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Review Article

Cognitive Dysfunction in Patient with Chronic Medical Condition in Sub-Saharan Africa

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Abstract

Chronic Medical Condition is a condition that last longer than one year or more, requires ongoing medical attention and limit activities of daily living. Among these conditions in sub-Saharan Africa (SSA) are epilepsy, diabetes mellitus, Human Immunodeficiency Virus infections bronchial asthma, chronic liver disease and others. Cognitive decline could be present in about 60% of patients with chronic medical conditions especially older adults and those with multiple comorbidities. These chronic medical conditions could have heterogenous patterns of presentation and may have different underlying pathophysiological mechanisms. Various instruments used for neuropsychological assessment of cognition in these conditions and treatment is basically through pharmacologic and non-pharmacologic therapies including cognitive behavioural therapy.

This review is an attempt to describe the specific patterns of presentations of cognitive dysfunctions in patients living with common chronic medical conditions in sub-Saharan Africa such as memory, information processing, attention/concentration, learning, visual spatial skills and other executive functions. We also highlighted recent advances of possible pathophysiological mechanism and management of this conditions. Furthermore, well conducted large scale trials to explore the peculiar pathophysiological mechanisms of cognitive decline in patients with chronic medical conditions in sub-Saharan Africa in the near future.

Keywords: Cognition; Cognitive Dysfunctions; Neuropsychology; Chronic Medical Conditions; Africa

Introduction

According to the National Centre for Chronic Disease Prevention and Health Promotion -NCCDPHP (www.cdc.gov), chronic medical condition refers to a condition that last 1 year or more and require ongoing medical attention and limit activities of the daily living or both (National Centre for Chronic Disease Prevention and Health Promotion - (NCCDPHP). Many of these chronic diseases may be inherited such as Diabetes mellitus, hypertension, asthma or acquired such as HIV/AIDS.

Researchers from the developed countries have shown that patients with chronic medical disorders have impaired quality of life and deleterious effects on vocations [1,2]. Recent publications from Centre for Diseases Control (CDC) indicated that chronic diseases are the leading cause of morbidity, disability and death in the United States of America (USA). They also affirmed that chronic diseases are the leading drivers of $ 4.1 trillion is annual health care cost [1].

In sub-Saharan Africa, the commonly encountered chronic diseases include cancers, diabetes mellitus, liver diseases, asthma, hypertension among others. Observational studies showed that most patients in sub-Saharan Africa have issue with academic and vocational achievements when they developed chronic medical conditions [3] and this has led some researchers in Africa to conduct some studies on cognitive performances among sufferers of chronic medical conditions. Most of these studies also aimed at determining the specific patterns of cognitive impairment peculiar to this medical conditions.

Epilepsy

According o the ILAE definition, epilepsy is a disorder of the brain characterized by an enduring predisposition to generate epileptic seizures. Epilepsy could also be defined as transient occurrence of signs and symptoms due to abnormal excessive or synchronous neuronal activity in the brain [4].

Prevalence studies in sub-Saharan Africa showed that about 20% of PWE have severe cognitive impairment [5-7].

Cognitive domains impaired in epilepsy

The sensitivity of the automated/computerized instruments that are utilized in some sub Saharan African countries for assessment of cognitive impairment has been validated and shown to be more sensitive in detecting cognitive impairments than "Paper and Pencil" psychometric instruments [8]. The cognitive domains that are impaired in patients with epilepsy include information processing, psychomotor speed [9,10], memory [9,10] attention and concentration [3,7].

Some studies from sub-Saharan Africa (SSA) especially those that utilized the "paper and pencil type" of cognitive tools showed that language, praxis, orientation and calculation may be affected by the impact of epilepsy on the brain [11,12].

Patients with epilepsy (PWE) with partial seizures especially those with structural aetiologies exhibited worse cognitive functions when compared to those with generalized seizures [13].

Several factors have been identified that affect cognitive performances of PWEs. These factors include low level of education, early age at disease onset, long duration of epilepsy, increased frequency of seizures and long duration of antiepileptic drugs (AEDs) use [8].

