants and (Bainbridge 2015) used 34 participants in each arm of the comparison groups which they studied and they all used convenience sampling method. In this study, the researcher sought to use 30 participants in each arm of the study, to be compared because it is a manageable number considering the demands of the instrument. The sampling method was convenience for participants without HIV and stratified random sampling for participants living with HIV. The

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sample size was calculated using the Dobson formula (Rose et al 2015). Sample size of this study was calculated using the formula

: $\boldsymbol{n = z^2pq \div e^2}$ (Rose et al 2015)

n=sample size

z=confidence interval (1.96)

P=prevalence of children under 15 years with HIV in Zimbabwe was 12.1% (AVERT 2015)

q= (1-p)

e=level of precision 10%

$$n = \frac{(3{,}84)\ (0{,}085)\ (0{,}915)}{(0{,}01)}$$

n= 29.87

For the sample to be representative to the population, n must be equal to 30. Therefore, the researcher suggested the sample size in each arm to be rounded to 30 children. Thus, the study sample that was used consisted of 60 participants i.e. (30 with HIV and 30 without HIV). Fifteen participants were recruited from each setting, hospital 1 and 2 and school 1 and 2, i.e. 30 children living with HIV in the first group and 30 children without HIV in the second group. Fifteen participants were to be recruited from each of the 4 study settings; two schools S1 and S2 located in the high density suburbs of Harare and two hospitals H1 and H2 located in the high density suburbs of Harare. A stratified random sampling method was used to select 30 children without HIV from S1 and S2 according to school grade. Convenience sampling method was used to select children living with HIV from H1 and H2 as they came to the clinics for regular medical check-ups. The participants in schools were matched according to gender, grade and age but participants in hospitals were not adequately matched according to gender, grade and age because diagnosis was not determined by gender, some were not attending school at the time of data collection and most children who were coming to the hospital were a little older than their counterparts in the other group respectively. The inclusion criteria were based on age (6 to 10 years old-children), HIV status which was confirmed by the children's parents, their personal medical books and also children whose parents gave consent to their participation. The exclusion criteria included children who fell sick on days of data collection and those whose parents did not give consent to their participation in the study.

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The Test of Visual Perceptual skills 3rd edition (TVPS-3), (Martin, 2006) may also be used to track progress over time and for research. The TVPS-3 is an appropriate tool to measure the visual perceptual strengths and weaknesses of people aged 4 years 0 months through 18 years 11 months. The test materials include an examiner's manual, test booklet and score sheets. The TVPS-3 test takes around 30 minutes depending on the child's age, amount of effort needed and experience of the assessor (Bainbridge 2015). It was locally adapted and used to assess the visual perceptual skills of children with or without HIV. It consisted of 112 black and white diagrams structured in 7 subtests. The 7 subtests are arranged in order of difficulty starting from visual discrimination, visual memory, spatial relationships, form constancy, sequential memory, visual figure ground and finally on visual closure. Each of the 7 sub-tests starts with two example items (which are not scored), followed by 16 test items of cumulative difficulty. Only in two subtests, visual memory and sequential memory, their item presentation is timed for 5 seconds whereas the responses to all other items are untimed. The TVPS-3 was in a multiple-choice format which is more of pictorial illustrations with verbal assistance from examiner and each child made their choice verbally and by pointing with a finger (Brown 2003). The TVPS-3 has not yet been validated in Zimbabwe but the study managed to engage the tool with a smaller sample initially then pave a way for other researchers to validate it using a larger sample of children (See Appendix 11).

The subtests are administered to the person as follows;

- Visual Discrimination (VD) - the person is shown a design and is asked to point to the similar design among the choices shown below the design (Brown 2003).
- Visual Memory (VM) - the person is shown (for 5 seconds) a design on one page, the page is turned, and the child is asked to choose the same design from among the choices shown on the following page (Brown 2003).
- Visual Spatial Relationships (VSR) - the person is shown a series of designs on a page and asked to choose the one that is different from the rest; it may differ in a detail or in the rotation of all or part of the design (Brown 2003).
- Visual Form Constancy (VFC) - the person is asked to find one design among others on the page; the design can be larger, smaller, or rotated (Brown 2003).

