

Neurocognitive Dysfunction Among Patients Living With HIV/AIDS in a National Teaching Hospital in Ghana: Mixed Method Approach

Delali Fiagbe (✉ dfiagbe@yahoo.co.uk)

University of Ghana School of Medicine and Dentistry <https://orcid.org/0000-0003-0570-3568>

Vincent Boima

University of Ghana

Vincent Ganu

Department of Medicine and Therapeutics, Korle-Bu Teaching Hospital

Maame Amissah-Arthur

Department of Medicine and Therapeutics, Korle-Bu Teaching Hospital

Ernest Yorke

Department of Medicine and Therapeutics, Korle-Bu Teaching Hospital

Dzifa Dey

Department of Medicine and Therapeutics, Korle-Bu Teaching Hospital

Kelvin Acquaye

University of Ghana

Anna Gyaban-Mensah

Department of Psychiatry, Korle-Bu Teaching Hospital

Peter Puplampu

Department of Medicine and Therapeutics, Korle-Bu Teaching Hospital

Patrick Adjei

Department of Medicine and Therapeutics, Korle-Bu Teaching Hospital

Charles Christopher Mate-Kole

University of Ghana Medical School

Research

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Abstract

Background

Studies have reported good therapeutic outcomes among persons living with HIV, however, there is evidence to indicate persisting cognitive deficits. The present study examined the pattern of neurocognitive deficits and psychosocial changes among persons living with HIV at a tertiary hospital in a Sub Saharan country, Ghana.

Method

This was facility-base cross-sectional study involving one hundred and twenty-three (123) patients recruited from an infectious disease unit in a national referral hospital. Structured questionnaire and standardized research instruments; Revised Quick Cognitive Screening Test (RQCST), Digit Span Test, Spatial Span Test, Cognitive Failure Questionnaire (CFQ), California Verbal Learning Test ii short form (CVLT), Santa Clara Strength of Religious (SCSR), Brief Symptom Inventory (BSI), WHO Quality of Life (WHOQOL) were used to obtain quantitative data on socio-demographic characteristics, cognitive function, spirituality, depression and quality of life. Eight individuals each were sampled for in-depth interviews. Responses were analyzed using interpretative phenomenological analysis (IPA). Statistical significance was set at < 0.05 .

Results

The results indicated that 54% of the participants experienced cognitive deficits. There was a significant correlation between duration of the illness in months and Revised Quick Cognitive Screening Test [RQCST] Global score, $r(73) = .29, p = .012$, and Verbal score, $r(73) = .35, p = .002$ and Brief Symptoms Inventory [BSI] Depression sub-domain, $r(61) = -.33, p = .009$. Physical Health, a domain in WHO quality of life was a significant predictor of cognitive deficits in patient living with HIV/AIDS

Conclusion

Cognitive deficits are associated with poor psychosocial outcomes in patient living with HIV/AIDS, Neurocognitive assessment should be considered a crucial aspect in the management of HIV rehabilitation.

Background

The Human Immunodeficiency Virus (HIV) pandemic is now a worldwide problem, with Sub-Saharan Africa as the epicentre¹ In 2019, approximately 37.9 million people were living with HIV and about 32 million people had died of AIDS-related causes since the beginning of the epidemic² In 2018, the prevalence of HIV in Ghana was estimated at 1.0% of the general population. The highest prevalence was in the Ashanti (3.2%), followed by Eastern (2.6%) and Central (1.5%), the lowest in the northern (0.6%) parts of country³.

Pathology in the brain induced by HIV usually referred to as HIV associated neurocognitive disorders (HAND) results in changes in behavioural, cognitive and motor functioning^{4,5}. The neurological dysfunction might be linked to the toxic HIV protein and cytokines secreted by infected mono-nuclear phagocytes in the brain resulting in dysfunction of brain cells and subsequent neuronal death⁶.

Neurocognitive disorders such as Mild Neurocognitive Disorder (MND), Asymptomatic Neurocognitive Impairment (ANI), HIV associated Dementia (HAD) are common among HIV positive patients compared to HIV negative patients irrespective of Antiretroviral Therapy (ART). Before the introduction of Highly Active Antiretroviral Therapy (HAART), the prevalence of dementia among HIV positive patients was high¹⁴. While the prevalence of dementia has decreased significantly in the post HAART era; mild cognitive deficits have become common despite treatment⁷.