The type of AEDs used for treatment of epilepsy was also found to influence the cognitive functions of patients with epilepsy (PWE) in some studies [13]; newer drugs such as Leviteracetam had milder adverse outcome on cognitive functions when compared with older drugs such as, carbamazepine, phenytoin or phenobarbitone [14] though some workers found selective affectation of cognitive functions in PWE who were using common drugs for treatment of epilepsy in SSA [15]. For example, Ogunrin et al showed that Phenobabitone had the worst scores on verbal and non-verbal memory tasks in that study.

Neuropsychological assessment

There are two types of neuropsychological tests that have been employed in the assessment of cognitive functions among PWE in sub Saharan Africa namely the computer -assisted type and psychometric "paper and pencil types".

Psychometric "paper and Pencil" type.

Mini mental State Examination (MMSE): Most of the earlier studies used MMSE for assessing cognitive function in PWEs were done by some worhers [6,7,11]. MMSE is a 30-point Test; it is a simple instrument that has bias against visually impaired subjects and has limited examination of visuospatial cognitive ability.

Community screening interview for dementia (CSID).

This is a modified/adapted form of MMSE. Both MMSE and CSID have similar cognitive domains, namely orientation, attention and concentration, language skills, visuo-spatial acuities or praxis, memory and ability to understand and follow instructions. The higher the MMSE or CSID scores the better the cognitive performance of the subject CSID was used in assessment of cognitive functions in PWE by [12,13].

The Short Blessed Test (SBT)

It is a six Item test that comprises six questions. The questions address memory and the total score on SBT is 28.

Normal cognitive function score is 0-4, questionable impairment, 5-9 and Dementia ≥ 10. SBT was used by *Ogunrin., et al.* in the evaluation of cognition in PWE [16].

Weschler Adult Intelligence Scale (WAIS)

Weschler -Believue Intelligence scale was first released in 1939 and since then it has undergone several modifications and adaptations. In 1955, WAIS R (1981) was released. The other versions were WAIS-III (1997) and WAIS- IV (2008). The domains assessed by WAIS are perceptual reasoning, processing speed, verbal comprehension and working memory. WAIS-III has been used in the assessment of intellectual functioning in epilepsy [17]. The WAIS III provided scores for verbal IQ, performance IQ and Full- scale IQ. The test has a good test - retest reliability. The test is limited for use in patients with visual or auditory impairment and scores subtest may also differ for neurodivergent adults depending on their unique traits and characteristics [18,19].

Computerized testing

In sub Saharan Africa, there are few studies that utilized computerized testing for determination of cognitive function in PWE. The pioneer work was by Ogunrin., *et al.* [8,9,15], when they used Fepsy (Iron Psychology) to evaluate PWEs in Nigeria. Subsequently, other researchers have used the Fepsy for similar assessment in epilepsy. been reported [6,7]. Fepsy is an automated test battery that was first employed in the assessment of children with epilepsy in Netherlands, Europe [20].

The Fepsy consist of items such as, auditory reaction times, visual reaction times, binary choice reaction times (these tests assess psychomotor speed) attention/concentration (assessed with binary choice reaction accuracy, computerised visual searching task time), memory (recognition memory Test - verbal and non-verbal) Vigilance (assessed with Perceptual sensitivity and response bias) and motor speed (finger tapping task). Other subtests of Fepsy such as Corsi block test, sea-shore rhythm and naming task are not usually employed in the evaluation of cognition in PWE in Nigeria [6,8,9].

Most of the studies on anatomic correlates of cognitive functions were not available for most reports from sub- Saharan Africa. This is due to non -availability of prerequisite equipment to carry out these investigation. Most of the recent insight to the anatomic abnormalities in the central nervous system (CNS) of PWE with cognitive dysfunction were from other countries of the world (Chauhan et al, 2022 and these studies showed amygdala, temporal lobes and thalamus of PWE were abnormal. A more recent study in 2018 by Wu., *et al*, [21] showed that anatomical and topological changes in neural networks in the hippocampus, amygdala, cerebral cortex, corpus callosum, cerebral white matter (WM) lesions are the fundamental, components of seizure and cognition that occurred in PWE.

