ORIGINAL ARTICLE

Motor skills and verbal fluency in HIV positive older adults in Rural Eastern Zambia

F Kayungwa[1]*, R Serpell,[1] R Heaton[2]

[1]*Department of Psychiatry, University of Zambia*
[2]*CHARTER- University of California, San Diego*

ABSTRACT

Objectives: To investigate the performance of HIV infected older adults resident in a rural area in Eastern Zambia with low education level on the motor skills and verbal fluency.

Materials and Methods: A quantitative and cross sectional study consisting of 28 HIV positive and 22 HIV negative rural resident adults in Chipata with the age range of 40-65years with fewer than five years of education. The present sub study extended the generalisability of the Zambia Neurobehavioral Test Battery (ZNTB) findings with literate, urban adults in the main study to a sample of less formally educated, elderly, rural adults, using tests of motor skill and some verbal fluency tests translated into local language, that were not expected to depend on formal education. The main sample study included 41 participants with the education range of 5-7 years drawn from the main sample in the 6 clinics in Lusaka. Some aspects of the ZNTB were used to measure cognitive functioning. The Finger Tapping Test of the Developmental Neuropsychological Test Battery was also used.

Results: Tests of motor skill were less sensitive to HIV infection (F (1, 48) = 1.134, p= .292) than verbal fluency tests-Hopkins Verbal Learning (F (1, 48) = 42.994, p= .000, Hopkins Verbal Learning Test- delay (F (1, 48) = 45.886, p= .000, Animal Naming (F(1, 48) = 14.772, p= .000 and Action Naming (F (1, 48) = 14.227, p= .000). Contrary to hypothesis, performance on the grooved pegboard test of motor skill was significantly higher by participants with full primary education (Z score= -0.90) than by less educated participants (Z score= 1.80).

Conclusions: This study has brought to light what was not known about the effect of HIV and education on the performance of the motor tasks and verbal fluency among the low literate adults. It has shown that regardless of the HIV status individuals can perform tasks normally on the motor tasks more especially with the improved treatment of HIV.

***Corresponding Author**
F Kayungwa
Department of Psychiatry, University of Zambia

INTRODUCTION

HIV and AIDS is a growing problem and it affects all people worldwide. As of 2009, it was estimated that there were 33.3 million people worldwide living with HIV and AIDS, with 2.6 million new HIV infections per year and 1.8 million annual deaths due to AIDS . In Africa, the Sub-Saharan region leads in the HIV and AIDS cases with Southern Africa most affected. In 2007, this sub-region accounted for 22.5 million people with HIV, which is 68% of the global total. In Zambia, with a population of 13.1 million, the prevalence rate of adults age 15-49 infected with HIV is 13 percent.

Among the complications that are associated with the HIV pandemic is the HIV Associated Neurocognitive Disorders (HAND). There are three HAND forms namely; Asymptomatic Neurocognitive Impairment (ANI), Mild Neurocognitive Disorder (MND) and HIV Associated Dementia (HAD) and all these forms require that there should be no pre-existing neurological disorder caused entirely or with the greatest likelihood by HIV infection itself. The above definitions concentrate very clearly on neurocognitive domains that are known to be affected by HIV infection, such as attention, information processing, language, executive skills, perceptual motor skills, memory including learning and recall, simple motor skills or sensory abilities.

HIV directly affects the Central Nervous System (CNS) causing neurological disorders by entering into the system within the first two weeks of primary HIV infection. The

HIV is carried across the brain-blood barrier where it differentiates into macrophages thereby inducing a chronic inflammatory process. Various neurocognitive domains are typically affected by HIV infection giving rise to various neurocognitive impairments. The motor domain is one of the neurocognitive functions that are affected by the HIV infection with observed deficits in motor functioning, including psychomotor processing and motor speed slowing. Psychomotor/motor slowing remains a common neurocognitive challenge among patients who are HIV positive and the classification of cognitive/motor disorder or minor neurocognitive disorder (including motor) remain among the most frequently observed types of motor disorder in cohort-based studies.

In order to find out the extent of neurocognitive deficits in humans as a result of HIV infection and other causes, a neuropsychological assessment is usually conducted. Neuropsychological assessment is now known to be useful in diagnosis of cognitive deficits and brain related disorders, treatment planning and care of the patient as well as in research.

Literature has shown that education plays a role in neuropsychological assessment as most of the tests require some level of proficiency in reading and writing. However, a sizeable number of adults in Zambia have not received any schooling particularly in the rural areas. In rural areas 20 percent of the adult population has never attended school, compared to 5 percent in urban areas. Very little research has been conducted in Zambia regarding the assessment of persons with low education and are HIV positive. Little is known about the effect of HIV, education, language of instruction, gender and age on the performance on the tests of motor domain among the low literate adults. This study therefore set to investigate the performance of HIV infected adults resident in a rural area with low education level on the motor skills and verbal fluency.

