IBRO Neuroscience Reports 12 (2022) 309–322

Contents lists available at ScienceDirect

IBRO Neuroscience Reports

journal homepage: www.sciencedirect.com/journal/IBRO-Neuroscience-Reports

Depression in Sub-Saharan Africa

Ismail Temitayo Gbadamosi [a,j], Isaac Tabiri Henneh [b], Oritoke Modupe Aluko [c], Emmanuel Olusola Yawson [d], Aliance Romain Fokoua [e], Awo Koomson [f], Joseph Torbi [f], Samson Ehindero Olorunnado [g], Folashade Susan Lewu [a], Yusuf Yusha'u [h], Salmat Temilola Keji-Taofik [a], Robert Peter Biney [b], Thomas Amatey Tagoe [i,*]

[a] Department of Anatomy, University of Ilorin, Nigeria
[b] Department of Pharmacotherapeutics and Pharmacy Practice, School of Pharmacy and Pharmaceutical Sciences, University of Cape Coast, Ghana
[c] Department of Physiology, School of Basic Medical Sciences, Federal University of Technology, Akure, Nigeria
[d] Department of Anatomy Redeemer's University, Nigeria
[e] Department of Animal Biology University of Dschang, Cameroon
[f] Department of Pharmacology and Toxicology University of Ghana, Ghana
[g] Department of Anatomy, Kogi State University, Nigeria
[h] Department of Human Physiology Ahmadu Bello University, Zaria, Nigeria
[i] Physiology Department, University of Ghana, Ghana
[j] Laboratory for Translational Research in Neuropsychiatric Disorders, BRAINCITY Nencki-EMBL Center of Excellence for Neural Plasticty and Brain Disorders, Warsaw, Poland

ARTICLE INFO

Keywords:
Major depressive disorder
Antidepressants
Sub-Saharan Africa
Medicinal plants

ABSTRACT

Mood disorders can be considered among the most common and debilitating mental disorders. Major depression, as an example of mood disorders, is known to severely reduce the quality of life as well as psychosocial functioning of those affected. Its impact on the burden of disease worldwide has been enormous, with the World Health Organisation projecting depression to be the leading cause of mental illness by 2030. Despite several studies on the subject, little has been done to contextualise the condition in Africa, coupled with the fact that there is still much to be understood on the subject. This review attempts to shed more light on the prevalence of depression in Sub-Saharan Africa (SSA), its pathophysiology, risk factors, diagnosis and the experimental models available to study depression within the sub-region. It also evaluates the contribution of the sub-region to the global research output of depression as well as bottlenecks associated with full exploitation of the sub region's resources to manage the disorder.

Introduction

Mood disorders are common mental disorders in Sub-Saharan African (SSA) that usually go undiagnosed and underreported. This subject was the theme of discussion at the International Brain Research Organization –Africa Regional Committee (IBRO-ARC) Advanced School on Depression and Mood Disorders in Sub-Saharan Africa, which took place at the University of Ilorin in the lead up to the bi-annual international meeting of the Society of Neuroscientists of Africa organised jointly with the Neuroscience Society of Nigeria. Although almost 10% of the overall disease burden in SSAa can be traced to neuropsychiatric disorders (Fekadu et al., 2017), there is currently a paucity of literature on depression epidemiology, research and management in Sub-Saharan Africa. Data available is scattered in several places and, at best, not contextualised to the sub-region. This review on depression in SSA is a product of the attendees of the IBRO-ARC advanced school that seeks to provide a comprehensive body of work, giving an overview of depression in SSA to spur on further contextualised work. We have explored the epidemiology, pathophysiology, risk factors, diagnosis, and experimental approach to studying depression in the context of Africa. We have additionally identified contributions of the sub-region in the study of the disorder and emerging management approaches, as well as necessary gaps to be filled. To identify relevant articles for this review, a systematic review of the PUBMED central, PsycINFO, and Google scholar databases, for articles published before 2020 was conducted using the following key terms: (1) mood disorders (2) depression; (3)

* Corresponding author.
E-mail address: tatagoe@ug.edu.gh (T.A. Tagoe).

https://doi.org/10.1016/j.ibneur.2022.03.005
Received 22 April 2021; Accepted 14 March 2022
Available online 17 March 2022

each sub-Saharan African country; and (4) epidemiology, pathophysiology, and treatment. Additional studies were identified through the bibliographic references used in the reviewed articles. The search was limited to articles published in the English language.

Epidemiology of depression in Sub-Saharan Africa (SSA)

Mood disorders are one of the most common and debilitating mental illnesses. Generally, psychiatric mood disorders may be classified into various categories including; depression (extreme low emotional state), mania (extreme high emotional state), bipolar disorder I and II (alternating periods of depression and mania), cyclothymia, depression with or without psychosis, recurrent mania with or without psychosis and dysthymia (Delgardo and Morena, 2006; Gureje, 2007; Kessler et al., 2007; Marvel and Paradiso 2008; Phillips and Kupfer 2013). Depression has been identified to have a 'chameleon presentation' as it cuts across all age groups (Safeekh, 2017; Adewuya et al., 2018; Adebayo Adebisi et al., 2019).

Epidemiological data on depression in SSA countries is poor. In many cases, country-specific data are absent and rather replaced by point prevalence. Only a few countries in Africa present epidemiological data for depression, and where available, there exists methodological inconsistencies and high variabilities across countries. This, in turn, limits the generalisation and synthesis of data across studies (Baxter et al., 2013; Esan and Esan, 2016).

The absence of data is a significant burden, nonetheless, incomplete data on the prevalence of depression is available for limited countries (Table 1). These countries include South Africa, Nigeria, Cameroon, Ethiopia, Sudan, Kenya, Uganda, Ghana, the Democratic Republic of Congo, Zambia, and Botswana. For the main part, data from these countries are obtained from cross-sectional or cohort studies in hospitals, schools or prisons, increasing the burden of missing data and misrepresentation. Despite the gaps and limited knowledge on the epidemiology of depression in SSA, available data suggests prevalence is only lower than that reported in the Americas and European regions as defined by the World Health Organisation(WHO) (Fig. 1) (Depression and Other Common Mental Disorders Global Health Estimates, 2017) (Fig. 2).

Altogether there are over 300 million cases of mood disorders recorded worldwide. Between 2005 and 2015, there was an increase of 18.4%, alluding to a continual yearly increase in the worldwide prevalence (Ferrari et al., 2013; Depression and Other Common Mental Disorders Global Health Estimates, 2017).