HIV associated cognitive deficits such as new learning, verbal memory, executive function are common presentation in sub-Saharan Africa.

A study from Cameroon showed a decline in executive function, speed of information processing, working memory and memory recall. This pattern of deficits is similar to studies from the western world⁸. CNS HIV Anti-Retroviral Therapy Effects Research (CHARTER) study⁸, showed that 23% of patients with Asymptomatic Neurocognitive Impairment (ANI) had worsening neurocognitive function compared to 30% with Mild Neurocognitive Disorder MND^{9,10}.

Recent findings indicate that HIV-associated dementia, which is the most severe form of neurocognitive disorder is uncommon(2-4%), but milder forms of neurocognitive deficits in the population continue to persist. In the same population, patients without AIDS had mild neurocognitive disorder prevalence of 30%; those with HIV(adult) a prevalence of 50%.¹¹

The presence of HAND affects the patient in diverse ways; patients with HAND are less likely to be employed; difficulty in coping with social situations like paying attention during a conversation in a noisy environment; problems in managing medication, and difficulty keeping track of medication schedules. These deficits affect quality of life of patients¹². In addition, there seem to be a gap in research between the high income and low income countries

regarding Antiretroviral Therapy (ART), burden of disease, tools for evaluating neurocognitive disorders¹³ necessitating a study of this calibre in a sub-Saharan African country, Ghana.

The study sought to examine the relationships between neurocognitive deficits and psychosocial correlates in persons living with HIV/AIDS (PLWHA). The study explored coping strategies of persons living HIV/AIDS and their formulation of what it means to suffer from HIV/AIDS

Materials And Methods

Study Design

A hospital-based cross-sectional study was conducted over a six month period among one hundred and twenty three PLHIV at an infectious disease unit in a national referral centre in Accra, Ghana. A mixed method approach was adopted which included quantitative study employing the use structured instruments, this was followed by exploration of lived experiences of selected participants.

The unit attends to at least 240 out patients every week. There is a psychology subunit where patients are counseled for adherence to medication and given appropriate required general support therapy. Complicated cases are referred to the Psychiatry department for further management. The first line ARV therapy used in this clinic per the national guidelines are Tenofovir, Lamivudine and Dolutegravir

Sample size

A purposive sampling was used to recruit one hundred and twenty-three participants. The sample size was determined by Cohen's formulae for clinical sample size determination which emphasizes that to attain a medium size with a statistical power of 0.85, ($p=.05$), using regression analysis is one hundred and twenty-three. With a sample size of one hundred (123), the probability of type II error occurring was adequately minimized¹⁴.

Eligibility criteria

Inclusion criteria

1. Patients diagnosed with HIV/AIDS within six months to a year of study participation.
2. Aged 18 years and over
3. Patients who consent to participate.
4. Agreement to allow samples taken for CD4 counts

Exclusion criteria

1. Patients diagnosed with HIV/AIDS with co-morbid medical presentations prior to the diagnosis
2. Individuals with histories of severe psychiatric illness (e.g., schizophrenia or bipolar disorder), and neurological diseases before the diagnosis of HIV/AIDS.

Data collection

Quantitative

A structured questionnaire was designed to obtain basic demographic data (age, gender, educational status, and living status) and medical information (co morbidities, and duration of HIV/AIDS diagnosis) of study participants. This was followed by the administration of a battery of neurocognitive and behavioural tests.

Neurocognitive Measures

Neurocognitive tests are essential in assessing deficits in the various domains of cognition which include but not limited to verbal memory, working memory, visual memory, executive functioning, perceptual motor and spatial memory; Tests administered included; Revised Quick Cognitive Screening Test (RQCST)¹⁵, Cognitive Failure Questionnaire (CFQ)¹⁶, Trail Making Test (TMT)¹⁷, California Verbal Learning Test Second Edition [CVLT-II]¹⁸, Spatial Span subtest of the WAIS –R-NI¹⁹, Digit Span Test²⁰

Revised Quick Cognitive Screening Test [RQCST]