METHODS

In the main study, HIV positive participants with at least 5 years of schooling and at least basic literacy were recruited with a wide range of ages and all resident in the urban areas of Lusaka. This group consisted of participants with the following education level (5-7 years, N=41), (8-9 years, N=78), (10-12 years, N=126) and (13-17 years, N=18). The age ranged from 20 to 65 years. In the sub-study, an extra sample was recruited comprising HIV positive and HIV negative adults with the education level of 0-4 years and aged between 40 years and 65 years resident in Chipata rural in the Eastern Province where the indigenous Zambian language Chichewa is spoken.

The present sub study extended the generalisability of the Zambia Neurobehavioral Test Battery (ZNTB) findings with literate, urban adults in the main study to a sample of less formally educated, elderly, rural adults, using tests of motor skill and some verbal fluency tests translated into local language, that were not expected to depend on formal education. The participants were tested on the motor domain and the verbal fluency domains.

The recruitment of participants was done through the health personnel in urban clinics in Lusaka District offering Anti-Retroviral Therapy (ART) Services and also rural clinics in Chipata. The clinics included Matero Main, Matero Referral, Kabwata, Chilenje, Kalingalinga in the case of the main sample and Magwero, Jerusalemu and Kantandala for the sub study. The prospective participants (HIV positive adults) were identified through medical records and those willing to participate in the study had their details recorded and then a date and time was fixed when they would take part in the study.

The participants were briefed on the nature of the study, completion of the demographic questionnaire, seeking their permission and signing of the Consent form. Since the study also involved participants with low education level these were helped to fill in the questionnaire and the Consent form which was read to them before signing or stamping as the situation required.

Information such as the Beck Depression Inventory, Patient's Assessment of Own Functioning Inventory, Activities of Daily Living, Substance Use, Substance Use History, Use of Academic Skills Questionnaire and the Neurobehavioural Medical Screen was filled in. The Zambia Achievement Test (ZAT) was also used at this stage.

The Grooved Pegboard Test (GPT) and the Fingertip Tapping Test (FTT) as well as theHopkins Verbal Learning Test, Hopkins Verbal Learning Test-delay, Animal Naming and Action Namingwere administered to the 50 participants with low education and with the age range of 40 to 65 years.

Table 1: Summary of instruments used

Learning and Delayed Recall (2 domains)	*Language*
Hopkins Verbal Learning Test, Revised-II	Category Fluency (Animals, Action)
Brief Visuospatial Memory Test – Revised	
Motor	***Screening for Effort***
Grooved Pegboard (Dominant and Non dominant)	Hiscock Memory Test Medical Screening Interview Behavioral Notes Summary Academic Skills Questionnaire

Ethical Consideration

At all stages of the study, ethical issues were followed. The participants were assured of confidentiality and were fully informed about the purpose, methods and intended possible use of the research and consent to participate in this study was sought from them. The study was approved by the University of Zambia Biomedical Ethics Committee and approval to conduct the study in various clinics was obtained by the Ministry of Health.

Data Analysis

The data was analysed using Statistical Package for Social Sciences version 16 (SPSS). Descriptive Analyses were performed for the selected dependent variables to obtain percentages, means, percentages and standard deviations.

One Way between -groups Analysis of Variance (ANOVA) was used to determine whether the HIV status, language of administration, gender, gender and HIV status, being Independent Variables, would have an effect on the performance on the tests of motor and verbal domain dependent variable.

ANOVA (Univariate) was used to establish whether education (Independent Variable) would have an effect on the performance on the motor and verbal domains.

RESULTS

Table 2: Effect of HIV within low education on motor and verbal fluency tests

ANOVA

Tests	*F*	Sig.	Partial Eta squared
Grooved Pegboard	1.134	.292	0.23
Finger Tapping	3.865	.055	0.074
Hopkins Verbal Learning	42.994	.000*	.472
Hopkins Verbal Learning-delay	45.886	.000*	.489
Animal Naming	14.772	.000*	.235
Action Naming	14.227	.000*	.229

***p a <.05**

A one- way between- groups ANOVA run to establish the effect of HIV within low education on each of the motor and verbal fluency tests indicated that there was statistical difference in all the verbal fluency tests, namely the Hopkins Verbal Learning (F (1, 48) = 42.994, p= .000, Hopkins Verbal Learning Test- delay (F (1, 48) = 45.886, p= .000, Animal Naming (F (1, 48) = 14.772, p= .000 and Action Naming (F (1, 48) = 14.227, p= .000. The effect sizes, calculated using partial eta squared for Hopkins Verbal Learning was .472, for Hopkins Verbal Learning-delay was .489, for Animal Naming was .235 and for Action Naming was .229 which according to Cohen (1988) are large effects. There was, however, no significance difference between groups in the mean scores on the tests of the motor domain, namely, the Grooved Pegboard (F (1, 48) = 1.134, p= .292 and Fingertip tapping (F (1,48) = 3.865, p= .055. The effect size, calculated using partial eta squared for the Grooved Pegboard was .023 and for the Finger Tapping was .074 which, according to Cohen (1988) were small and medium effects respectively.