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- Visual Sequential Memory (VSM) - the person is shown (for 5 seconds) design sequences, the page is turned, and the child is asked to choose the matching design from among the choices on the following page (Brown 2003).
- Visual Figure Ground (VFG) -the person is asked to find one design among many within a complex background (Brown 2003).
- Visual Closure (VC) - the person is shown a completed design on the page and is asked to match it to one of the incomplete patterns shown on the page (Brown 2003).

The visual perceptual skills are further combined into Basic processing skills, Sequencing skills and Complex processing skills. The Basic processing skills are Visual discrimination, Visual memory, Visual Spatial relationships and Visual form constancy. The Sequencing skills include Visual sequential memory. The Complex processing skills include the Visual figure ground and Visual closure. (Bainbridge 2015). The score sheets have the date of test, date of birth, child's school, child's grade and chronological age that need to be filled in. The chronological age is calculated by subtracting the date of test of each child from their date of birth (Martin 2006). Each child's responses on the TVPS-3 booklet for each subtest is recorded on the score sheet. Each subtest has a total of 16 test items and the child's responses will be recorded as 1 for correct answer and 0 for an incorrect answer (Martin 2006). The total correct answers of the child in each subtest will be added up to produce a raw score which is then recorded on the front page of the score sheet. The raw scores would be seven representing the seven subtests on the instrument. The raw scores will be converted to standard scores using age equivalent conversion tables and then they will be further converted to percentile ranks using the same tables so as to produce measurability of the child's visual perception skills (Martin 2006) (See Appendix 13).

2.2 Data collection methods

Data was collected between December 2016 to February 2017 from the two hospitals and the two schools. The administrator was the author of this study and she received the training at the Occupational therapy classes offered by University of Zimbabwe College of Health Sciences. No inter-rater reliability was measured at the time of the study as the focus was not mainly on the instrument but for future studies, researchers can investigate the reliability and validity of the TVPS-3 instrument in Zimbabwe with a larger sample size. Informed consent was obtained from

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the children's caregivers during a meeting that was arranged in the morning before their check-ups. Those who agreed to participate were given consent forms and child assent forms prescribed in English or Shona language as per their preference. The HIV status was confirmed from their medical books. For primary schools, data were collected in the morning and during break-time. Children aged 6-10 years i.e. grade 1 to 4 were given consent forms to give to their parents to confirm their participation in the study. According to the method described above, for those who agreed to participate, the child's HIV status was confirmed from medical/clinical books.

The TVPS-3 was administered to participants individually at school classrooms and hospitals. The children's age, school name, date of test, date of birth and school grade were recorded. For each child, the test duration was approximately 25 to 40 minutes. Each subtest had a total of 16 test items and the child's responses were converted to 1 for indicating correct answer and 0 for incorrect answer. The correct answers in each subset for each child were summed-up to produce a raw score which was recorded on a score sheet. Seven sets of raw scores representing 7 subtests on the instrument were obtained. The raw scores were converted to standard scores using age-equivalent conversion tables and to percentile ranks using the same tables to produce measurability of the child's visual perceptual skills. The score sheets of all participants were sealed and treated with confidentiality. The data entry sheets only contained the numerical code for each participant's data without their names or addresses.

2.3 Ethical considerations and permissions

The researcher was granted permission to carry out the study by the Joint Parirenyatwa Hospital and College of Health Sciences Research Ethics Committee (JREC Ref: 291/16). Similarly, permission to carry out the study in primary schools was granted by the Ministry of Primary and Secondary Education (Ref: C/426/3). The researcher was granted ethical approval by the Medical Research Council of Zimbabwe (Ref: MRCZ/B/1166) and the Harare Central Hospital Ethics Committee (HCHEC 260916/74). Parental informed consent and child assent were also sought as described earlier. The results of the testing were made available to the parents, nurses in charge at the hospitals and school headmasters after the analysis was done. The children who were found to have very poor visual perceptual skills were advised through their teachers and parents to visit the occupational therapy departments in the hospitals near to them for treatment. The information that

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was gathered by the researcher was kept under lock and key and no names of schools or publication would be used publicly for confidentiality reasons.

