Review Article

Burden and Risk Factors of Neurocognitive Disorders in Community-Dwelling Older Persons in Sub-Saharan Africa

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ABSTRACT

Neurocognitive impairment is a major challenge globally because of the increasing proportion of older persons who are at risk. The condition is classified as either minor when one or more domains of cognition is/are affected without compromise of functional ability or major when both cognition and functioning are impaired. The important clinical types are mild cognitive impairment (MCI), vascular cognitive impairment (VCI) and dementia. In the sub-Saharan Africa, MCI affects between 7% and 39% of older persons, while the age-adjusted prevalence of dementia is 4.7%. About 50% of stroke survivors develop VCI and between 8% and 15% of these progress to vascular dementia. The risk factors include old age, vascular risk factors, frailty and stress. Suggested preventive strategies aimed at reducing the burden of dementia are based on the recommendations of the Lancet Commission on Dementia.

Key words: Burden, dementia, mild cognitive impairment, prevention, risk factors, sub-Saharan Africa, vascular cognitive impairment

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INTRODUCTION

The world's population is ageing and the sub-Saharan Africa (SSA) is not left out. Currently, approximately 46 million people in the SSA are older than 60 years of age and the number is projected to increase to about 160 million by 2050.[1] The proportion of older persons is estimated to rise from 4.5% to 12.9% by 2050 in West Africa.[1] Of the many conditions affecting the older individuals, neurocognitive disorders (NCDs) constitute a major challenge and require urgent attention because dementia, the most severe form, is associated with high morbidity and mortality.[2] Managing these cases is expensive and increased budgetary allocation to the health sector is necessary in many developing economies. Disease burden is assessed in terms of prevalence (total number of cases over base population within a time period), incidence (new cases in a defined geographic area over a specified period which is usually a year), mortality (number of individuals with disease of interest that died over the base population) and, lastly, the disability-adjusted life years (derived from the addition of years lost due to disease and years lived with disability).[3] A vast majority of the studies on neurocognitive impairment in SSA have provided prevalence estimates as the measure of disease burden.

Cognition is defined as the mental action or process of acquiring knowledge and understanding through thought experience and the senses.[4] Cognitive impairment refers to a group of disorders in which the primary deficit is in one or more domains of cognition, and this may be acquired, developmental or result from neurodegeneration. Clinically, it denotes a decline from a previous level of cognitive performance which when assessed objectively, yields a score lower than the expectation for that age. The synonyms are cognitive impairment, cognitive dysfunction, cognitive decline and cognitive disorders.

DOMAINS OF COGNITION

Cognitive ability depends on the integrity of many components referred to as domains. The major domains are: (i) memory – for

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the recall of information. It is sub-divided into episodic or spontaneous, semantic (naming), procedural (recall of activities or procedures) and working memory (essential for day-to-day performance; [5] (ii) learning – for acquisition, retention and retrieval of new information through study, being taught or by experience; (iii) language – knowledge of words and their meaning. It is assessed through speech coherence, content, communication skills and understanding of information; (iv) orientation enables individuals to maintain a sense of self-continuity from the past to the future by tracking external events and conducting daily activities. It is assessed in terms of time, place and person; (v) executive function comprises abstraction, judgement and calculation, which are essential for high level of thinking and decision-making; (vi) perceptual motor function refers to the ability to do things through awareness, of the senses. It is linked with visuo-spatial ability that enables individuals to identify, integrate and analyse structural details in more than one dimension; (vii) complex attention involves ability to maintain and manipulate information. It influences the speed of processing information and execution of tasks and (viii) social cognition for responding to emotion-laden stimuli and insight.[6] These domains are interconnected and are functionally dependent. For instance, semantic memory requires intact language function, while complex attention is essential for procedural/working memory testing. Optimal cognitive performance also requires intactness of all the six senses and mental alertness. It is possible for one domain to be affected and the other domains intact. On the other hand, multiple domains can be simultaneously affected, resulting in more severe impairment.