Depression, which is often associated with indifference, low spirits and misery, is the most common of all the mood disorders, having an estimated prevalence of 4.4% with a higher incidence in females (5.1%) compared to males (3.6%) (Ferrari et al., 2013). The burden of depressive disorders varies by WHO regions, ranging from 2.6% in males located within the Pacific to 5.9% in females located within Africa. In addition, prevalence rates also vary by age, peaking in older adulthood (55 – 74 years) with a 7.5% rate among females and 5.5% among males (Kessler et al., 2007; Depression and Other Common Mental Disorders Global Health Estimates, 2017).

In Africa, about 29.19 million people (9% of 322 million) suffer from depression, with over 7 million in Nigeria (3.9% of 322 million). Estimates place the lifetime prevalence of depressive disorders from 3.3% to 9.8% (Esan and Esan, 2016). The co-occurrence of stroke and depression is high, with 1 in every 3 stroke patients being diagnosed as clinically depressed (Ojagbemi et al., 2017). This high co-incidence has been linked to functional dependency and reduced quality of life after stroke within the region. Similarly, depression is two- to three times more prevalent in people living with HIV (PLHIV) than in the general population (Bernard et al., 2017). This goes to further support the link between the reduced quality of life and depression as previously stated.

In northern Nigeria, depression is the most prevalent mood disorder, with an incidence of 54.5% in patients attending clinics in Northern

Table 1
Depression rates recorded in the general population versus small controlled populations.

Country	% Depression rate in general population[a]	% Depression rate in controlled population
Angola	3.6	38 – 67 (Xavier and Peixoto, 2015) (Bernatsky et al., 2007)
Benin	3.9	11.6 – 89 (Melgar and Rossi 2010; Nubukpo et al., 2004)
Botswana	4.7	15–38 (Lawler et al., 2011)
Burkina Faso	3.6	4.3 – 11 (Ouedraogo et al., 2019; Duthe et al., 2016)
Burundi	4.2	15–43 (Tol et al., 2014; Ventevogel et al., 2014)
Cameroon	3.9	7 – 31 (Gaynes et al., 2012; Ngasa et al., 2017)
Cape Verde	4.9	6 (Conde et al., 2019)
Central African Republic	4.2	5.1 – 88.6 (Fouchier and Kedia 2018; Mbelesso et al., 2014)
Chad	3.5	3.9 – 13.1 (Koyanagi et al., 2010)
Democratic Republic of Congo	3.9	3.8–27 (Maj et al., 1994; Koyanagi et al., 2010)
Cote D'Ivoire	3.8	2–48.9 (Ulanja et al., 2019; Bindt et al., 2012; Koyanagi et al., 2010)
Equatorial Guinea	4.2	–
Eritrea	4.3	6.2–81.6 (Kelifa et al., 2020; Netsereab et al., 2018; Nakash et al., 2016)
Ethiopia	4.7	4.8–57 (Duko et al., 2018; Bitew, 2014)
Gabon	4.3	48.4 (Camara et al., 2018)
Gambia	3.9	7.5 – 73.9 (Sherwood et al., 2015; Bartram 2018)
Ghana	4.2	6.2 – 62 (Cristobal-Narvaez et al., 2020; Alhassan et al., 2014)
Guinea	3.9	13 – 34 (Secor et al., 2019; Camara et al., 2014)
Guinea-Bissau	4	–
Kenya	4.4	6.3 – 72.9 (Cristobal-Narvaez et al., 2020; Kamau et al., 2012)
Lesotho	4.8	8–28 (Stahlman et al., 2015; Cerutti et al., 2016)
Liberia	3.5	12.6–40 (Vinck et al., 2013; Johnson et al., 2008)
Madagascar	4.4	21.5 (Melgar and Rossi 2010)
Malawi	4.1	4.2–30.3 (Stewart et al., 2009; Udedi M, 2014)
Mali	3.6	3.3 – 26.7 (Cristobal-Narvaez et al., 2020; Zoungrana et al., 2017)
Mauritania	4.1	2.7 – 12.4 (Melgar and Rossi, 2010; Cristobal-Narvaez et al., 2020;)
Mauritius	4.4	6.9 – 51.8 (Cristobal-Narvaez et al., 2020; Duval et al., 2010)
Mozambique	4.1	

(*continued on next page*)

Table 1 (*continued*)

Country	% Depression rate in general population[a]	% Depression rate in controlled population
		7.03–34 (Melgar and Rossi 2010; Zacarias et al., 2012)
Namibia	4.4	5.6 – 30 (Cristobal-Narvaez et al., 2020; Kalomo 2018)
Niger	3.4	75.62 (John et al., 2019)
Nigeria	3.9	7.8 – 30.6 (Amoran et al., 2007; Abasiubong et al., 2011; Uche et al., 2015)
Rwanda	3.8	5 – 75 (Binagwaho et al., 2016; Bolton et al., 2002)
Senegal	3.9	4.5 – 57.8 (Rai et al., 2013; Diale et al., 2015; Sy et al., 2019)
Sierra Leone	3.9	7.1 – 80 (Bah et al., 2020; Secor et al., 2019)
South Africa	4.6	1.9 – 38 (Cooper et al., 2009; Flutterman et al., 2010)
South Sudan	4.4	6.4 – 47.5 (Ayazi et al., 2012; Assil and Zeidan, 2013)
Swaziland	4.2	1.7 – 22.7 (Murray and Burnham, 2009; Malgvist et al., 2016;)
Tanzania	4.1	2.7 – 15.5 (Gaynes et al., 2012; Marwick and Kaaya 2010)
Togo	3.9	4.4 – 39 (Nubukpo et al, 2004; Kakpovi et al., 2017)
Uganda	4.6	8.1 – 21 (Kinyanda et al., 2011; Amone-P'Olak et al., 2013)
Zambia	4	5.1 – 53.7 (Chipimo and Fylkesnes, 2010; Mbewe et al., 2013)
Zimbabwe	4	2.3 – 33 (Chibanda et al., 2010; Abas and Broadhead 1997)

[a] Adapted from the WHO Global Burden of Disease Study 2015 (Depression and Other Common Mental Disorders Global Health Estimates, 2015)