3.0 Data analysis

The researcher used the Statistical Package for Social Sciences Program (SPSS) version 22.0 and STATISTICA 13 for data entry, generation of descriptive statistics, analytical statistics and to calculate frequencies then Microsoft Excel 2016 was used for plotting bar graphs. The raw data scores on score sheets from the participants were first coded into numbers for identification. The raw scores were then entered on a spreadsheet on SPSS. The raw scores were converted to percentile ranks using age-dependent tables of visual perceptual skills which are part of the TVPS-3 test kit. The percentile ranks were used because they are easy to interpret and measure the person's performance unlike raw scores which can be confusing (Bainbridge 2015). The information was then manipulated using SPSS to generate descriptive analysis i.e. to produce frequencies, means and standard deviations between two groups in the study. The researcher further used analytical tests such as the Univariate analysis and Multivariate analysis to test the differences between two independent groups using their mean values of their TVPS-3 percentile rank scores (See Appendix 12). Regression models were created using SPSS to determine factors that were significantly associated with the children's performances on the TVPS-3 scores (See Appendix 12). The 50^{th} percentile rank was used as a benchmark as the average visual perceptual ability a child can have. If the child had scores above 50^{th} percentile rank it indicated good visual perceptual skills and if the child had scores below the 50^{th} percentile rank it indicated poor visual perceptual skills.

4.0 Results

Out of 76 caregivers who were approached, 60 of them gave consents giving an estimated response rate of 80% while 16 did not give consent to participate citing their unavailability due to time constraints. Overall, the mean age was 7.9 years old (SD 1.2) with children with HIV being older than those without HIV (Table 1). There was an equal number of males and females in the participants without HIV and more males than females in participants living with HIV. Most of the participants were attending school except for (give a number) 23.3% of children who had HIV who were not attending school at the time of data collection.

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Table A1. Demographic characteristics of the norming sample (n = 60)

Demographic characteristics	Overall (Both groups)	HIV Negative (n=30)	HIV Positive (n=30)	P value
Gender: Male Female	32 (53%) 28 (47%)	15 (30%) 15 (30%)	17 (56.7%) 13 (43.3%)	0.612
Age in years Mean (SD)	7.9 (1.2)	7.6 (1.3)	8.2 (1.1)	0.046
Centres: Schools (1 and 2) Hospitals (1 and 2)	30 (50%) 30 (50%)	30 (100%) 0	0 30 (100%)	0.000
School attendance: Attending Not attending	 53 (88.3%) 7 (11.7%)	 30 (100%) 0	 23 (76.7%) 7 (23.3%)	0.000
Grade 1 Grade 2 Grade 3 Grade 4	10 (18.9%) 13 (24.5%) 14 (26.4%) 16 (30.2%)	6 (20%) 8 (26.7%) 8 (26.7%) 8 (26.7%)	4 (13.3%) 5 (16.7%) 6 (20%) 8 (27%)	0.090

Performance of children with and without HIV on the specific sub-tests of the TVPS-3 (Percentile Ranks)

Figure 1. shows that children living with HIV had lower percentile ranks than children without HIV in all visual perceptual skills (Visual discrimination, Visual memory, Visual-spatial relations, Visual sequential memory, Visual figure-ground and Visual closure) except for Form constancy and Figure-ground perception where they outperformed children without HIV. The results further

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showed that both groups scored below the 50th percentile rank in all subtests.