Cognitive function in patients with HIV infection in SSA

HIV- Associated neurocognitive disorder (HAND) is a cognitive disorder in the setting of HIV infection; another name for HAND is HIV- encephalopathy. Earlier works on HAND in sub-Saharan Africa were in south Africa, Central Africa and East Africa [22]. The original large scale Trial in patient with HAND was the multicentre AIDS cohort study groups who demonstrated the presence of cognitive dysfunction in patients with HIV infection and this stimulated further research among people living with HIV/AIDS into cognitive functions in patients with HIV infections in SSA [22].

Prevalence of HAND in HIV infection in SSA.

The prevalence of HAND in sub Saharan African patients with HIV infection varies depending on the severity of HAND in context; mild HAND has been estimated to have a prevalence of 60%-80% in cases of AIDS and severe HAND has been estimated to range from 3%-25% of HIV population in SSA [24-26].

Cognitive impairments profile in HIV/AIDS patients with HAND in Sub Saharan Africa.

The cognitive domains that are impaired in patients with HIV in SSA include information processing/psychomotor speed [27], memory and attention/concentration. (i).

In some patients with HIV/AIDS, learning, language and praxis functions were impaired [25,26].

Variables that may affect the severity of HAND in patients with HIV in SSA are low CD4 cell count [27,29] lower body weight, presence of anaemia, presence of other opportunistic infections in the CNS and advanced HIV disease stages [29]. Type 1 HIV infection has also been associated with worse cognitive performance [30].

Neuropsychological assessment of hand in SSA.

Most of the Neuropsychological assessments done in patients with HIV infection in SSA could be broadly divided into “paper and pencil” type and automated test types.

Community screening interview for dementia (CSID) which was adapted from Ibadan-Indianapolis Dementia study in Ibadan is a validated tool in Nigerian population and has been described earlier on [12]. It is relatively simple and easy to administer to patients.

The Montroeal Cognitive Assessment Test (MoCA):- has also been used to assess cognitive domains; visuospatial skill, naming, , attention, language, abstraction, delayed recall and orientation .Maximum point score on MoCA is 30 [31].

WAIS

WAIS – II was initially used in the evaluation of HAND in Nigerian patients with HIV infection by Sunmonu., *et al.* 2015 [29]. WAIS has been described earlier on.

International HIV dementia scale (IHDS).

It consists of three subtests namely, timed finger tapping, alternating hand sequence test, and recall of four items at 2 minutes and is usually administered according to the protocols of its developers as described in a study in Nigeria [32]. A cut off score of >10 indicates HIV Dementia. It is a simple and easy to administer neuropsychological too [32,33].

The Multidisciplinary Neuropsychological test (MDNPT) is a battery of tests consisting of Hopkin Verbal learning test (revised), delayed recall and trial recognition seed of information processing, Weschler Adult Intelligence Scale III symbol search, motor peg board and abstraction/executive function assessment.

MDNPT was demonstrated to be sensitive to detect HAND in Nigeria [30,33].

FePsy test battery

FePsy is a computerized neuro psychological Test battery that was found useful in detecting HIV associated neurocognitive disorder in Nigeria. The advantage of using FePsy use is that it is usually objective and the patients result are usually displayed on the computer screen immediately after the test [6-8,15].

Anatomic correlates of HAND in patients with HIV

Much of the progress in identifying the anatomic correlates of HAND in the brain of people who have HAND are generalized cerebral atrophy [35] and some neurological soft signs (NSS). A study [36] using Heildeberg scale and whole brain voxel based morphometry reported that NSS scores which were correlated with gray matter were significantly increased in the HAND group when relatively compared to NSS total score in the neurologically healthy group markedly in the cerebral cortex, insula and cerebellum though previous reports showed the presence of global cerebral and subcortical atrophy in HIV patients.