MECHANISMS OF COGNITIVE DISORDERS IN OLDER PERSONS

Many mechanisms have been postulated to explain the development of cognitive disorders in older patients.

i. Neurodegeneration: Old age is associated with progressive death of brain cells either genetically programmed (apoptosis/autophagy/mitophagy) or due to disease. [7,8] Dead neurons lose their cytoarchitecture and atrophy. Their remnants contain deposits of misfolded proteins and other cell debris such as amyloid that may be present in neuritic plaques and in tangles, hyperphosphorylated tau protein, Lewy bodies and prion proteins. These protein aggregates serve as biomarkers of neurodegenerative disease.[9] Death of neurons in specific regions of the brain has peculiar manifestations that aid clinical diagnosis. For instance, if the frontal and temporal lobes are affected, the individual affected may present with behavioural changes and speech deficits, while hippocampal atrophy progressing to global brain atrophy occurs in Alzheimer's disease (AD) which presents predominantly with memory impairment
ii. Vascular lesions: Neuronal functioning relies on adequate blood supply of oxygen and nutrients for metabolism. This can be disrupted when stroke occurs either from occlusion or rupture of blood vessel in the brain. The former is usually a consequence of atherosclerosis which progressively encroaches on the vascular lumen until there is complete blockage. Alternatively, atherosclerotic fragments or plaques may break off, get carried as emboli to distal circulation and disrupt blood supply. Stroke is common in older persons, and the modifiable risk factors are uncontrolled hypertension, diabetes mellitus, obesity and dyslipidaemia. [10] Long-term hypertension causes medial lipohyalinosis, thickening of the vessel walls and narrowing of the lumen of the arterioles and the small perforating arteries that supply the deep white matter. [11] The pathological features are infarcts, lacunes, microbleeds and periventricular seepage of the cerebrospinal fluid. Multiple small infarcts result in compromise of cognition, but a single infarct involving critical areas such as the pre-frontal cortex, thalamus and angular gyrus can lead to major NCD. Vascular lesions in the brain also cause oxidative stress which may co-exist with neurodegeneration[7,8,11]
iii. Disruption of the blood–brain barrier can allow toxic substances to travel into the central nervous system unrestricted and interfere with normal brain activities. [12] Infections, trauma and tumours are important causes
iv. Abnormal blood constituents with accumulation of toxic substances in the brain due to terminal organ failure (kidneys, liver and lungs); medications, hormonal imbalances and poor glycaemic control can impair normal metabolic processes and result in neuronal death or the compromise of cognitive processes[13,14]
v. Neurotransmitter abnormalities notably acetylcholine, glutamate and catecholamines can affect normal brain functioning and result in cognitive dysfunction. AD, the most common type of dementia, is associated with deficiency of acetylcholine in the basal forebrain nucleus of Meynert and characterised by severe memory loss[5,7]
vi. Infections: It is hypothesised that infectious agents such as Herpes simplex virus I, *Chlamydia pneumonia* and spirochetes can remain latent in the brain and get reactivated intermittently with ageing, immune decline and stress, resulting in viral inflammation. The resulting synaptic dysfunction, neuronal loss and ultimately amyloid deposition in the brain can lead to neurodegeneration. [15] Recently, gut microbiomes have been postulated to play a role in neurodegeneration. The human immunodeficiency virus infection is an important cause of neurocognitive dysfunction culminating in dementia in SSA. With the advent of highly active antiretroviral drugs, which has enabled longer lifespan for people living with HIV/AIDS, the problem may increase. Although infections are important causes of cognitive impairment in SSA, this review will focus on neurodegenerative and vascular disorders of cognition.

CLASSIFICATION OF NEUROCOGNITIVE DISORDERS

The most recent publication of the Diagnostic and Statistical Manual of the American Psychiatric Association (V) classified NCDs simply into minor and major types.[16]

a. The minor NCD is characterised by objectively determined deficit in one or more domains of cognition without impaired performance of daily activities. Subjective cognitive dysfunction is diagnosed when an individual complains of a decline in his/her mental action such as forgetfulness, but the deficit cannot be confirmed on clinical testing. Though worrisome, it is obviously not yet an illness but has been recognised in some studies to pre-date dementia. The other minor disorders are mild cognitive impairment (MCI) and vascular cognitive impairment (VCI)
b. Major NCD: Dementia is the most severe form and in this group of disorders, cognitive impairment is associated with functional decline in the absence of clouding of consciousness and the affected individual requires supervision in the advanced stages.