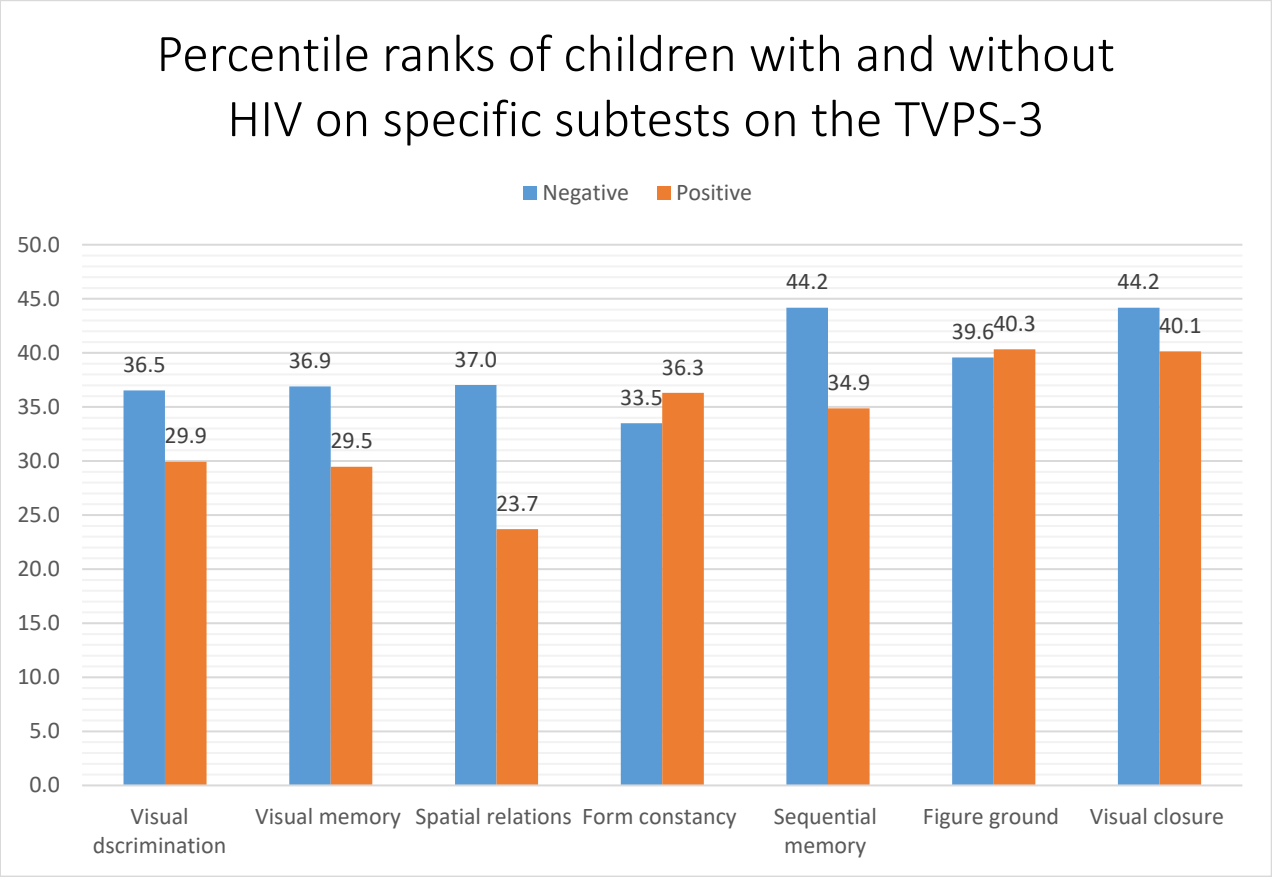

Figure A1. The performance of children with and without HIV on specific visual perceptual skills of the TVPS-3 (Percentile ranks).

Performance of Children with or without HIV on the combined sub-tests of the TVPS-3 (Percentile Ranks)

The visual perceptual processing skills were categorized into four broad areas namely; Overall, Basic, Sequential and Complex processing skills. All the seven sub-tests were under the Overall processing skills category. In the Basic processing skills, there is Visual discrimination, Visual memory, Spatial relations and Form constancy. The Sequential processing skills only consists of the Visual sequential memory sub-test. Lastly, the Complex processing skills consists of Figure-ground and Visual closure. As shown in Figure 2 and as highlighted above, participants from both groups had percentile ranks that were below 50. Children with HIV had lower percentile ranks than children without HIV on their performances on the TVPS-3. However, in both groups,

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participants had the lowest scores in the Basic visual perceptual processing skills and best performances in Sequential and Complex processing skills (Figure 2).