The RQCST is a mid-range cognitive screening test¹⁵. Domains evaluated include orientation, language, memory, visual spatial and visuo-constructional skills. It generates 3 main domains (i.e., Global, Verbal and Non-verbal scores). Cronbach alpha of total Verbal is .84 and total Non-verbal is .84 and Global score is 0.84²¹

Cognitive Failure Questionnaire (CFQ) is a 25-item self-report questionnaire that measures an individual's likelihood of committing an error in the accomplishment of an everyday task; it assesses attentiveness in daily life. It has been shown to elicit attentional deficits in a precise manner. The Cronbach's alpha for the CFQ was reported to be 0.91, with a test-retest reliability of 0.82 over an interval of 2 months²².

Trail Making Test (TMT) measures speed processing, sequence alternation, executive function, cognitive flexibility, visual search, motor performance and complex attention¹⁷. A aspect of TMT has a reliability coefficient of 0.83 and for B is 0.90²⁴.

California Verbal Learning Test-Second Edition [CVLT-II] is a verbal memory test that assesses memory. It adopts the use of semantic associations as a means of learning words it has split-half reliability of 0.87 to 0.89 and alternate form reliability of 0.72 to 0.79 for all the measures.²⁵

Spatial Span subtest of the WAIS –R-NI evaluates cognitive capacity for temporary storage of spatial information. Spatial Span explore the ability to recall the virtual relationships between objects in space, it is considered a nonverbal version of the WAIS-IV subtest¹⁹.

Digit Span Test; Digit Span measures both auditory attention and span of immediate verbal memory recall¹⁹

Behavioural Measures

Brief Symptom Inventory (BSI) assessed behavioural outcomes of potential stressors. The major domains are Somatisation, Depression, Anxiety and Global Severity Index. The internal consistency is good with the following indices: Somatization $\alpha = .82$, Depression $\alpha = .87$, Anxiety $\alpha = .84$ and GSI $\alpha = .93$ ²⁶

The WHOQOL-BREF is a 26-item Likert type scale that assesses four domains of quality of life: Physical Health (e.g. "How much do you need any medical treatment to function in your daily function in your daily life?"), Psychological Health (e.g.: How often do you have negative feelings such as blue mood, despair, anxiety or depression?), social relationships (e.g. "How satisfied are you with your sex life?"), and environmental wellbeing (e.g. "How safe do you feel in your daily life?").

The four item Morisky Medication Adherence Scale (MMAS) was validated with acceptable reliability and validity in patients with other chronic diseases. It is assesses self-report measure for adherence to medication²⁷. Internal consistency index ranges from 0.26-0.86.

The Santa Clara Strength of Religious Faith Questionnaire (SCSRFQ) is a self-report measure that assesses strength of religious faith and engagement suitable for use with multiple religious traditions. Internal consistency index ranges from 0.94 to 0.97²⁸.

Laboratory characteristics

Participants' blood samples were taken for hemoglobin levels, lipid profile, renal function test, urine samples were also taken for urinalysis; the CD4 count and viral load at the time of diagnosis will be extracted from participants' folders

Qualitative

An interview guide with open ended questions was designed and used for in-depth interviews; this involved a face-to-face interview with eight participants. Participants were voluntary and anonymous. Participants were at least 18 years of age. Participants diagnosed with severe neurological co-morbidity such as stroke and seizure disorder, and acute psychiatric disorders were excluded from the study.

Sample question include,

- "In your experience, what does it mean to be "HIV POSITIVE?"
- Describe the difficulties/challenges associated with the HIV/AIDS disease.
- Can you tell me how you have coped?
- Are they any Ghanaian cultural coping strategies you are aware of? If so, in what way has it influenced your management/coping with the HIV/AIDS disease in the past and now?

Data analysis

Descriptive statistics on categorical variables were reported in the form of frequencies and percentages while that of the continuous variables (RQCST total, Digit Span, Santa Clara Strength of Religiosity, WHO Quality of Life (WHOQOL) were presented in terms of means and standard deviation or median with interquartile range depending on the distribution of the data. Chi-squared\Fishers' exact test of independence was used to test for association between categorical independent variables and the outcome variable.