Table 3: Degree to which education influences performance on the motor and verbal fluency tests

Test	*F*	P value	Partial Eta Squared
Grooved Peg Board (N=28)	55.098	.000	.451
Hopkins Verbal Learning Test (N=41)	95.870	.000	.589
Hopkins Verbal Learning Test-delay (N=41)	51.680	.000	.264
Animal Naming (N=41)	112.682	.000	.627
Action Naming (N=41)	77.930	.000	.365

***p a <.05**

The ANOVA (Univariate) computed to compare the performance of HIV positive adults (N=28) in the low literacy residents of Chipata with the education range of 0 to 4 years with the HIV positive adults (N=41) in the main study with education range of 5 to 7 years on the Grooved Pegboard, Hopkins Verbal Learning Test, Hopkins Verbal Learning Test- delay, Animal Naming and Action Naming. Education range found that education had significant effect on all the tests and the effect sizes for all the tests were large.

The results also indicated that older participants scored lower on motor tasks (*M=376.09, SD=117.49*) than younger participants (*M=237.34, SD=74.36*) and gender did not influence motor test performance (F (1,48) = 2.566, p= .116).

DISCUSSIONS

Effect of HIV on the performance of the tests of the motor and verbal fluency

The results indicate that the difference in performance between the HIV positive participants with low education (0-4 years) and HIV negative participants with similar education status was less on the motor domain than on the verbal fluency domain. The results are clearly in agreement with the earlier study in Ugandathat found that, after adjusting for education, the scores of HIV negative and HIV positive participants differed significantly on measures of verbal learning and memory, speed of processing, attention and executive functioning, but their difference in scores on the Grooved Pegboard test using the dominant and non-dominant hands was not statistically significant.

There could be a number of explanations to this. Firstly, the HIV (virus) in the participants that were targeted in the study may not have advanced far enough to affect their neurocognitive well- being. Specifically, the HIV may not have caused damage to the motor domain. As highlighted above, fine motor activity depends on the ability to perform precise movement co-ordination and includes elements of hand eye co-ordination and that of manual dexterity which require increased concentration.

It could be that the participants with HIV were also engaging themselves with the day to day tasks for survival especially farming. Therefore, the need to exercise fine motor control in their ongoing regular agricultural work could have caused them to make some kind of adaptation to overcome neurological impairment.

Secondly, since some of the participants who were HIV positive were taking Anti-Retroviral Therapy (ART) this could have affected the results. Initiation of antiretroviral therapy in these individuals could have reversed some of the neuropsychological deficits, and allow continued maintenance of employment outside of the home, or to complete activities to maintain the household. There is, though, still some debate on the effect of ART on the neurocognitive domains with some scholars indicating that there is an effect while others do not agree with these assertions.

As for the tests of the verbal fluency domain which include the Hopkins Verbal Learning, Hopkins Verbal Learning- delay, Animal Naming and Action Naming, it may be that the verbal fluency domain is affected in the earliest stages of HIV infection as compared to the motor domain.

Degree to which education influences performance on the motor and verbal fluency tests

Contrary to hypothesis, performance on the grooved pegboard test of motor skill was significantly higher by participants with full primary education.

Education had a large and significant effect on both the Grooved peg board and the verbal fluency tests. These results are consistent with the findings of the earlier studies,, ,,,,, who found that education had an effect on the performance on motor and verbal fluency tests.

The Grooved Pegboard Test (GPT) and Fingertip Tapping Test (FTT) may be affected by education differently. The pegboard task, in addition to motor execution also requires vision. The GPT is said to be a more cognitively demanding task than other motor tasks. This is so because, in addition to motor dexterity, vision, speed, attention and continuous monitoring of accuracy are also important components of task performance. The GPT is more strongly correlated with measures of most domains (memory, processing speed, executive functioning, and spatial organization) than the FTT. All these components discussed above point to the fact that some level of education is required to adequately perform these tasks for the GPT. For instance, an individual will need to plan in order to execute some task such as mentally rotating the pegs before physically inserting the same in the hole to fit squarely. Therefore, performance on the Grooved Pegboard may be enhanced by some aspects of education or schooling such as writing and drawing in which skills for pincer grasp, are for instance, developed and sharpened which are critical in hand dexterity and speed.