Liver cirrhosis

Chromic liver disease usually occurs as a progression from acute liver diseases such as viral hepatitis alcoholic liver disease and liver diseases secondary to chronic drugs or chemicals use. These severe chronic liver affectations could lead to decompensation and hepatic encephalopathy. Minimal epatic encephalopathy (MHE) is a neurocognitive dysfunction which occurs in a cirrhotic patients and is characterized by a number of neuropsychological deficits despite patients having a normal mental and neurological status on global examination [37]. The global prevalence of, MHE ranges from 60% to 80% in patients with liver cirrhosis [38].

MHE affects the patients activity of daily living and patients may not be able to perform complex tasks that require attention and concentration such as operation of heavy machinery. The working and earning capacity may be reduced and can lead to development of overt hepatic encephalopathy and subsequently death [39].

Cognitive domains that are impaired in MHE in SSA.

There is paucity of literature in sub-Saharan Africa on the evaluation of MHE among liver cirrhosis patients. A study showed impairment of psychomotor speed and attention/concentration functions in patients with liver cirrhosis [40] but no significant decline was observed in the Recognition memory tasks and vigilance tasks between the liver cirrhosis patients and normal controls [4041]. Language, working memory, attention/calculation and Praxis functions were impaired in the patients with liver cirrhosis relative to normal controls in that study. These findings are in keeping with the results from other regions of the world. The type of hepatitis virus that the patients have could greatly impact on the cognitive functions of the patients, as patients with Hepatitis C Virus infection has significantly worse cognitive performance than healthy controls especially on psychomotor speed assessment [41].

Neuopsychological assessment of MHE in SSA.

Few studies used Community Screening Interview for Dementia because of advantages of this instrument which include its simplicity, low cost and availability.

FEPSY

This automated test has also been used for the evaluation for MHE in SSA. The advantages of FePsy include its accuracy automation and objective assessment of cognitive function. The Fepsy battery is more sensitive for detection of impairment of subcortical or executive functions which are more prevalent in patients with MHE [41].

Abnormalities of neurophysiological and neuroimaging parameter, have been noted in some patients with liver cirrhosis with MHE previously [39]. Another study showed that learning and

memory impairment in patients with liver cirrhosis correlated with decreased functional neutral networks in the hippocampus especially between the presubiculum, subiculum seeds and bilateral precuenus [42].

Type 2 Diabetes mellitus and cognitive functions in SSA

Type 2 Diabetes mellitus (DM) is a chronic condition that affects the way the body processes sugar (glucose). There is inadequate production of insulin or resistance to insulin by the body in this medical illness. About 1.5million cases are seen in per year in Nigeria. The American Diabetes Association [43]. have the following criteria for the diagnosis of type 2 DM. Fasting plasma of> 126mg/dl or 7.0 mmol/l.

A 2hour plasma glucose level of >200mg/ol or higher plasma glucose during 75g oral glucose tolerance test.

A random blood glucose of >200mg/dl or 11.1 mmol/L in a patient with classic symptoms of hypoglycaemic or hyperglycaemic crisis.

Prevalence of cognitive functions impairment in Type 2 DM patients in SSA.

Cognitive dysfunctions occurs in 40% of patients with Type 2 DM evaluated in a study from a Tertiary health centre in Nigeria [44,45]. Also studies in SSA reported that majority of Type2DM patients had mild cognitive impairment and only small percentage had severe cognitive impairment [45].

Cognitive Domains impaired in patients with Type 2 DM.

Majority of the few studies carried out in SSA on Cognition in Type 2 DM patients showed impairment of information processing and executive functions [45]. Languages functions such as naming, abstraction, delayed recall were also affected in one study [45]. 2 DM.

The risk factors associated with cognitive disfunction in SSA were old age, low education, lower body mass index and increased serum, level [44,46,47]. Also low level of serum vitamin E, and Low serum total protein have been associated with poor cognitive functions in Type 2 diabetes mellitus patients [47]. The reasons why measurements of glycaemic controls such as blood glucose and serum HBAIC concentration were not associated with cognitive function parameters need to be fully explored in future clinical studies in people of African descent.