Nigerian Tertiary Institutions (Aiyelero et al.,2011). A reported 33% of women attending mental health clinics in the Niger-Delta region of Nigeria were diagnosed with depression. In this instance, common associations with depression included childhood adversity, sexual violence, and substance misuse in both sexes (Nduna et al., 2013). Another study conducted in Yoruba-speaking communities of Nigeria, Gureje et al. (2007) reported the lifetime and 12-month prevalence estimates of major depressive disorder to be 26.2% (95% CI 24.3–28.2) and 7.1% (5.9–8.3) respectively in persons aged 65-years and above (Gureje et al., 2007). However, in another large community-based study comprising 6752 adults aged 18 and above selected from 21 out of the 36 states in Nigeria, lifetime and 12-month estimates of major depressive episodes were 3.1 ± 0.3% and 1.1 ± 0.1% respectively (Gureje et al., 2006). A total of 721 (65.2%) were from urban communities, while 384 (34.8%) were from the rural community. The overall prevalence of depression was found to be 5.2%. Again, depression was found to be more prevalent among women than men (5.7% vs 4.8%). Furthermore, depression is more common in the rural areas of Nigeria than in the urban areas (7.3% vs 4.2%) (Amoran et al., 2007). This ties in well with the previously established relationship between quality of life and depression.

South Africa reports similarly high cases of depression, with the prevalence of depressive symptoms being 20.5% in females and 13.5%

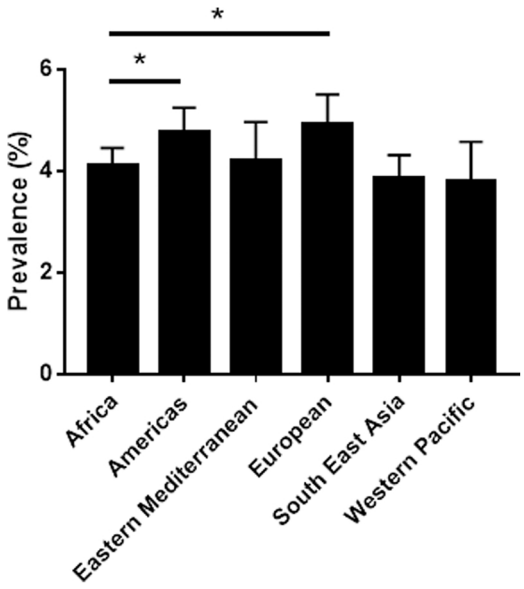

Fig. 1. Depression rates in designated WHO regions. Countries in the WHO Africa region, which represent the SSA countries, have a depression rate (4.1 ± 0.05%) which is significantly lower than that recorded in the Americas (4.8 ± 0.09%) and the European region (4.9 ± 0.1%) *p < 0.0001. One-Way ANOVA Kruskal-Wallis Post-hoc test. Primary data obtained from the WHO Global Burden of Disease Study 2015 (Depression and Other Common Mental Disorders Global Health Estimates, 2015).

in males. Studies among HIV-positive patients in South Africa, Botswana, Zambia, and Uganda have also reported a high prevalence of depression, with the prevalence ranging from 11.5% in Uganda (Kinyanda et al., 2019) to nearly 30% in South Africa, Zambia, Sudan and Botswana (Esan and Esan, 2016; Opondo et al., 2018; van den Heuvel et al., 2013; Assil and Zeidan, 2013); (Stein et al., 2008). In Ethiopia alone, the prevalence of depression ranges between 11% and 38%, dependent on the population of interest (Bitew 2014; Duko et al., 2018). Cross-sectional studies among medical students in Cameroon have revealed that depression was high in that group and associated with chronic medical conditions and major life events (Ngasa et al., 2017). From that study, it was reported that about one-third of women (30.6%, 95% CI: 22.8–36.7) had major depressive disorder. With regards to the severity of depression, 34.6%, 26.4%, 3.4% and 0.80% students were classified as having mild, moderate, moderately severe and severe depression respectively (Ngasa et al., 2017). Postpartum complications, ageing, imprisonment, unwanted pregnancy, cardiovascular diseases, HIV, drug abuse, and conflicts make up the main risk factors of depression in SSA.

A recent WHO's Global health estimate for depression and other common mental disorders reports that the African region represents about 10% of the global burden of mental disorders (5.4% and 3.2% for depression and anxiety, respectively) (Depression and Other Common Mental Disorders Global Health Estimates, 2017). Unfortunately, these statistics are not representative of the real extent of depression in African countries due to factors including misdiagnosis, undiagnosis, and unpublished data. The data on Africa presented as % depression rates in Table 1 is certain to be a misrepresentation of the real number of patients but serves as a starting point to assess the gravity of depression on the continent. In most countries where data could be retrieved, there was a sharp contrast with % depression rates reported in small controlled populations ranging from hospital settings (HIV patients, pregnant women, etc.) to prison populations. For many of these populations, depression was not the primary health concern for which they attended a health facility. As such, in the absence of comorbidity, which moves patients to report to the hospital, many cases would have gone