Participants were categorized into two groups of whether or not they experienced cognitive deficit based on the mean Global score on the RQCST. Mean score was calculated from Global Scores obtained and used as a benchmark for deciding cognitive performance.

Depending on the distribution of the continuous variables, Welch t-test\Wilcoxon rank-sum test was used to compare means\median of continuous variable across levels of the outcome variable. Test of normality of continuous variables was done using the skewness and kurtosis test. Multiple Logistic regression model as well as Poisson regression model were used to assess the effect of the various independent variables on neurocognitive dysfunction. All statistical tests were done at 5% significance level. The results obtained from the various analyses are presented in Tables 1 & 2.

Interpretative Phenomenological Analysis (IPA) was adopted to analyze and discuss qualitative information. Interpretative Phenomenological Analysis is an appropriate approach that is adopted to seek how individuals perceive a particular situation in our case HIV and associated stress they may encounter

and how they make meaning out of their personal and social world²⁹. With Interpretative Phenomenological Analysis, assessment of key emergent themes for the whole group is vital hence, we record and transcribe words of informants. Thoughts and reflections culled from recurring phrases and the researcher's questions were made while reading transcripts.

Transcriptions of data were done with the help of two (2) research assistants, who had background information on qualitative studies.

Results

Background Information of Participants

One hundred and twenty three participants were recruited comprising 47 males (38.2%) and 76 females (61.8%). Mean age of study participants was 39.2 years (SD = 10.7). The average number of years of education was 9.5 years (SD= 4.2), with majority (30.1% (37/123) having had Junior High Secondary/Middle school as their highest level of education. The mean duration of HIV diagnosis was 26.3 months (SD= 36.8) with a range of zero months to 132 months (See Table 1).

The prevalence of HIV 1 was 118 (95.2%), and 6 (4.8%) had HIV 1 and 2. The mean CD4 count was 320.2 (SD= 279.6) and the viral load was 231338.3 (SD= 643669.4). 44.8% had cognitive deficits, 55.2 % had average cognitive performance.

The mean score for total Free Recall, Short Delay Free Recall and Long Delay Free Recall on the California Verbal Learning Test (CVLT) for the entire group were 17.7 ± 5.7 , 5.1 ± 1.9 and 4.5 ± 2.0 respectively. The mean total score for Digit Span test was 11.7 ± 3.7 , and Spatial Span test was 8.4 ± 3.3 . The mean for the Global Severity Index of the Brief Symptom Inventory with 18 items (BSI-18) was 0.8 ± 0.7 , and its subdomains had means of 0.7 ± 0.9 , 0.9 ± 0.9 and 1.0 ± 1.0 for Anxiety, Somatization and Depression respectively. Cognitive Failures Questionnaire (CFQ) had a mean total score of 22.6 ± 16.2 among participants.

Table 1

Analyses of association between Socio-demographic, clinical characteristics and neuropsychological tests, and Cognitive deficit