Neuropsychological Assessments utilized in the evaluation of cognitive function in Type 2 DM

Majority of the studies employed the use of psychometric tests such as Mini Mental State Examination [46] and Montreal cognitive Assessment Test [44,47]. The results obtained from all these tests are in keeping with those obtained from the use of automated Test battery such as Cambridge automated test battery.

Anatomic/neuroimaging Correlates of Type 2 DM cognitive dysfunction

Few studies from SSA dwell on the risk factors for the development of cognitive dysfunction in Type 2 DM patient. A study from the Northern Nigeria reported occurrence of markers of haemolytic anaemic in patients with Type 2 DM and cognitive impairment when compared to controls subjects revealed that Type 2 DM patients with MCI have reduced antioxidant capacities [47]. It was demonstrated in a large lipidomic Type 2 DM studies that these patients have increased concentrations of neurotoxic lipids. Patients with Type 2 DM with cognitive impairment were found to have brain atrophy and white matter changes when evaluated with Brain MRI [48].

Asthma

Asthma is a condition characterized by airway inflammation, narrowing, swelling and production of extra mucus resulting in difficult breathing. Asthma can be mild or severe and may interfere with activities of daily living, An earlier study in Nigeria [49] showed a high prevalence of psychopathology in asthmatic patient but the nature of psychopathology involved were not explored in detail in that study. A more recent study [50] showed that severe cognitive impairment was present in 2 out of 40 patients (5%) who had mild to moderate asthma. In this study the instrument used for the neuropsychological assessment was the FePsy Test battery which has been described earlier on.

The patients with stable asthma only had prolonged visual reaction and binary choice reaction times (psychomotor speed) when compared with healthy controls. The memory functions, attention/concentration and vigilance functions were similar between stable asthmatics and healthy controls [50]. This result is quite different

from the study that found a high degree of cognitive dysfunction particularly executive dysfunctions in severe asthmatic patients [51].

Anatomic correlates of cognitive functions in Asthma.

A study in 2020 provided evidence for further understanding of the potential cerebral alterations in the pathophysiology of asthma [51]. The authors showed by fMRI study that there were neutral connectivity network function abnormalities in the left angular gyrus, right praecuneus and inferior temporal gyms within the default mode network. Also other key regions such as superior frontal gyms and occipital lobes were involved. The degree of abnormalities detected in lingual gyms correlated with degree of airway obstruction. Another study showed white matter integrity distruptions in patients with cognitive impairment [52]. The white matter abnormalities were involved in the forceps major, cingulum, right uncinated fasciculus and inferior longitudinal fasciculus. The degree of these abnormalities correlated with duration of asthma and asthma control test scores [52]. All these provided evidence that emotion and visual pathways alter regulation of cognitive functioning.

Cognitive functions in patients with chronic kidney diseases and hypertension in SSA

There is paucity of literature in SSA on the impact of blood pressure on cognitive function A study that used the CSID as the test instrument in Nigeria showed that the blood pressure does not have much relationship with cognitive function especially among elderly individuals [53]. The effect of chronic kidney diseases on cognitive functions were elucidated by two studies in sub-saharan Africa [54,55]. The prevalence of cognitive Impairment was about 35.3%. The cognitive impairment was present in 25%, 41.0% and 46.2% of the stage III, IV, V chronic kidney disease respectively implying that the worse stage of chronic kidney disease, the severe the cognitive impairment [54]. The domains affected in these studies were the psychomotor speed (Auditory visual reaction and binary choice reaction times) and attention/concentration (computerized visual searching tasks) [55]. The factors which influenced the cognitive functions in the CKD patients were low serum bicarbonate level and high serum urea level [54]. A recent report showed that cognitive impairment in CKD patients could be due to pathology resulting from impaired clearance of uraemic metabolites, depression, sleep disturbances, anaemia and polypharmacy. Modifications of these factors and reduction of albuminuria may slow down cognitive decline in CKD patients [56].