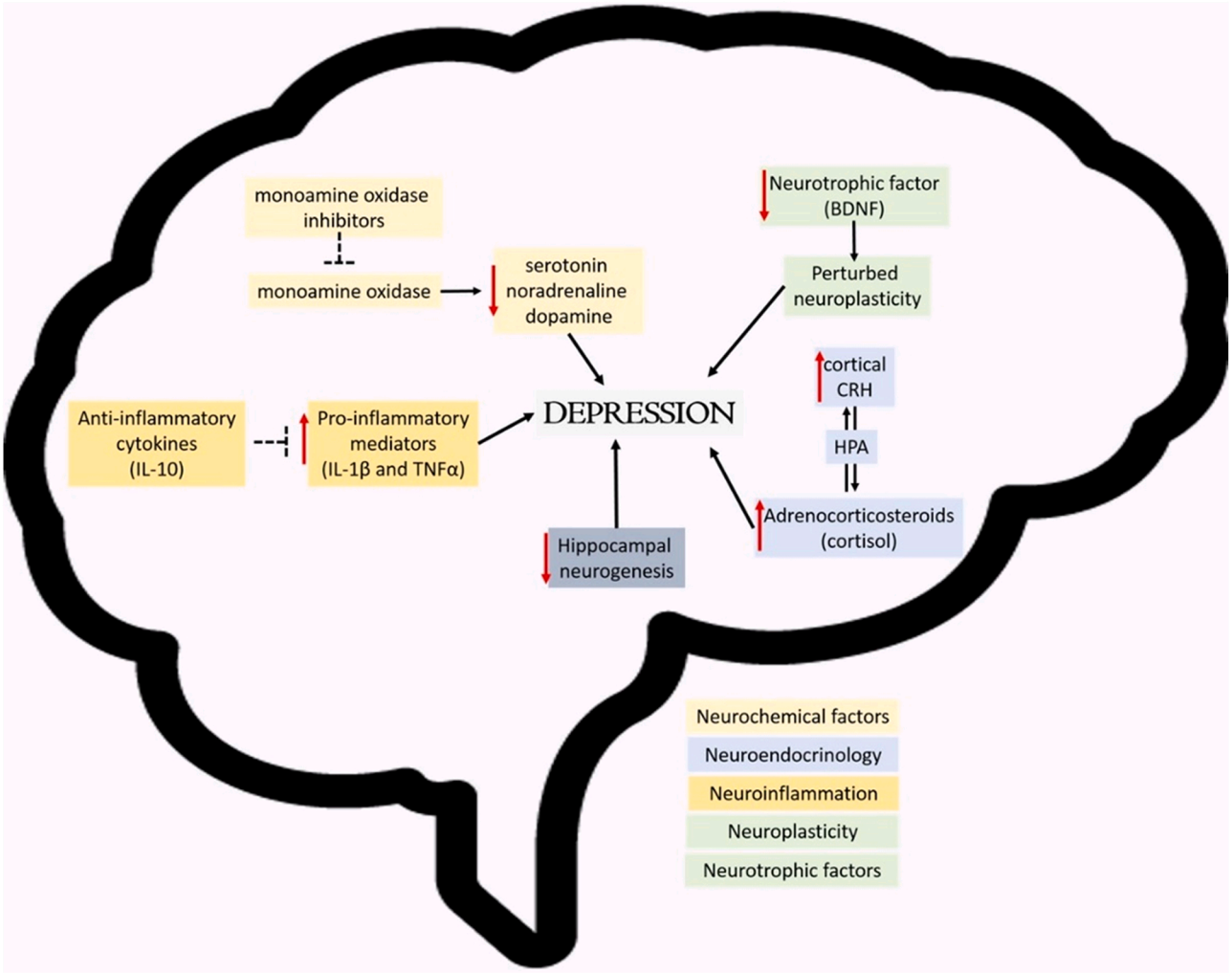

Fig. 2. Pathophysiology of Depression. Schematic diagram classifying the known pathophysiological mechanisms underlying depression. These are Neurochemical factors, Neuroendocrinology, Neuroinflammation, Neuroplasticity and Neurotrophic factors.

unreported. Therefore, although it is expected that smaller population studies will yield higher prevalence rates in comparison to the national prevalence rate, the vast number of undiagnosed cases must be acknowledged.

Pathophysiology of depression

Several factors contribute to the pathophysiology of depression. Some of the most common pathophysiological pathways are associated with neurochemical factors, neuroendocrinology, neuroinflammation, neuroplasticity, and neurotrophic factors.

The contributions of neurochemicals such as serotonin, noradrenaline, dopamine, and others in depression have been widely studied and reported on, as such will only be briefly reviewed here (El Yacoubi et al., 2003; Torrey et al., 2005). The monoamine hypothesis describes one of the more popular pathophysiological mechanisms underlying depression. It proposes that depression occurs as a result of decreased levels of monoamines such as noradrenaline, serotonin, and dopamine found in the anterior cingulated cortex, ventral tegmentum and the Brodmann area 25 regions of the brain (Amthor, 2014). There are several studies that have provided evidence in support of the monoamine hypothesis based on their location, behaviours they mediate and consequences of controlled depletions. (Maes and Meltzer, 1995; Asberg, 1997; Placidi et al., 2001; Stockmeier, 2003). The monoamine hypothesis has for many years served as the foundation for the production of antidepressant drugs, specifically monoamine oxidase inhibitors, to restore the normal levels of monoamines (Thomsen and Sorensen, 2007; Ramesh et al., 2017; Jesulola et al., 2018).

Though depression is regarded as a stress disorder, there is usually no damage to the Hypothalamus-Pituitary-Adrenal (HPA) axis (Belmaker and Agam, 2008). This is despite the fact that cortical brain regions implicated in psychological stress induce the release of corticotropin-releasing hormone (CRH), which acts via the hypothalamic-pituitary-adrenal (HPA) axis to release cortisol among other adrenocorticosteroids from the adrenal gland. However, there are a few cases of depression where there is evidence of abnormalities to the HPA axis and the CRH release/control system (Pariante and Lightman, 2008). High CRH levels are implicated in some depressed symptoms such as reduced appetite, disturbed sleep, as well as decreased libido (Nemeroff, 1996). Furthermore, high cortisol levels may be the connection between depression and associated long term diseases such as coronary heart disease, osteoporosis and type II diabetes (Gold and Chrousos, 1999). High CRH levels are observed in the cerebrospinal fluid (CSF) of depressed patients (Hasler, 2010), and post-mortem studies have demonstrated increased CRH secreting neurons in limbic brain regions in depressed patients (Hasler, 2010).

Neuroinflammation mediated by cytokines has also been implicated in the pathophysiology of depression (Hurley and Tizabi, 2013). Several cytokines are associated with depression; notable amongst these are interleukins (IL), interferon-gamma and tumour necrosis factors (TNF)

(Strawbridge et al., 2017). Studies suggest that markers of neuro-inflammation underlie both the development of depression and chronic stress (Dhabhar, 2000; Mc Ewan, 2000). Pro-inflammatory mediators such as IL-1β and TNFα may be responsible for behavioural responses such as hyperthermia, loss of appetite, sleep disruptions, anhedonia, nausea, fatigue and loss of interest in physical and social environments as observed in depression (Dantzer et al., 2007; Jesulola et al., 2018). Anti-inflammatory cytokines such as IL-10 prevents an excess building and signalling of pro-inflammatory cytokines. Therefore, an imbalance of the pro and anti-inflammatory cytokines is likely to play a role in the pathogenesis of depression (Dantzer et al., 2007).