Mild cognitive impairment

This concept has evolved over the past four decades to describe the transitional phase between normal cognition and dementia.[17] There is documented cognitive deficit in one or more domains on neuropsychological assessment without functional impairment. MCI can be regarded as symptomatic pre-dementia stage on the continuum of cognitive decline. The affected individuals are neither normal nor demented.

Burden of mild cognitive impairment

Table I provides a summary of the prevalence estimates of MCI in SSA, which range between 7% and 37.9%.[18-28] It is essential to note that variations in research methodology could account for the differences in rates. The Mayo Clinic revised criteria dichotomised the diagnosis of MCI into amnestic and non-amnestic types, which can affect single or multiple cognitive domains.[29] The amnestic variety has predominant memory complaints (concerns or detected on questionnaire). Individuals in this category usually progress to AD. The non-amnestic variety presents with affectation of other cognitive domains without memory deficit. A community-based study in Lalupon, Lagelu Local Government Area of Oyo State, found that the amnestic variety of MCI accounted for over 80% of the MCI cases.[24]

Table I: Prevalence estimates of mild cognitive impairment in sub-Saharan African countries

Country	Prevalence (%)	References
Benin Republic (65 years+)	10.4	Guerchet M *et al*., 2009
Botswana (60 years+)	9.0	Clausen T *et al*., 2011
Congo (65 years+)	37.9	Mbalesso P *et al*., 2012
Senegal (55 years+)	10.8	Coume M *et al*., 2012
Tanzania	7.0	Paddick SM *et al*., 2015
Nigeria (65 years+)	18.4	Ogunniyi A *et al*., 2016
The Democratic Republic of the Congo	13.6	Desomais I *et al*., 2018
Ghana/South Africa	15.3	Vancamfort D *et al*., 2019
South Africa	8.5	Koyanagi A *et al*., 2019
Cameroon	33.3	Tianyi FL *et al*., 2019

Risk factors for mild cognitive impairment

MCI can be regarded as the 'leading edge' for the prevention of dementia. It is, therefore, essential that the predisposing factors be properly delineated and appropriate intervention be implemented. Rich data now exist on the risk factors for cognitive impairment in SSA, which can be grouped into the following five categories:

Demographic

Age is by far the most important risk factor for cognitive impairment, and this was consistently documented in virtually all studies. Salthouse carried out cross-sectional comparisons and showed that increased age was associated with lower levels of cognitive performance from the latter part of the second decade progressively up to the seventh decade of life, when it becomes clinically significant.[30] The prevalence estimates in Table I show that much lower rates were reported in studies that had younger population as in Botswana and Senegal.

The association of MCI with gender is less consistent. Studies carried out in Cameroon and Tanzania reported association with female gender.[23,28,31] This association can be ascribed to their longer lifespan and the old cultural practice of limited education opportunities for female children. Individuals with limited education are more likely to perform poorly when tested on certain domains of cognition that require exposure to Western education. It is, however, important that culturally appropriate and validated tests with adjustments made for educational status are used for community assessment of cognitive status. Being single is another risk factor identified by Tianyi *et al*.[28] that may suggest limited psychosocial stimulation as the possible reason.

Socioeconomic factors

Severe food insecurity was reported to be associated with a fourfold increased risk of MCI.[27] Low body mass index (BMI) (<18.5), a surrogate of undernutrition, as well as poverty and food insecurity were found to be associated with MCI in the EPIDEMCA study.[32] Lack of employment compounds poverty and food insecurity. Short stature was reported by Kobayashi *et al*. in the INDEPTH study in South Africa to increase the risk of MCI.[33] A link can be drawn among poverty, undernutrition and food insecurity. Short stature reflects early life cumulative net nutrition. Therefore, poor nutrition in early life could deprive the brain of essential nutrients for optimal functioning. A hungry individual will be distracted and/or pre-occupied with the search for food. Hence, he/she would not pay attention to new information being provided and would therefore perform poorly on cognitive testing.