Characteristics	Total	Normal***	Cognitive Deficit	P-value
Gender, N (%)				.085 [§]
Male	47 (38.2)	29 (65.9)	15 (34.1)	
Female	76 (61.8)	35 (48.6)	37 (51.4)	
Age in years, Mean ± SD	39.2 ± 10.7	38.2 ± 10.8	40.0 ± 11.0	.896
Years of Education	9.5 ± 4.2	10.2 ± 4.3	8.5 ± 4.1	.064
HIV Typing, N (%)				.076 [§]
HIV1	117 (95.2)	68 (55.5)	49 (44.5)	
HIV1&2	6 (4.8)	3 (50.0)	3 (50.0)	
ARV exposure status N (%)				.172 [§]
ARV-naïve	68 (55.3)	30 (49.2)	31 (50.8)	
ARV-exposed	55 (44.7)	34 (61.8)	21 (38.2)	
Disease duration, N (%)				.024* [§]
0-6 months	57 (50.9)	23 (43.4)	30 (56.6)	
7-12 months	19 (17.0)	8 (50.0)	8 (50.0)	
13-60 months	21 (18.8)	13 (61.9)	8 (38.1)	
Above 60 months	15 (13.4)	13 (86.7)	2 (13.3)	
Mean scores ± SD				
RQCST Global score	57.2 ± 12.8	66.6 ± 6.4	45.6 ± 8.3	<.000**
RQCST Verbal score	23.2 ± 8.8	28.5 ± 5.8	16.5 ± 7.2	<.000**
RQCST Non-verbal	23.7 ± 6.2	26.7 ± 4.1	19.8 ± 6.2	<.000**
CVLT Total Free Recall	17.7 ± 5.7	19.5 ± 5.9	15.2 ± 4.3	<.000**
CVLT Short delay FR	5.1 ± 1.9	5.7 ± 1.7	4.4 ± 1.7	<.000**
CVLT Long delay FR	4.5 ± 2.0	5.1 ± 2.0	3.8 ± 1.7	.001**
Digit Span total	11.7 ± 3.7	12.9 ± 3.6	10.4 ± 3.0	<.000**
Spatial Span total	8.4 ± 3.3	9.6 ± 3.0	6.8 ± 3.0	<.000**
CFQ Total score	22.6 ± 16.2	23.5 ± 15.7	22.6 ± 16.9	.766
BSI anxiety	0.7 ± 0.9	0.4 ± 0.7	1.0 ± 1.0	.001**
BSI somatization	0.9 ± 0.9	0.8 ± 0.8	1.1 ± 0.9	.083
BSI depression	1.0 ± 1.0	0.7 ± 0.9	1.2 ± 1.0	.010*
BSI GSI	0.8 ± 0.7	0.6 ± 0.6	1.1 ± 0.8	<.000**
WHOQOL-BREF Subdomains				
1 (Physical health)	23.5 ± 4.6	24.6 ± 4.1	21.9 ± 4.8	.008**
2 (Psychological)	20.3 ± 4.2	20.8 ± 4.4	19.6 ± 4.0	.185
3 (Social relationships)	10.8 ± 2.5	11.1 ± 2.5	10.5 ± 2.4	.273
4 (Environment)	27.3 ± 5.4	27.4 ± 5.9	27.1 ± 4.8	.771

*p<0.05, **p<0.01 *** p<0.001 normal means participant had a score of >57; § p-values based on Pearson chi-square and Fisher's exact test for categorical variables, all other p-values from t-test of mean difference between participants with normal cognition and those with cognitive deficit based on RQCST global score; ARV's: Antiretroviral treatments; RQCST: Revised Quick Cognitive Screening Test; WHOQOL-BREF: World Health Organization Quality of Life Instrument, Short Form

Characteristics	Total	Normal***	Cognitive Deficit	P-value
Total, N (%)		64 (55.2)	52 (44.8)	
*p<0.05, **p<0.01 *** p<0.001 normal means participant had a score of >57; § p-values based on Pearson chi-square and Fisher's exact test for categorical variables, all other p-values from t-test of mean difference between participants with normal cognition and those with cognitive deficit based on RQCST global score; ARV's: Antiretroviral treatments; RQCST: Revised Quick Cognitive Screening Test; WHOQOL-BREF: World Health Organization Quality of Life Instrument, Short Form				

Participants who displayed cognitive deficit based on RQCST Global score (a score less than 57) were older (40.0 ± 11.0) than those who did not show cognitive deficit (38.2 ± 10.8)

There was a statistically significant difference in Global score on the RQCST across the categories of duration in months, $F(3,101) = 3.86, p < .05$, with the specific difference between the 0-6 months group and the group who have been diagnosed for more than 60 months (Mean difference = 11.24, $p < .05$).

There was a significant correlation between duration of the illness in months and RQCST Global score, $r(73) = .29, p = .012$, RQCST Verbal score, $r(73) = .35, p = .002$ and BSI Depression sub-domain, $r(61) = -.33, p = .009$. RQCST Global score was a statistically correlated with the Physical Health domain of the WHOQOL-BREF, $r(85) = .33, p = .002$.

44.7 percent of the study population were taking anti-retroviral drugs. There was no statistically significant difference in cognitive function between ARV-naïve and ARV exposed participants $t(1,116) = 1.87, p = .172$.