Reduced hippocampal neurogenesis and volume have been identified as an underlying correlate of depression (Hayley and Litteljohn, 2013). Decreased activity of neurotrophic factors such as the brain-derived neurotrophic factor (BDNF) leading to disturbed neuroplasticity has also been implicated in depression (Sacher et al., 2012; Cattaneo et al., 2010). The underlying mechanism could be due to a missense polymorphism with substitution of methionine which causes disruptions in the maturation of the protein leading to reduced BDNF action (Chen et al., 2004). This polymorphism in BDNF action is related to the start of depressive disorder (Schumacher et al., 2005; Frielingsdorf et al., 2010). All this contributes towards aberrant neuroplasticity which may play a role in some depressive cases (Hayley and Litteljohn, 2013).

In addition to the action of BDNF in adults, there is enough evidence to show the link between depression and disturbances of normal neurogenesis during the early development of the brain (Jacobs et al., 2000; Monteggia et al., 2004; Duman and Monteggia, 2006). The widespread action of BDNF in the nervous system and the inter-connections with depression prevents it from being fully exhausted here but has been handled elsewhere (Borroni et al., 2009; Castrén and Rantamäki, 2010; Yu and Chen, 2011).

Diagnosis of depression and mood disorders in Sub-Saharan Africa

Diagnosis of depression and mood disorders is a challenging science, giving that depression is characterized by a myriad of symptoms and syndromes that mimic other disorders. Often, depression does not occur alone but coexists with other conditions which tend to confound an accurate diagnosis. According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V), the diagnosis of a Major Depression Episode (MDE) requires five or more symptoms recurring in one or more episodes for at least a period of 2-weeks (Shaffery et al., 2003; American Psychiatric Association, 2013; Tolentino and Schmidt, 2018). One of the primary symptoms should be either a depressed mood or anhedonia (loss of interest or pleasure), while the secondary symptoms are changes in appetite or weight, sleep disturbances (insomnia or hypersomnia), psychomotor agitation or retardation, fatigue or loss of energy, diminished ability to think or concentrate, feelings of worthlessness or excessive guilt, and recurrent thoughts of suicide (Shaffery et al., 2003; Tolentino and Schmidt, 2018). The symptoms must be significant enough to; (1) cause impairment in social, educational or occupational activities, (2) must not be due to any other medical condition or substance,(3) must not be due to bereavement unless beyond a period of 2 months and (4) must not be due to mania (Shaffery et al., 2003).

Depression is often episodic with specific classifications including mild, moderate, or severe, with or without psychotic features, in full or partial remission, chronic (at least two years in duration); with catatonic, melancholic, or atypical features; or with postpartum onset (American Psychiatric Association, 2013; Tolentino and Schmidt, 2018). Diagnosis of depression is largely by clinical interview-based instruments, and in a few cases, laboratory tests exist for depression screening (Smith et al., 2013). In SSA, where medical personnel with expertise in mental health are not as abundant as observed in Europe, many do not have the training to effectively administer diagnostic tools. Where skilled practitioners do exist, they do not have the time and/or resources to administer diagnostic tools to all individuals at risk of mood disorders (Ali et al., 2016). This makes the identification of individuals with depression intractable, coupled with cultural and social stigma associated with the disorder (Adewuya et al., 2006a, 2006b). Despite this setback, a frantic effort is being made to increase awareness of depression in SSA. In many high-income countries, depression screening is standard routine practice during primary care using several validated instruments (Smith et al., 2013). In settings with few mental health specialists, it is often difficult to achieve diagnostic goals with these same tools due to vast differences in cultural definitions of the disorder and unavailability of validated instruments which are context-specific (Abiodun, 1994; Adewuya et al., 2006b; Sweetland et al., 2014). Regardless of these challenges, several validated screening instruments are still used across SSA in addition to unstructured interviews to diagnose depression cases (Table 2). Among all these tools, the specific ability of an instrument to correctly identify “true cases” (sensitivity) from “non-cases” (specificity) is paramount (Sweetland et al., 2014).

Although these instruments have been validated for use across diverse settings, methods for establishing their confidence vary widely, and there is an overall lack of consensus about best practices for ensuring cross-cultural equivalence (Sweetland et al., 2014). Many of the best performing diagnostic tools have been those that were locally adapted. The validity of a screening tool can always be improved for local adoption through focus group discussions with representatives of the population in which the screening tool is to be implemented (Ali et al., 2016). The main aim of these discussions should be geared towards standardizing these instruments to the greatest extent possible to enhance cross-cultural comparison and facilitate their usage (Sweetland et al., 2014). This will also allow the incorporation of local idioms of distress into the diagnostic tool to better account for the local experience and expression of mood disorders.

The problem with diagnosis of depression is further complicated by the rich diversity of languages and cultures across SSA; an instrument used satisfactorily in one cultural setting may or may not have the same applicability in another setting, or within a different population, even in the same country. Many of the western derived diagnostic tools often require careful contextualisation to maintain sensitivity. Five essential features such as establishing equivalence across language, content, concept, techniques and criteria have been described by Flaherty et al. as essential for a particular instrument to be considered “culture-free” (Flaherty et al., 1988; Sweetland et al., 2014). Notwithstanding the inconsistencies in the prominence, manifestation and expression of symptoms across the socio-cultural divide in SSA, there is also considerable evidence that supports universality in the experience of depression, anxiety and other mood disorders. Attention should, therefore, be geared towards standardizing these instruments for use while considering the diverse socio-cultural and linguistic settings within the sub-region.

Pharmacological management of depression

Based on the neurobiology of depression and other mood disorders, varying hypotheses have been postulated, which have driven the development of effective therapeutic interventions. The earliest pharmacological agents introduced for the management of mania were barbiturates (Lopez-Munoz et al., 2018). Management of depression has evolved into interventions that involved the use of monoamine oxidase inhibitors (MAOIs), tricyclic antidepressants (TCAs), selective serotonin reuptake inhibitors (SSRIs), serotonin and norepinephrine reuptake inhibitors (SNRIs), noradrenaline reuptake inhibitors (NRIs) and mood stabilizers (Quello et al., 2005; Delaloye and Holtzheimer, 2014). These classes of agents seek to either modulate the activity of the neurotransmitters such as serotonin, noradrenaline, dopamine, γ-aminobutyric acid, and glutamate, as well as their receptors and/or enhance activity BDNF (Li et al., 2012; Mathews et al., 2012; Wang and Si, 2013;

Table 2
The mst common diagnostic tools used in clinical settings and the SSA countries where use of these tools have been reported.