The other explanation is that significant differences in performance between education ranges of 0-4 years and

5-7 years on the Grooved Pegboard test could be attributed to the familiarity with testing. The participants with the education range of 5-7 years have been administered many tests at school and therefore are familiar and at ease with testing. On the other hand, the participants with the education range of 0-4 years have not been exposed to many situations and activities that require testing and hence their performance.

On the other hand, for the verbal fluency just one or two years of formal education may result in significant difference in test performance. In addition, successful performance of fluency tasks requires other cognitive domains such as executive functions like inhibition of words that do not conform to the rules of the task and mental set switching. The verbal fluency domain contains test items that require the production of English words and therefore, it is comprehensible that an educational effect was observed in this domain.

There are some limitations to consider when interpreting the findings of this study. The two tests on motor were somewhat brief and were from two different test batteries being the International Neurobehavioral Test Batterywhile the Neuropsychological Test Battery (NEPSY).

The study has brought to light what was not known about the effect of HIV and education on the performance of the motor tasks and verbal fluency among the low literate adults.

ACKNOWLEDGEMENTS

This study was conducted as part of the larger project by the Norad Masters Program (NOMA) in the Department of Psychiatry. The Primary investigators of the larger project are Prof. Robert Serpell (UNZA) and Prof. K. Hestad (Norwegian University of Technology, Norway).

REFERENCES

1. UNAIDS/WHO, (2010). World epidemic update.WHO Library Cataloguing-in-Publication Data.
2. Central Statistical Office (2014). *Zambia Demographic and Health Survey 2013-14.* Rockville, Maryland, USA: Central Statistical Office.
3. Rackstraw, S. (2011). HIV-related neurocognitive impairment- A review. Psychology, Health and Medicine, 16:5,548-563.
4. Davis, L.E., Hjelle, B.L., Miller, V.E., Palmer, D.L., Llewellyn, A.L., Merlin, T.L., & Wiley, C.A. (1992). Early viral brain invasion in iatrogenic human immunodeficiency virus infection. Neurology, 42, 1736–1739.
5. Gonza´ lez-Scarano, F.,& Marti´n-Garci´a, J. (2005). The Neuropathogenesis of AIDS. Nature Reviews Immunology, 5, 69–81.
6. Dennis, B.C., Houff, S.A., Han, D.Y., & Schmitt, F.A. (2011). Development of neurocognitive disorders in HIV AND AIDS. Neurobehavioural HIV medicine, 3, 9-18.
7. Lezak, M. D., Howeison, D. B., and Loring, D. W. (2004). Neuropsychological Assessment (4th Ed.) New York: Oxford University Press.
8. Central Statistical Office (2003) ? Zambia 2000 Census of Population and Housing: Zambia Analytical Report, Vol. 10" Lusaka: November, 2003.
9. Robertson, K.R., Nakasujja, N., Wong, M., Musis, S., Katabira, E., Parsons., T.D., Ronald, A., &Sacktor, N. (2007). Pattern of Neuropsychological performance among HIV positive patients in Uganda.*BMC Neurology*, **7**-8.
10. Reis, A., & Castro-Caldas, A. (1997). Illiteracy: A cause for biased cognitive development. Journal of the International Neuropsychological Society, 3, 444–450.
11. Ostrosky-Solis, F., Ardila, A., Rosselli, M., Lopez-Arango, G., Ureil-Medoza, V. (1998). Neuropsychological test performance in illiterates. Archives of Clinical Neuropsychology, 13, 645-660.
12. Ardila, A., Ostrosky-solis, F., & Mendoza, V.U. (2000). Learning to read is much more than learning to read: A neuropsychologically based reading program., Journal of the International Neuropsychological Society,. 6,789-801.
13. Ostrosky-Solis, F., & Ramirez, M. (2004). Effects of Culture and Education on Neuropsychological Testing: A Preliminary Study with Indigenous and Nonindigenous Population. Applied Neuropsychology, 11 (4), 186-193.
14. Manly J.J., Byrd, D., Touradji, P., Sanchezi, D., & Stern, Y. (2004). Literacy and cognitive change among ethnically diverse elders. International Journal of Psychology, 39 (1) 47-60.
15. Rosselli, M., Tappen, R., Williams, C., Salvatierra, J., &Zoller, Y. (2009). Level of Education and Category Fluency Task among Spanish Speaking Elders: Number of Words, Clustering and Switching Strategies. Aging, Neuropsychology, and Cognition, 16, 721-744.
16. Ashendolf, L., Vanderslice-Barr, .J.L., & Mc Caffrey, R.J. (2009). Motor Tests and Cognition in Healthy Adults. Applied Neuropsychology, 16 (3), 171-176.