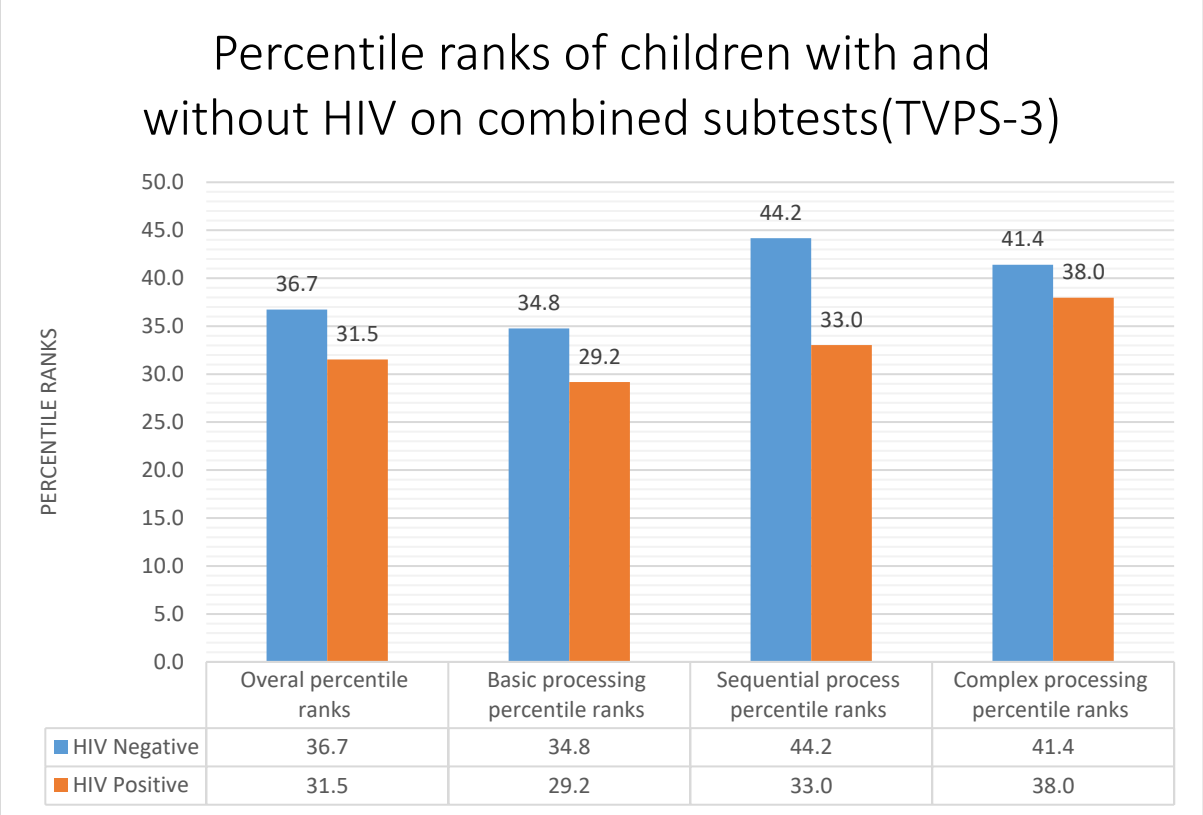

Figure A2. The performance of children with or without HIV on the combined visual perceptual skills of the TVPS-3 (Percentile ranks).

Comparison of the Performances of children with or without HIV on the TVPS-3

The Univariate analysis was conducted to test whether there was a statistically significant difference in the performance of children with and without HIV on the TVPS-3. For the test to be applied, an assumption was made that there was independence between children with and without HIV. The researcher tested the null hypothesis that there was no difference between the visual perceptual sub-test percentile rank scores obtained between the two groups, while the alternative hypothesis was held that there was a significant difference between the two groups. To generate the decision on whether to accept or reject the null hypothesis, the researcher used the p-value and compared it with a specified critical value. The critical value (p-value) of less than 0.05 was considered to be significant. The researcher assumed that if the value was less than the critical

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value (0.05) then it was possible to reject the null hypothesis. Table 2. illustrates the results of the analysis. HIV status had no significant effect on the percentile ranks scores of all other sub-tests except for Spatial relations as denoted by the p-value of 0.042.