Diagnostic Tool	Countries Reported	References
Self-Reporting Questionnaire (SRQ)	Burundi, Cote D'Ivoire, Ethiopia, Eritrea, Gambia, Ghana, Guinea-Bissau, Malawi, Mauritius, Mozambique, Nigeria, Rwanda, Uganda, Zambia, Zimbabwe	(De Jong, 1996; Rumble et al., 1996; Patel et al., 1997; Uwakwe, 2000; Youngmann et al., 2008; Hanlon et al., 2008; Stewart et al., 2009; Chipimo and Fylkesnes, 2010; Scholte et al., 2011; Rivet-Duval et al., 2011; Nakimuli-Mpungu, 2012; Bahadur Thapa, 2014; Weobong et al., 2014; Familiar et al., 2016; Netsereab et al.,2018; Slekiene and Mosler, 2019)
Mini International Neuropsychiatric Interview (MINI)	Burkina Faso, Cote D'Ivoire, Democratic Republic of Cong, Ethiopia, Kenya, Namibia, Nigeria, Rwanda, Sierra Leone, Uganda, Zambia, Zimbabwe	(Adewuya et al., 2008; Kinyanda et al., 2011; Kamau et al., 2012; Igwe et al., 2013; Umubyeyi et al., 2014; Dialé, 2015; Duthé et al., 2016; Kwobah et al., 2017; Howlett et al., 2018; Tang et al., 2019)
Composite International Diagnostic Interview (CIDI),	Benin, Burkina Faso, Cameroon, Chad, Cote D'Ivoire, Democratic Republic of Congo, Ethiopia, Gambia, Ghana, Kenya, Malawi, Mali, Mauritania, Mauritius, Morocco, Namibia, Nigeria, Senegal, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe,	(Bertschy et al., 1992; Ndetei et al., 2009; Gaynes et al., 2012; Koyanagi et al., 2017; Cristóbal-Narváez et al., 2020; Mughal et al., 2020)
General Health Questionnaire (GHQ)	Angola, Benin, Central African Republic, Ethiopia,Gambia, Kenya, Liberia, Namibia, Nigeria, Rwanda, Zambia	(Nubukpo and Preux, 2004; Bernatsky et al., 2007; Kessler et al., 2007; Chipimo and Fylkesnes, 2010; Scholte et al., 2011; Bitew, 2014; Mwape et al., 2016; Dabilgou et al.,2019; Rodriques and Pieters, 2019)
Hopkins Symptom Checklist (HCSL)	Benin, Botswana, Central African Republic, Democratic Republic of Congo, Ethiopia, Ghana, Liberia, Nigeria, Rwanda, Siwerra Leone, Tanzania, Zambia	(Bolton, 2001; Bolton et al., 2002; Kaaya et al., 2002; Adewuya et al., 2006a and 2006b; Ventevogel et al., 2007; Basset al., 2008; Weobong et al., 2009; Vinck and Pham, 2010; Guptaet al., 2010; Ertl et al., 2011; Sheikh et al., 2016; Bah et al., 2020)
Becks Depression and Anxiety Scales	Botswana, Ethiopia, Gambia, Ghana, Kenya, Namibia, Nigeria, Senegal, Togo, Uganda, Zambia	(Berard et al., 1998; Ndetei et al., 2009; Lawler et al., 2011; Dialé et al., 2015; Mossie et al., 2016; Musyimi et al., 2017; Tang et al., 2019; Mughal et al., 2020)
PHQ-9	Botswana, Cameroon, Democratic Republic of Congo, Cote D'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Liberia, Mozambique, Namibia, Nigeria, Rwanda, Sierra Leone,	(Bindt et al.,; Kaaya et al., 2002; Adewuya et al., 2006a and 2006b; Weobong et al., 2009; Ertl et al., 2011; Gaynes et al., 2012; Gelaye et al., 2013; Yotebieng et al., 2017; Audet et al., 2018; Duko et al., 2018; Osok et al., 2018; Halsted et al., 2019; Secor et al., 2020; Ngasa et al., 2017)
Centre for Epidemiological	Benin, Burundi, Gabon, Gambia, Ghana, Guuinea, South Africa,	(Myer et al., 2008; Chishinga et al., 2011; Klis et al., 2011; Nakimuli-Mpungu et al.,

Table 2 (*continued*)

Diagnostic Tool	Countries Reported	References
Studies Depression Scale (CES-D)	Zambia, Gambia, Kenya, Senegal, Namibia, Rwanda, Senegal, South Africa, Zambia	2012; Othieno et al., 2014; Mughal et al., 2020)

Jun et al., 2014; Ashok et al., 2017). Antidepressants in these categories include fluoxetine, olanzapine, mirtazapine, imipramine, risperidone, lamotrigine and nefazodone (Youdim and Bakhle, 2006; Bauer et al., 2010; Li et al., 2012; Shim et al., 2017).

Worldwide, most guidelines recommend new-generation antidepressant, especially SSRIs, as 1st line of agents for the management of depression (Excellence, 2009). This is attributed to the fact that although they are of comparative efficacy among other antidepressants, they have the most favourable risk-benefit ratio (Cipriani et al., 2018). Other antidepressants like TCAs are associated with an increased risk of overdose and likelihood to discontinue use due to side effects (Kato et al., 2018). In SSA, SSRIs are registered for use in 12 countries where data could be retrieved (Table 3). The relatively high-cost of SSRIs to TCAs limits their use even though they are of a better risk-benefit ratio. Within the SSRIs, fluoxetine is the most widely available in the sub-region and the most widely prescribed. Other SSRIs like sertraline which are widely used in developed nations due to acceptability and balance of benefit, is only available in a few African countries and seldom prescribed.

Emerging pharmacotherapy for depression

Several challenges plague current treatments that limit the extent of the use of current antidepressants. Studies have shown there are little differences between placebo and some antidepressants in current use (Bear et al., 2019). There is also a significant time-lapse between the initiation of therapy and the onset of therapeutic actions. The time-lapse, in certain antidepressants, from the onset of medication to

Table 3
Nationally approved antidepressants in selected SSA countries by their respective drug regulatory authorities.