Tables 1-4 illustrate some of the data from some of the studies on cognitive function in patients with chronic medical condition in sub-Saharan Africa.

Authors	Date Of Pub.	Study participant type	N	ART Dom (ms)	ARTNon-Dom (ms)	VRT Dom (ms)	VRT Non-Dom (ms)	BCRT (ms)	BCRA (%)	RMT words (%)	RMT figures (%)	Vig B	Vig d	CVST (s)
Ogunrin., *et al*.	2000	Epilepsy	60	473.1	443.3	423.1	396.7			41.9	34.2	0.63	0.79	
		Control	60	296.2	284.6	266.9	272.8			75.8	53.6	1.8	0.8	
Ogunrin and Adamolekun	2005	CMZ	19	500	434	464	439			44.0	40.31	0.69	0.75	
		Phenytoin	18	501.3	532	544	453			48.75	30.79	0.15	0.75	
		Phenobart	18	442.5	420	370	357			34.0	32.4	0.87	0.79	
Ogunrin., *et al*.	2005	Epilepsy	370	473.1	443.3	423.1	39.71	522.6	78.1	77.6	48.2	0.68	0.82	
		Control	270	443.8	286.6	266.9	278.8	432.7	85.1	88.1	56.5	1.84	0.81	
Sunmonu., *et al*.	2008	Epilepsy	41	409	369	416	369	577	84.1	51.8	39.9	0.85	0.90	
		Control	41	398	333	384	397	475	87.8	61.1	40.9	1.35	1.07	
Arinzechi., *et al*.	2019	Epilepsy	41	409.6	369.5	418.5	396.5	576.9	84.1	51.8	39.3	0.65	0.90	

		Control	41	398.4	333.0	384.5	392.1	474.5	87.8	61.1	40.1	1.35	1.07	
Ogunrin., *et al.*		Asympt HIV	96	494.6	479.8	593.2	583							
		Sympt HIV	96	668.8	594.2	662.5	634.4							
		Control	96	488.8	481.6	581.6	574.6							
Ogunrin., *et al.*	2007	Asympt. HIV	96											20.26
		Sympt HIV	96											22.08
		Controls	96											17.50
Odiase., *et al.*	2007	Asympt. HIV	96					587.1	900	73.1	51.9			
		Sympt HIV	96					665.2	85.1	51.7	31.3			
		Controls	96					432.8	95.1	81.5	65.2			
Authors	**Date Of Pub.**	**Study participant type**	**N**	**ART Dom (ms)**	**ART Non-Dom (ms)**	**VRT-Dom (ms)**	**VRT Non-Dom (ms)**	**BCRT (ms)**	**BCRA (%)**	**RMT words (%)**	**RMT figures (%)**	**Vig B**	**Vig d**	**CVST (s)**
Sunmonu., *et al.*	2016	HIV	50	530.4	432.9	361.8	524.9	679.8	81.0	40.6	38.7	0.77	0.74	22.18
		Controls	50	303.4	307.5	92.8	363.9	495.6	95.5	54.1	46.1	0.64	1.04	18.5
Owolabi., *et al.*	2016	ESRD pts	80	350.8	375.9	284.1	310.0		57.9	53.9	35.8			14.23
		Controls	80	196.9	204.6	133.4	141.9		71.1	71.8	51.4			6.95
Sunmonu., *et al.*	2012	Liver Cirrhosis	34	519.4	482.4	563.2	563.9	671.3	83.9	48.1	38.6	1.25	0.88	23.62
		Controls	41	380.8	324.5	412.0	382.3	499.3	93.4	53.4	24.4	0.71	1.08	18.00
Sunmonu., *et al.*	2019	Asthma	38			506.4	402.7	537.2	92.8	59.7	41.3	0.64	0.90	18.90
		Controls	40			411.8	385.4	473.2	95.4	59.1	43.9	0.58	1.04	17.0

Table 1: Studies in sub-Saharan Africa Utilizing Fepsy Neuropsychological Test.