Vascular factors

Many studies in SSA have reported association of MCI and high blood pressure (systolic and/or diastolic).[28,34-36] In Lalupon, hypertension was associated with two-fold increased risk of MCI.[33] Novel vascular risk factors for MCI include mean arterial pressure (MAP), peripheral arterial disease and markers of atherosclerosis. Adebiyi *et al*. utilised the MAP and pulse pressure to calculate cardiovascular risks and showed that when the value was >10%, there was significant association with cognitive impairment after adjusting for age, gender, educational level and years of smoking. Individuals who had their MAP in the fourth quartile (>115 mmHg) were up to three times more likely to be cognitively impaired when compared to those with MAP <94 mmHg. Second, low ankle brachial index (ABI) which is an evidence of peripheral vascular disease was associated with MCI.[35] In the EPIDEMCA study, Desormais *et al*. reported that MCI was significantly higher in those with ABI ≤ 0.90 than in those with normal values (20.1% vs. 12%), and there was a 52% increase in the risk of MCI with low ABI.[25] A recent study in Uganda by Mworozi *et al*. reported that the presence of carotid artery plaque was associated with three-fold increase in the risk of MCI.[37]

Frailty

Frailty occurs with ageing and has been associated with cognitive impairment. The phenotype is defined by any three of the following features: low grip strength, low energy, slowed waking speed, low physical activity and unintentional weight loss.[38] Two components of frailty were investigated in some studies in SSA. Vancamfort *et al*. reported a 54% increase in the risk of MCI in South Africans and Ghanaians aged 65 years and older with weak hand grip,[26] while slower baseline gait was associated with cognitive decline in the study by Ojagbemi *et al*. in Southwest Nigeria.[39]

Miscellaneous factors

Perceived stress which can disrupt normal brain activity through heightened anxiety and release of catecholamines is associated with increased MCI risk.[27] In the same vein, hearing impairment affects information reception and processing. It was reported in a systematic review by Taljaard *et al*. to increase the risk of MCI.[40] Depressive illness was also reported to be a risk factor for MCI.[31,41]

Vascular cognitive impairment

VCI describes the spectrum of cognitive changes related to vascular causes from early cognitive decline to dementia. Harmonised data from 3146 individuals collated on diverse populations in eight countries mainly in Europe, Australia and Nigeria reported that 44% of stroke survivors developed post-stoke global cognitive impairment within 2–6 months.[42] The domains of cognition affected were attention and processing speed, memory, language, executive function and perceptual motor.[42] Two studies on VCI from Nigeria and Ghana reported that between 34% and 40% of stroke survivors developed VCI and another 8% and 14% progressed to dementia (post-stroke dementia, vascular and/or mixed dementia with AD features).[43,44] The risk factors for VCI are older age (odds ratio [OR] = 1.05); low education (OR = 5.09); pre-stroke cognitive decline (OR = 4.51) and functional disability. Medial temporal lobe atrophy on neuroimaging was also associated with significantly increased risk (OR = 2.25).[45] However, pre-stroke consumption of fish was reported by Akinyemi *et al*. to be protective.[43] Akpalu *et al*. reported that post-stroke cognitive impairment adversely affected the quality of life.[46]

MAJOR NEUROCOGNITIVE DISORDER (DEMENTIA) IN THE SUB-SAHARAN AFRICA

Four decades ago, dementia was presumed to be rare in SSA for many reasons which included paucity of data, relatively young population, early deaths of cases, concealment of cases within households and more daunting problems of malnutrition and communicable diseases (especially HIV). However, the situation has changed with ageing of the population and the availability of more studies. The global increase of 7.7 million new cases, approximating to one new case every 4 s,[47] has increased public health concern, and the World Health Organization described dementia as a public health priority needing global attention.[2] It is projected that the number of cases in SSA would increase from 2.1 million to 7.6 million (over 250% increase) between 2015 and 2050.[1] The main drivers of the increase in SSA are population ageing and adoption of Western lifestyle with increasing cardiovascular risk. The diagnosis of dementia is associated with stigma which could be enacted (elder abuse) or implied in stereotyping and relationship with the affected individuals and their family members.[48]