Country	Approved Antidepressants	References
Botswana	Amitriptyline, fluoxetine, trimipramine	(Ministry of Health, 2012)
Ethiopia	Fluoxetine, amitriptyline	(Ethiopia Food Medicine and Healthcare Administration and Control Authority, 2010)
Ghana	Fluoxetine, sertraline, citalopram, imipramine, amitriptyline	(Ministry of Health, 2017)
Kenya	Amitriptyline, fluoxetine, venlafaxine	(Ministry of Health)
Nigeria	Fluoxetine, amitriptyline	(Federal Ministry of Health, 2018)
South Africa	Fluoxetine, citalopram, amitriptyline	(National Department of Health, 2015)
Sudan	Imipramine, sertraline	(Federal Ministry of Health, D. G. of P. 2014)
Uganda	Amitriptyline, fluoxetine, imipramine	(Ministry of Health)
Zambia	Sertraline, clomipramine, fluoxetine	(Zambia Ministry of Health, 2019)
Malawi	Amitriptyline, fluoxetine,	(Ministry of Health, (Government of Malawi), 2015)
Rwanda	Amitriptyline, fluoxetine, flupenthixol	(MINISTERE DE LA SANTE REPUBLIQUE DU RWANDA, 2010)
Zimbabwe	Amitriptyline, fluoxetine, sertraline, imipramine, citalopram, venlafaxine, duloxetine, mianserin	(The National Medicine and Therapeutics Policy Advisory Committee, 2015)

effective therapeutic benefits, can result in exacerbation of depressive symptoms. These shortcomings are driving the search for novel antidepressants to produce superior and rapid results (Machado-Vieira et al., 2010). These challenges have led to the development of alternative hypotheses and mechanisms of depression because traditional hypotheses like monoamine theories cannot completely explain the treatment shortfalls. With new mechanism comes newer approaches to managing depression. Prominent among these is the glutamate approach. Selective NMDA receptor subtype 2B antagonists (Ibrahim et al., 2012), glutamate release inhibitors, partial agonists of glycine-site modulators of NMDA (Preskorn et al., 2015) and metabotropic glutamate receptor antagonist antagonists (Dwyer et al., 2013) are all being evaluated for antidepressant effects. Negatively modulating $GABA_A$ with the use of selective $GABA_{A\alpha5}$ inverse agonist is also being explored (Fischell et al., 2015). These approaches have been shown to produce rapid-onset and long-lasting antidepressant effects, as such, are envisioned to be game-changers.

Additionally, reduced neuroplasticity and the upstream signalling pathways that contribute to neuroplasticity and neurogenesis have also been implicated in depression (Huang et al., 2017) and are currently areas of active research and experimentation for novel therapeutics (Duman et al, 2016). There are also emerging brain stimulation applications that target resistant/refractory depression. Methods such as transcranial magnetic stimulation (TMS) (Harel et al., 2014; Rachid, 2018), Transcranial Direct Current Stimulation (tDCS) (Loo et al., 2012; Loo et al., 2018), Cranial Electrotherapy Stimulation (CES) (Gilula and Kirsch, 2005; Yennurajalingam et al., 2018) and newer alternatives like Magnetic Seizure Therapy (MST) (Sun et al., 2018; Daskalakis et al., 2020). Each of these is increasingly being evaluated and applied in investigational treatment settings. They are believed to exert antidepressant effects mediated by glutamate interruption that ultimately results in enhanced neurotransmitter transport trafficking and increased synaptic plasticity and synaptogenesis.

It is important to note that SSA is behind with regards to research and development of these emerging approaches owing to challenges such as access to adequate funding and the lower number of available scientists required to contribute to these areas of research (Maina et al., 2020). Except for South Africa, no other SSA country is currently using or investigating the use of brain stimulation approaches to treat depression. The same scenario pertains to other emerging approaches where the research has been contributed by researchers in the Americas, Europe and Asia.

Indigenous therapies for depression management in Sub-Saharan Africa

Africans have used natural products for managing a host of diseases since ancient times. The use of several medicinal plants for the management of mood disorders has been reported in several ethnobotanical studies (Stafford et al., 2008; Teixeira et al., 2016; Ior, 2017; Amoateng et al., 2018; Wubetu et al., 2018). Some of the plants identified in ethnobotanical studies have been evaluated preclinically to access their efficacy in a simple test for antidepressant activity, such as the tail suspension and forced swim tests and were found to reduce immobility (Table 4). However, few have been extensively evaluated for their mechanisms of antidepressant action. Indeed none of the studies identified used transgenic animal models of depression for evaluation of mechanisms of action. This finding is in line with a recent report which highlights the absence of advanced techniques in neuroscience studies carried out in Africa (Maina et al., 2020). The use of molecular-based techniques to identify molecular markers of antidepressant action are also few in number. It is important to note that clinical trials involving natural products or standard herbal extracts from SSA evaluating in depression management are non-existent. Moving forward, work must be done to the point of standardized herbal extracts, which can be used clinically. In this aspect, some strides have been made with regards to *Sceletium tortuosum* (Terburg et al., 2013). The standardized herbal extract will pave the way for much more feasible clinical trials to prove the efficacy of these medicinal plants.

Risk Factors for depression and mood disorders in Sub-Saharan Africa

There are many known and unknown risk factors that increase one's chances of developing depression and other mood disorders. Risk factors are largely genetic or environmental, with some of the risk factors associated with poor health, low quality of life, socio-economics and relationships.

Poor health management as a result of poor patronage and utilization of medical services is a major cause of depression among the aged (Padayachey et al., 2017). It was also found to contribute to disability, increased morbidity and mortality among a similar population (Padayachey et al., 2017). Treatment of conditions such as Alzheimer's disease, Parkinson's disease and dementia which were found to be risk factors of depression, are typically present in the elderly (Felicia et al., 2013).

The quality of life in the family characterized by parental warmth is very important for healthy living in adolescents. These include quality time from a parent, family routine activities, maternal support and

Table 4
Emerging novel therapeutic agents for managing depression.