Table A2. Comparison of the visual perceptual sub-test skills of children with or without HIV on the TVPS-3: Results from a Univariate analysis

The Visual Perceptual sub-test skills on TVPS-3 (Percentile ranks)	HIV Positive (N=30) Mean (SD)	HIV Negative (N=30) Mean (SD)	F value	P value
Visual discrimination	29.9 (26.6)	36.5 (32.1)	1.535	0.220
Visual memory	29.47 (23.7)	36.9 (37.0)	2.338	0.132
Spatial relations	23.7 (19.3)	37.03 (32.1)	4.306	0.042
Form constancy	36.3 (29.5)	33.5 (31.4)	2.254	0.139
Sequential memory	34.87 (25)	44.17 (29.7)	0.341	0.561
Figure ground	40.33 (29.9)	39.57 (33)	0.831	0.366
Visual closure	40.13 (31.7)	44.17 (32.6)	2.080	0.155

4.6 Independent predictors of the children's performances on the TVPS-3: Results from a Multivariate analysis

All effects regression models were done for the TVPS-3 sub-test skills as dependent variables and for the following independent variables; grade, school group, age, and HIV status to determine the factors that explain the performance of children on the TVPS-3 sub-tests after controlling for confounders. The results showed no significant relationship between HIV status and performance on all TVPS-3 sub-tests after controlling for other factors. However, age was significantly associated with performance on Visual memory ($p = 0.009$), Spatial relations ($p = 0.040$), Form constancy ($p = 0.003$), Visual closure ($p = 0.006$) and Sequential memory ($p = 0.045$). The school

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grade was also significantly associated with Visual closure only (p = 0.040). Table 3. shows representative examples of table of coefficients obtained from the regression models for Visual closure sub-test. See Appendix 12 for further results of the other sub-tests of the TVPS-3 scores.

Table A3. Independent predictors of the children's performances on Visual closure skills on the TVPS-3

Visual Closure skills	Co-efficient	Standard Error	T-value	P-value	
Grade	8.70	4.14	2.10	0.040	
School group	-11.49	12.74	-0.90	0.371	
HIV	12.86	10.48	1.23	0.225	
Age	-13.07	4.53	-2.89	0.006	
Constant	120.29	28.72	4.19	0.000	
Adjusted R^2					0.076
F-Ratio					2.21

NB- Standard Error is that of the co-efficient.

5.0 Discussion

Children without HIV had percentile ranks that were below 50 but much higher than those who were living with HIV in most of the sub-tests scores. They had significantly low scores in figure-ground and form constancy sub-tests. Bainbridge (2015) in South Africa, also found similar results, all her participants with and without traumatic brain injury had percentile ranks below 50 on the TVPS-3. In 2016, a survey to determine the prevalence of visual perceptual deficits in typically developing children in India was done using the Motor-Free Visual Perception Test-Revised (MVPT–R) and they found similar results which pointed out that typically developing children can perform better than the HIV infected group on the visual perceptual sub-tests although more than half presented with some visual perceptual deficits (Misra 2016). The reason why they had percentile ranks below 50 could have been because most of the children were learning at low socio-economic primary schools which had few resources that stimulate their visual perceptual skills. In 2017, Mlambo and colleagues in Harare, Zimbabwe, also found that typically developing

 doi:10.20944/preprints201808.0462.v1

children from low socio-economic schools performed below the 50th percentile score on the adapted Detroit Tests of Learning Aptitudes 4th edition (Mlambo et al 2017).

Children living with HIV also performed poorly with percentile ranks that were below 50 and they had much lower scores than those without HIV on most of the visual perception sub-test skills on the TVPS-3. Their mean percentile ranks ranged from 23.7 to 40.3. In a study by (Bainbridge 2015), a similar pattern was observed in participants with traumatic brain injury who had very low percentile ranks that fell between 13.4 and 18.11. A study done in 1987 in a group of children with learning disabilities demonstrated lower total TVPS accuracy scores and had significantly lower accuracy sub-test scores on Visual Form Constancy, Visual Sequential Memory, Visual Figure-Ground and Visual Closure (Hung et al 1987). In another similar study comparing visual perceptual skills of children with Attention Deficit Hyperactive Disorder with typical children done by (Ahmetoglu 2013), children with Attention Deficit Hyperactive Disorder presented with poor visual perceptual processing skills in almost all the sub-test skills. This could indicate that people with some form of trauma on the brain or viral disease which affects the brain may induce some form of impairment in their visual perceptual processing skills. In this study, children living with HIV were asymptomatic suggesting that they could perform on the TVPS-3 like their HIV negative counterparts but with slightly lower scores in six of the sub-tests and very low scores in Spatial Relations sub-test. The low scores in Spatial Relations might be due to lack of exposure to games, toys or school activities that incorporate the use of body awareness and spatial relations of objects in space