Burden of dementia

Prevalence estimates of dementia in SSA range between 2.3% and 11%,[18,19,24,49-55] with an overall age-adjusted figure of 4.7% according to the Alzheimer Disease International (ADI).[1] The comparative figures for Western countries range between 5% and 11%.[56] AD is the most common type of dementia, accounting for more than half of the cases.[53,57] The other common types are vascular dementia, frontotemporal lobar degeneration and dementia associated with Parkinson's disease (Lewy body dementia and atypical Parkinson's disease). There is a group of reversible dementia which should be the target for practicing physicians because appropriate treatment of the underlying causes can result in complete recovery of cognitive functions. Table II summarises the important distinguishing clinical and pathological features of the various types of dementia.

Risk factors for dementia

NCD is a spectrum, and the overlap of risk factors between MCI and dementia is therefore not surprising. Age is a universal risk factor for dementia.[1,2] In a systemic review by the ADI, the prevalence estimates of dementia increased

Table II: Distinguishing features of common degenerative dementia sub-types

Sub-type*	Predominant clinical features	Pattern of progression	Pathology
AD	Memory loss pre-dominantly	Progressive	Amyloid deposition in plaques and tangles, elevated CSF tau protein; brain atrophy – global and hippocampus
VD	Focal deficit, executive problems	Stepladder	Subcortical and cortical infarcts, lacunes, microbleeds
FTD	Behavioural problems, language deficit – semantic and progressive aphasia	Progressive	Circumscribed atrophy of the brain, astrogliosis; inclusions (Pick's bodies); progranulin, TDP-43
LBD	Visual hallucinations, non-motor PD features; neuroleptic sensitivity, REM sleep disorder	Fluctuation	Lewy bodies, alpha-synuclein deposition; brain atrophy
PDD	Slowness, rigidity, memory loss + executive problems	Progressive	Depigmentation of substantia nigra, Lewy bodies
HDD	Chorea + cognitive dysfunction	Progressive	Atrophy of caudate nucleus, astrocytosis; trinucleotide repeats

*AD: Alzheimer's disease, VD: Vascular dementia, FTD: Fronto-temporal dementia, LBD: Lewy body dementia, PDD: Parkinson's disease dementia, REM: Rapid eye movement, HDD: Huntington's disease dementia, CSF: Cerebrospinal fluid

from 1.2% in those aged 60–64 years to 17.6% for those over 85 years.[1] The other risk factors are social isolation, high blood pressure, low BMI (<18.5), alcohol, financial distress, low-fibre diet, psychosocial stress and bereavement (death of a parent).[19,24,36,50,55,57-59] Low education and lack of spousal relationship were also reported to increase the risk in the study by Yusuf *et al*. in Zaria.[60] The latter could imply depressive illness. MCI, especially the amnestic type, was associated with higher conversion rate to dementia in the Indianapolis-Ibadan Dementia Study.[61] Apolipoprotein E ε4 allele, located on chromosome 19 and involved with cholesterol transport in the brain, has recently emerged as a risk factor for dementia (AD) among the Yoruba.[62] This was contrary to previous reports in Nigeria and other countries that found no association.[19,57,58]

The Lancet Commission on Dementia carried out a meta-analysis of risk factors along the lifespan and categorised them into genetic (specifically apolipoprotein E risk from birth), less education in early life, hypertension, obesity and hearing loss in middle life (<65 years), while smoking, social isolation, diabetes mellitus and low physical activity become important after the age of 65 years.[63] The other risk factors for dementia are traumatic brain injury, occupational exposure to particulate matter and heavy metals and vitamin/dietary deficiencies.[64]