CMZ: Carbamazepine; Symptom: Symptomatic; Asympto: Asymptomatic; Dom: Dominant; CVST: Computerized Visual Searching Task; Non-Dom: Non: Dominant; (ms): Milliseconds; (s): Seconds; ART: Auditory Reaction Time; VRT: Visual Reaction Time; BCRT: Binary Choice Reaction Time; N: Total Number; BCRA: Binary Choice Reaction Accuracy; RMT: Recognition Memory Test; Vig: Vigilance; ESRD: End Stage Renal Disease

Authors	Date	Study participant type	n	Language	Memory	Orientation	Attention	Praxis	Total CSID
Sunmonu., *et al.*	2009	Epilepsy	41	29.25	18.29	11.90	7.56	1.66	69.32
		Controls	41	36.10	21.22	12.92	8.20	1.98	80.10
Arinzechi., *et al.*	2016	Epilepsy	51	19.96	3.58	5.41	5.25	3.21	31.0
		Controls	51	25.53	4.52	8.43	5.61	1.92	42.18
Ogunjinmi., *et al.*	2020	CMZ	46	22.0	18.3	9.9	7.22		57.2
		Leviter cetan	41	22.6	19.5	9.9	7.3		59.2
Odiase., *et al.*	2006	Asympt HIV	96						60.31
		Symp HIV	96						56.02
		Controls	96						66.46
Sunmonu., *et al.*	2017	HIV	50	26.86	7.59	11.42	7.60	1.08	66.32
		Controls	50	32.40	10.42	11.96	7.60	1.66	76.34
Adekanle., *et al.*	2012	Liver Cirrhosis	40	28.87	20.79	11.77	7.69	1.23	70.08
		Controls	41	31.63	22.12	11.93	7.98	1.61	74.61

Table 2: Studies in SSA that utilized CSID Questionnaire as Test Instrument.

SSA: Subsaharan Africa; n: Total Number; CSID: Community Screening Interview for Dementia

Blank spaces for the subtests indicaed that the value obtained for this subtest was not used for the study.

Authors	Date	Study Participants type	n	Memory	Construct	Time taken (s)	Psychomotor Speed	Time Taken for task (s)	Total Score
Ogunrin., *et al.*	2009	Asympt HIV	80	3.56	1.23	10.12	4.06	19.3	8.85
		Symptom HIV	80	1.82	0.84	24.21	2.54	39.2	5.2
		Controls	80	3.68	1.96	9.84	5.14	15.9	10.78
Oshinaike., *et al.*	2012	HIV	208						8.36
		Controls	91						10.70
Asekomeh., *et al.*	2013	HIV	130	3.47	2.55		3.54		9.57
		Controls	130	3.79	3.38		3.81		11.01

Table 3: Studies in SSA that Utilized IHDS Scale as Test instrument.

n: Total Number; IHDS: International HIV Dementia Scale.

Authors	Date	Study Participants type	n	Total MMSE Score	WAIS (verbal) IQ Scores	WAIS (Performance) IQ Score	WAIS full Scale
Imam., *et al.*	2005	Epilepsy	65	26.1			
		Control	65	27.9			
Sunmonu., *et al.*	2008	Epilepsy	41		90.10	76.90	83.34
		Controls	41		99.20	85.95	92.59
Oshinaye., *et al.*	2013	HIV	208	27.7			
		Controls	91	27.8			
Sunmonu., *et al.*	2015	HIV	58		Wais z scores -0.77	Wais z Scores -1.32	Wais z Score 92.59
		Controls	50		0.00	0.00	0.00
Yusuf., *et al.*	2022	Type 2 Dm	332	22.69			

Table 4: Studies in SSA that utilized MMSE and WAIS as Test Investigation.