The mean score on the Santa Clara Religiosity Scale (SCRS) was 37.40 (SD = 4.15). Duration of diagnosis in months and the total score on Physical Health sub-domain of WHOQOL-BREF were statistically significant factors associated with cognitive deficit. Participants who had been diagnosed for at least 6 months have decreased odds of having significant cognitive deficit by 59.4% (95% CI: .18 - .89). Further, every unit increase in Physical Health domain of WHOQOL-BREF reduces the likelihood of cognitive deficit by 13.2% (95% CI: .78 - .97) after linear regression analysis. In the multinomial logistics regression analysis, physical health of WHOQOL-BREF was a significant predictor of cognitive deficit [Adjusted Odds ratio: .87 (95% CI: .78 - .98), $p = .022$] (See Table 2)

Table 2
Predictors of Neurocognitive dysfunction in patients with HIV/AIDS

	Unadjusted			Adjusted		
	UOR	95% CI	P-value	AOR	95% CI	P-value
Physical Health	0.87	0.78 - .97	.013	0.87	0.78 - 0.98	.022*
0-6 Months	Ref.			Ref.		
Above 6 months	0.41	0.18 - 0.89	.025*	0.40	0.08 - 1.92	.250
ARV-naïve	Ref.			Ref.		
ARV-exposed	0.60	0.29 - 1.25	.173	1.37	0.29 - 6.57	.690
*p<0.05,**p<0.01,***p<0.001; UOR: Unadjusted odds ratio, AOR: Adjusted odds ratio						

Qualitative Results

Eight (8) participants of the study sample were conveniently selected and engaged in one-on-one in-depth interviews. The interviews focused on three main thematic areas; Knowledge about Seropositivity, Day-to-day Challenges and Coping Skills employed by participants.

All eight participants displayed adequate knowledge about what it means to be HIV positive. Sub-themes generated from their responses includes biological understanding and negative progression of the disease. Two participants reported that;

"It means you have contracted HIV or been diagnosed with HIV" (Participant, 041) Female, 46

"Through blood transfusion" (Participant,067) Male, 45yrs

Two others;

"If not treated it will advance to AIDS" (Participant, 058 Male 35yrs

"When the person is having the virus and might not be as healthy as they were before" (Participant, 062)Male, 29yrs

Challenges faced by participants due to their HIV statuses were categorized into three sub-themes including stigmatization, anxiety and occupational dysfunction. Two out of eight participants indicated that stigmatization was a major challenge for them.

"Stigmatization, not being able to share stuff with others is quite disturbing." (Participant, 034 Female 20)

"Stigmatization by your friends and the society when they find out your status." (Participant, 102) Female 38

Others reported on anxiety stating that;

"I feel uncomfortable going amongst people; it affects sex life and becomes worrying." (Participant041) Female 46yrs

"Thinking about it a lot is the main difficulty/challenge because when you think about it too much you can die." (Participant, 056 Male 34yrs)

And one participant indicated challenges related to occupational dysfunction;

"I can't work; I can't do anything because of the disease." (Participant, 058)

Male 35yrs

Coping strategies used by participants to help manage the effects of the challenges outlined included social support, avoidance, and general cautiousness. They reported receiving support from friends and significant others,

"My friends from work help me cope. I have faith, I hope in the medication I take." (Participant, 058) Male 35yrs

Others reported using avoidance coping mechanisms,

"I have withdrawn from people because I don't want them to be infected." (Participant, 041)

Female, 46

"I don't think about it at all. I even feel like I don't have it. I just take my drugs at all times." (Participant, 056) Male 34yrs" ...Life is normal as if nothing has happened." (Participant, 102) Female 38

Some participants indicated that they try to be cautious so as not to affect others,

"I have a daughter who does not have HIV so as much as possible, I don't share sharp objects or toothbrush or sponge with her. Also, I practice effective personal hygiene so that others do not get infected." (Participant, 034) Female 50yrs

"...Do not use sharp objects and share with others. Avoid fluid contact like blood or saliva with others. Be careful to not have unprotected sex." (Participant, 041)

Female, 46

Discussion

This present study explored the effects of neurocognitive dysfunction on the quality of life of patients and for the predictors for impaired neurocognitive function in this population. We also evaluated the lived experiences of participants with regards to their coping skills and how they conceptualized the illness.