The performance of the children with and without HIV did not statistically differ in all TVPS-3 sub-tests except for the Spatial Relations sub-test in which children with HIV scored significantly lower than their counterparts without HIV. This result is inconsistent with previous studies where children with HIV or any neurodevelopmental conditions performed significantly lower than those without (Ahmetoglu 2013; Molloy et al 2013; Mona et al 2015). The reasons for no significant difference between the two groups in this study could be to do with the low performance of children without HIV who were all from low socio-economic surroundings while a proportion of children with HIV were coming from better socio-economic surroundings as depicted by the schools they were attending. Mlambo and colleagues (2017) found that low socio-economic status as depicted by school type had a negative impact on children's neuro-cognitive performance

 doi:10.20944/preprints201808.0462.v1

including visual perceptual skills. Another possible reason for a lack of significant difference may have to do with the assessment tool which has not been validated and normed for the setting. As a result, there is a tendency for all children's performance to be rated as poor. Percentile ranks in this study in both groups were below 50 indicating the need for occupational therapy services for all the children whether HIV positive or not.

Visual perceptual processing skills in children can be challenged by different factors apart from HIV depending on the child's health condition and environmental surroundings. In this study, some factors that affected children's visual perceptual performances on the TVPS-3 were age and school grade. In a fact sheet compiled by American Optometric Association (2017), they discussed that visual perceptual skills of children were affected by many factors such as age, school grade, attention span and learning disabilities which is consistent with the results of this study. Different studies by Arterberry (2008), Farroni & Menon (2008) and Kim et al (2014) showed that age could affect visual perceptual skills and visual motor integration skills of people. Age and school grade can affect visual perceptual skills of children may be because as children grow up, their brain cells mature and develop together with their visual perceptual skills. The school grade may affect children's visual perceptual skills because as they progress in school they face an increasing demand on their visual perceptual abilities e.g. when a child starts school, it has little exposure to visual perceptual materials like diagrams, shapes, colours, etc. and as the child progresses to higher school grades, the demands of visual perceptual skills increase therefore bringing up challenges to the child.

Limitations and strengths of the study

This study was limited in sample size, hence for future research, there is need to carry out a large scale study involving multicentre enrolment of participants and approaches to improve the outcome. The study was limited in proper matching so future studies can also perform proper matching of participants. Other limitations of the study included; the TVPS-3 instrument had not been normed for children in the Zimbabwean setting and there was lack of reliability scores for the instrument therefore, future studies can investigate the reliability and validity scores of the TVPS-3 in Zimbabwe with a larger sample size. The study was done in the high-density suburbs of Harare which is usually associated with low socio-economic status, so for further research, there is need to conduct this study comparing the visual perceptual processing skills of children from

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high-density suburbs (public primary schools) and children from low-density suburbs (private primary schools) of Harare, Zimbabwe. For future research, mixed methods strategy using quantitative and qualitative approach would allow full exploration of different factors that affect the visual perceptual skills of children with and without HIV. Further research can be done using the TVPS-3 to assess the visual perceptual skills of other groups of children such as those with cerebral palsy, autism, etc., comparing them to children of typical development.

6.0 Conclusion and Recommendations

From the study, it was noted that all participants had percentile ranks that were below 50 indicating the need of occupational therapy services that focus on improving the visual perceptual skills of children in public primary schools before they mature into adolescence. Occupational therapy services should also expand to the paediatric opportunistic infections clinics to cater for the needs of children living with HIV. Occupational therapy students in Zimbabwe should also be trained to use the tools for assessing visual perceptual skills in children and adults. We recommend to The Ministry of Primary and Secondary Education of Zimbabwe to implement or revive early arts and crafts lessons in the curriculum of children from 6 to 10 years of age i.e. preschool to grade 5 in primary schools in Zimbabwe so that children have early exposure to different types of visual perceptual skills needed in their everyday life. This indicates the need to incorporate at least one or two occupational therapists to work with school teachers in public primary schools to run the arts and crafts lessons.

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