SSA: Subsaharan Africa; MMSE: Minimental State Examination; WAIS: Wechsler Adult Intelligence Scale; n: Total number; IQ: Intelligence Quotient

Social and economics implications of cognitive impairment in people with chronic medical conditions

Cognitive impairment in patients with chronic medical conditions such as epilepsy could result in poorer academic performance [3] due to impairment of executive function. The affected individuals may have challenges with maintaining full employment or marital relationship. They may also encounter problems with processing speed In asthmatics, diabetics and patients with liver cirrhosis, cognitive impairments could lead to reduced health literacy especially in the older patients and this may cause problems with self management including understanding and remembering physicians instructions and adherence to multiple medications use because of the deleterious effects of cognitive decline on the social and economic aspects of life in patients with chronic medical conditions, it is imperative to make early diagnosis and institut prevention/reversion to reduce the impact on disease course.

There are two types of Management approaches available for these patients. These include pharmacologic and non- pharmacologic approaches.

Pharmacologic approaches

The management of the underlying chronic medical conditions have been shown to decrease cognitive impairment in affected patients. For example, the use of dexamethasone was found to improve both airway bronchodilatation and cognitive performances in patients with bronchial asthma (Ben., *et al*. 2021), The use of insulin in patients with diabetes mellitus and consequent improved glycaemic control results in improved cognitive performance [57]. In Nigeria two studies showed that patients with epilepsy that were treated with antiepileptic drugs had improved seizure control and better cognitive performance [13,16].

Use of drugs licensed for the treatment of dementia could be employed in the treatment of cognitive decline in patient with chronic medical conditions. Donepezil 10mg that was administered to 18 patients with epilepsy showed improvement in words recall after 3months of drug treatment but not in measures of attention, verbal sequencing, mental flexibility and [59] but the drawback for Donepezil therapy in PWE is increased seizure risk [59].

In liver cirrhosis with minimal Hepatic encephalopathy, butyrylcholineserase activity was found to be reduced and it has been suggested that butyrylcholinsterace could contribute to the cognitive impairment in patient with MHE [60]. A systematic analysis also showed the effectiveness of hypoglycaemic agents in the management of cognitive dysfunctions in patients with type 2 DM disease may lead to improvement in the cognitive function of the patient: For example good blood pressure control, correction of Uraemia through dialysis, correction of anaemia and reduction of polypharmacy could decrease the rate of cognitive decline in CKD patients [56]. Organ replacement therapies like renal transplantation and liver transplantation has been shown to improve cognitive functions (attention and praxia functions) in patients with CKD and liver cirrhosis with MHE respectively [61,62].

Some studies showed that other treatment modalities such as use of lactulose and lactilol could improve symptoms of MHE. Probiotics and antibiotics that target gut flora could also be used to improve cognitive function in patients with liver cirrhosis and MHE [61,62].

Cognitive Behavioral Therapy

Could also be used as adjunct in the management of chronic medical conditions and a good response rate have been noted in epilepsy patients [63]. Also the efficacy of cognitive behavioral intervention has been shown in asthmatic patients [64]. Insula subregions functional connectivity was restored in some asthmatic patients who had group cognitive behaviour Therapy [65]. Modifying the occupation of patients and simplifying patient: s tasks could be helpful in some patients with chronic medical conditions . Exercise such as yoga and other physical activities could also serve as adjunct in the management of cognitive decline in patients with chronic medical conditions [66].

Conclusion

Most of the studies done in the sub-Saharan Africa have utilized “pen and pencil” type neuropsychological tools for assessment of cognitive functions in patients with chronic medical conditions and only few studies used objective computerized testing. It is also pertinent to know that most of the experiences and knowledge acquired in the study of cognitive function in chronic medical conditions in SSA were gained through the pivotal studies of cognitive functions in patients with epilepsy. There is the need for more computerized neuropsychological testing and use of artificial intelligence in the near future to broaden the extent of cognitive

assessments in patients with chronic medical conditions in SSA. Researches in SSA would need utilization of sophisticated and advanced investigation techniques to improve future research in patients with chronic medical condition to explore the peculiarities of the nature of cognitive functioning of patients with chronic medical condition in sub-Saharan Africa

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