About 54% of population experienced cognitive deficits. Duration of the illness in months was significantly correlated with RQCST Global score, $r(73) = .29$, $p = .012$, RQCST Verbal score, $r(73) = .35$, $p = .002$ and BSI Depression sub-domain, $r(61) = -.33$, $p = .009$. In the multiple regression analysis, Physical Health was predictor of cognitive dysfunction [Adjusted Odds ratio: .87 (95% CI: .78 - .98), $p = .022$]

In our study, male participants had better performance with total RQCST than females though not statistically significant. The differential performance was also replicated in the California Verbal learning Test. A study on gender differences in verbal memory and learning efficiency on a battery of neuropsychological tests in Zambia concluded that male subjects performed significantly better on the tests than female subjects.³⁰ supporting our finding in this study. Biologically, changes in body chemistry, immunity and metabolism can account for the difference in neurocognitive dysfunction; it is also reported that women tend to report early for clinical care and hence are least likely to present with advanced form of disease³¹

In determining the characteristics and pattern of neurocognitive disorder in our study population, we examined performance over the various domains explored by RQCST. Mean scores were used as outcome measure for performance in key domains of cognition. Forty-eight percent of the study population had scores below the mean score obtained in this study; this was expected as we know HIV-induced pathology results in changes in behavioural and cognitive dysfunction⁴⁵. Similarly, a cross sectional study in Switzerland showed the prevalence of HAND was 84%; 24% of patients had Asymptomatic Neurocognitive Impairment (ANI) while 52% had Mild Neurocognitive Disorders(MIND) ; 8% had HIV-associated dementia(MND)⁷. A study in Cameroon

also showed a decline in executive function, speed of information processing, working memory and memory recall. This pattern of the deficits is similar to studies from the western world³²

In our study, the participants with neurocognitive dysfunction had verbal domains severely impaired than non-verbal domains. Domains affected include Arithmetic, Vocabulary, Naming, Abstract Reasoning, Similarities and Analogies, working memory, Immediate recall, delayed recall and new learning; the worst affected domain was new learning (0.26 ± 1.26). Robertson et al. found cognitive domains commonly affected among HIV/AIDS patients include executive functioning, information processing, motor functioning, attention, learning, and memory¹³

In our study lower CD4 count was associated with poorer cognitive deficits. It is expected that patients with higher CD4 mount competent immune responses against HIV virus. Although HIV does not infect neurons directly, viral components from infected cells can potentially cause harm to neurons. These components include host-derived inflammatory cytokines and chemokines released from infected or activated glial cells³³. Widyadharma et al. showed in their study that lower CD4 levels was associated with poorer neurocognitive outcomes.³⁴

Postmortem studies of HIV/AIDS infected brain has shown that virus has a predilection for midfrontal aspects as well as cerebellar cortex; these are essential components of frontostriatal cortical circuits that subserves cognitive functioning. Impaired cognitive function has also associated with reduced internal connectivity of frontostriatal pathway that is linked also to impaired dopaminergic metabolism.^{35,36}

Largely, it is expected that duration of exposure to HIV/AIDS affects cognitive performance¹¹. Our study revealed longer duration of diagnosis is associated with better cognitive performance. A possible consideration is modulating effect of ARVs. Cole et al. found that cognitive impairment did not worsen in the population they studied³⁷. Robertson et al. found neurocognitive function improved as their patients were on ARVs³⁸. The CNS HIV Anti-Retroviral Therapy Effects Research (CHARTER) study in which patients were followed up at 18 and 42 months; 23% of patients with ANI had worsening neurocognitive function compared to 30% with MND⁹. This indicates that neurocognitive dysfunction generally worsens with time; a fact clearly antagonized by our study.

In our study, there was no significant difference in cognitive impairment between patients who were ARV-naïve and ARV-exposed. In our study site, patients are initiated on ARV's when they test positive for HIV, their CD4 count and viral loads are used to monitor progress. In a study by Carvalhal et al. patients who were started on antiretroviral therapy had better neuropsychological profiles than those were not on medication³⁹

Patients with neurocognitive impairment had low scores on the on tests assessing working memory, visuospatial abilities, verbal learning and memory. Cassimjee et al. showed that participants with HIV had poorer performance profiles in global cognitive functioning, memory, executive functioning, visuo-constructional ability, psychomotor functioning, and processing speed⁴⁰ which are cognitive domains tested by the afore-mentioned tools.