PREVENTIVE STRATEGIES

The global increase in the number of individuals affected by NCD, particularly dementia, can only be checked through purposeful interventions against the identified risk factors. Intervention should target the modifiable risk factors such as hypertension, diabetes mellitus, obesity and hearing impairment because nothing can be done about longevity. Optimal blood pressure, smoking cessation, good glycaemic control as well as checks to limit excessive weight gain and dyslipidaemia cannot be overemphasised because these underlie the vascular damage that eventually results in cognitive decline. Good nutritional advice is essential, and the consumption of meals providing adequate calories, rich in fruits and vegetables, is recommended. Preferably, the diet should be composed of whole grains, fish, nuts and legumes prepared using cholesterol-free oil to mimic the popular Mediterranean diet.[65] The Lancet Commission on Dementia recommended strategies for reducing brain inflammation; increasing brain cognitive reserve and reducing damage from oxidative stress, vascular injury and exposure to neurotoxins.[63] Brain disorders should be treated appropriately and in a timely fashion to prevent chronicity and neuronal losses. Treatment of depression and/or the development of psychosocial skills which combat stresses will improve brain performance. The use of non-steroidal anti-inflammatory agents is recommended for reducing brain inflammation. However, this must be done with caution to avoid potentially fatal gastrointestinal bleeding and renal impairment, particularly in the elderly population. Traumatic brain injury should be reduced by enforcing compliance with highway laws including wearing of appropriate protective gears.

Cognitive reserve can be increased through preserved hearing using appropriate aids and mass literacy campaigns with promotion of adult education at community level to increase literacy level. Rich social networking is considered beneficial and makes the older persons relevant. Elderly patients should be encouraged to participate in communal meetings and religious activities. They can also participate in local board games and other brain-stimulating activities within their neighbourhood to improve their cognitive ability. The phrase 'use it or lose it' applies to cognitive functioning. Experience with cognitive stimulation therapy (CST) which is a group-based, psychological and social reminiscence treatment for mild-to-moderate stages of dementia was shown to enhance cognitive performance. It is usually administered twice weekly over 7 weeks by nurses and occupational therapists. CST, in our experience, brought about significant improvement in overall cognitive performance and reduction in caregiver burden with reduced utilisation of clinic services.[66] The era of 'tales by moonlight' that enabled the older persons to interact and teach the young people things of cultural value seemed to have passed, partly because the previous multigenerational living arrangements in many communities is no longer favoured by

the current changes in social dynamics and economic pursuits. This needs revisiting, even in urban settlements.

Exercise and increased physical activity overlap with three approaches i.e., reducing inflammation; increasing cognitive reserve and reducing damage from oxidative stress, vascular injury and exposure to neurotoxins. Exercise is cost-effective and should be done within the capability of the individual and cardiovascular tolerance. Twenty-six out of 27 articles in a systemic review by Carvalho *et al*. showed that physical activity improved cognition in older persons.[67] Exercise does this by promoting wellness, facilitating neuroplasticity with enhanced neuronal connection density and improvement in cerebral blood flow and lastly through the release of neurotrophins (granulocyte colony-stimulating factor and brain-derived neurotrophic factors). The deterrents to physical activities in the elderly such as idleness, absence of clearly demarcated walkways for pedestrians on many roads, reckless driving by commuters (tricycle, motor cycle and commercial drivers) encroaching on the paths of people exercising, built-up neighbourhoods, prolonged time spent sitting and watching television and total dependence on others (domestic helps) to do chores should be discouraged through legislation and advocacy. Aerobic exercises interjected between discussions at meetings will keep older persons active.

CONCLUSION

This review has highlighted the important NCDs affecting older persons in SSA. MCI is the most common, and up to half of the individuals who recover from stroke could develop VCI. AD is the most common type of major NCD. The increasing prevalence of dementia is a source of concern, and attempts at stemming the tide should focus on treatable risk factors and improved brain stimulation. Preventive strategies aimed at reducing the burden of cognitive disorders deserve priority in SSA.

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Conflicts of interest

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