Good quality of life is an expected outcome for good medical care in chronic conditions; findings from our study suggests that neurocognitive performance was positively associated with the physical health subdomain of quality of life. Improved living conditions of patients living with HIV/AIDS can improve their cognitive function. Our finding is in consonance with one conducted by Tozzi et al where poor cognitive performance was related to poor QOL in all domains.⁴¹

We noticed that participants with neurocognitive impairment experience mood dysregulation and stress disorders; they reported symptoms suggestive of depression and extreme anxiety levels culminating in reduced global severity indices. In a review by Gorman et al, HIV contributes to emotional and behavioural disturbances from psychosocial stressors that ultimately leads to poor adherence, fatigue and social incapacitation.

The predictors of neurocognitive dysfunction in this study were Physical Health and duration of diagnosis beyond six month. Embedded in physical health are socio-economic capacity, accessibility to health facility, and condition of living. Concerning duration of illness, pathophysiological changes coupled with non-adherence to medication contribute immensely to negative trajectory of neurocognitive dysfunction in patient living with HIV.⁴²

Findings from the qualitative study indicate that a small fraction of participants have erroneous notions about seropositivity and transmission of the virus. Those who had adequate knowledge show individualized means of preventing spread of infection. Participants also suffered consequences of stigmatization a common phenomenon with patients who suffer from chronic illness⁴³. Participants also experience anxiety and persistent sense of foreboding contributing to their poor quality of life and worsening effect on Global severity index. Poor quality of life appears to run through both quantitative and qualitative study Ignoring perceived consequences of the illness was a coping strategy adopted by participant. There is evidence that these coping strategies have yielded some resilience in this population.⁴⁴. Participants were concerned about the deleterious effects of HIV on their occupation and the impact on quality of life thereof. Strikingly, a point of divergence is where none of the participants spontaneously mentioned cognitive dysfunction as a challenge, a prominent finding in the quantitative work-up. A possible explanation is the lack cognitive insight or there were pressing concerns like stigmatization.

A possible limitation is that this is a single center study hence the results are not generalizable to the entire HIV population in Ghana However, this study explored neurocognitive dysfunction with its attendant psychosocial correlates. The study gives feedback on the cognitive functioning in patients living HIV/AIDS in a Low-to-Middle-Income Country (LMIC). Findings from this paper will refine interventions to improve patient's health outcome by an inclusion of cognitive neuro-rehabilitation in every stage of therapy.

Conclusion

This study examined the neurocognitive dysfunction of patients with HIV/AIDS patients; deficits found include poor verbal skills, impaired working memory and spatial span. Some psychosocial correlates include physical health, mood dysregulation, associated anxiety and inaccessibility of health facilities. Predictors of neurocognitive dysfunction include duration of diagnosis and physical health. It is expected that policies that address modifiable variables of cognitive dysfunction such as physical health in our context be promote to allow participant access health in good time to forestall such complications. It will interesting to know how future studies can explore how participants develop resilience during the stages of HIV infection. With the advent of the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection future studies will explore the combined effect of covid-19 and HIV/AIDS on neurocognitive function.

Abbreviations

RQCST
Revised Quick Cognitive Screening Test
WHOQOL
World Health Organization Quality of Life
HIV
Human immunodeficiency Virus
AIDS
Acquired Immune Deficiency Syndrome

Declarations

Ethical consideration

This research was approved by University of Ghana Medical School Institutional Review Board (IRB) with protocol identification number of UGMS CHS-Et/M.2-P4.14/2016-2017. All participant consented to take part in the study.

Consent for publication

Not applicable

Disclosure

Authors declare no conflict of interest

Competing interests

Not applicable

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Data Availability and materials

Data will be made available on request

Authorship

Fiagbe D and Ganu V were involved in the research design, performance of research, manuscript writing and data analysis. Boima V, Yorke E, Dey D and Amissah-Arthur MB, Anna Gyaban-Mensah, Pupilampu P, Adjei P contributed to the design and manuscript writing. Mate-Kole CC supervised all aspects of the work and edited the manuscript. Kelvin Acquaye was the main data analyst.

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