Plant (Family)	Country of Study	Plant part Evaluated	Mechanism (s) of anti-depressant activity	References
Adansonia digitata (Bombacaceae)	Nigeria	Stem bark	Dopaminergic, muscarinic and noradrenaergic pathways	(Murtala and Akindele, 2020)
Agapanthus campanulatus (Alliaceae)	South Africa	Leaves, Flowers, Roots	Inhibition of SERT, NET and DAT	(Pedersen et al., 2008)
Boophone distica (Amaryllidaceae)	South Africa	Bulb	Inhibition of SERT, NET and DAT	(Pedersen et al., 2008)
Cymbopogon citratus	Nigeria	Leaves	Via serotonergic and noradrenergic pathways	(Umukoro et al., 2017)
Gladiolus dalenii (Iridaceae)	Cameroon	Corms	Via NMDA, serotonin and noradrenergic systems	(Ngoupaye et al., 2014a)
Kalankoe integra (Crassulaceae)	Ghana	Leaves	Via serotoninergic, opioidergic, and noradrenergic systems	(Kukuia et al., 2015)
Mondia whitei (Asclepiadeace)	South Africa		Inhibition of SERT	(Pedersen et al., 2008)
Newbouldia laevis (Bignoniaceae)	Nigeria	Leaves	Via D_2 receptor	(Murtala and Akindele, 2020)
Palisuta hirsute (Commelinaceae)	Ghana	Leaves	Potentiation of noradrenergic neurotransmission	(Woode et al., 2010)
Pseudospondias microcarpa (Anacardiaceae)	Ghana	Leaves	Via NMDA, nitric oxide and serotonin pathways	(Adongo et al., 2015)
Ruta graveolens (Rutaceae)	South Africa	Leaves	Monoamine oxidase inhibition	(Stafford et al., 2007)
Sceletium tortuosum (Aizoaceae)	South Africa		Monoamine oxidase inhibition	(Coetzee et al., 2016)
Trichilia monadelpha (Meliaceae)	Ghana	Stem bark	Serotonergic and Opiodergic mechanisms	(Kukuia et al., 2018)
Xylopia aethiopica	Ghana	Fruits	Enhancement of 5-HT neurotransmission	(Biney et al., 2016)

improved communication. However, the lack of these can lead to major depressive disorder. The amount of time spent with parents has been known to improve depressive symptoms in adolescents already diagnosed with depression (Manczak, 2019). Nonetheless, a high incidence of depression is reported among the older generation when compared with the younger generation, and this higher incidence is often associated with functional disability, social, economic and political factors (Akosile et al., 2017; Pannetier et al., 2017).

Again, the geographical location and socio-economic environment of individuals has been shown to affect the rate of depression. For instance, a recent report indicates a higher rate of depression among elderly persons in low- and middle-income countries compared to those in high income countries (Ojagbemi et al., 2020). Unsurprisingly, the Ibadan Study of Ageing which was carried out in a low- and middle-income country (Nigeria) reported one of the highest rates of major depressive disorder in the literature with a 12-month prevalence of about 7% (Gureje et al., 2007) compared to an average rate of about 3% reported in high-income countries (De La Torre-Luque and Ayuso-Mateos, 2020). Additional reports suggest that elderly persons in low-middle-income countries may be at elevated risk of depression compared to their peers in high income countries (Gureje, 2020).

Another factor that is known to increase the risk of depression is the disease state of people. One of such diseases is HIV/AIDs. Unsurprisingly, it has been shown that almost half of persons living with HIV are affected by depression (Osok et al., 2018). Taking a sample population in South Africa, it was discovered that people living with HIV had higher rates of mood disorders when compared to the general population (Spies et al., 2018). Most people living with HIV show signs and symptoms of depression when they were screened for HIV testing regardless of whether the result comes back positive or not (Kagee et al., 2017; Spies et al., 2018). It is worthy of note that depression has an undesirable consequence on the progression of treatment of HIV patients, especially as it concerns attitude to regular use of medication (Lima et al., 2007; Mayston et al., 2012; Spies et al., 2018). In line with this, depression has been associated with worsening of clinical outcomes among people living with HIV due to poorer virologic response, reduction in physical functioning and medication adherence. This effectively creates a positive feedback loop, with other factors such as bereavements, low economic status, insufficient social support, poor educational background and substance abuse, further worsening both disease conditions (Brown et al., 2013; Kaneez, 2016). Apart from HIV, maternal depression in low and middle – income countries have been reported to be unusually high (antenatal depression) (Brittain et al., 2015; Huang, 2016). For example, pregnant youths in rural areas of Kenya, who are HIV positive and at a very young age were found to be at higher risk of exhibiting depressive symptoms when compared to pregnant adolescents at a much older age (Osok et al., 2018). Other chronic diseases such as arthritis and hypertension are also known to increase the risk of depression (Meng et al., 2012; Beurel et al., 2020).

Experimental modelling and evaluating depression and mood disorders

Over the years, several researchers have developed various experimental models for the study of depression and associated mood disorders. The wide range of behavioural deficits associated with depression makes it a challenging task to create these disorders in a controlled environment for study (Benedikz et al., 2009). However, the development of suitable experimental models has gone a long way in accelerating mood disorder research by increasing the understanding of the mechanism underlying the pathophysiology of the disorder and providing the possibility of early-onset screening (El-Mallakh et al, 2003).

Animal models have given many insights into the underlying mechanisms of mood changes, neurodegenerative symptoms and attention deficit in depression, but human depression is complex, thereby making the generation of insightful and valid models less straightforward when compared to other conditions (Miller and Raison, 2016). Advancement in genetic and pharmacological methodologies have aided in the creation of more relevant experimental animal models. These advancements have provided a clearer insight into some intrinsic intracellular mechanisms that play critical roles in the pathophysiology of depression (Valvassori et al., 2013).

It has been proposed from an evolutionary perspective that depression is an analogue of the involuntary defeat strategy, which is initiated when struggling for limited resources. (Sloman, 2008). However, modelling detailed psychiatric features of depression in rodents or other primitive primates is impossible because behaviours such as suicidality and guilt are uniquely human features and cannot be replicated in animal models. However, the features that can be modelled include anhedonia, neurovegetative changes, measures of helplessness, alterations in sleep, behavioural despair and change in appetite patterns. These available models and their use in Africa are discussed in subsequent sections and summarised in **(**Table 5**).**

Animal models of depression and mood disorder

Animals are commonly used to recreate features that mimic depression, particularly to identify new therapeutic targets and preclinical screening of novel therapeutic agents (Valvassori et al., 2013) (Krishnan and Nestler, 2011). Over the years, different researchers have made a series of attempts to create animal models that mirror some

Table 5
Evidence of proven capacity in the use of animal models of depression.

BEHAVIOURAL TEST	SSA COUNTRIES WITH PROVEN CAPACITY	REFERENCES
Forced swim test	Algeria, Cameroon, Egypt, Ethiopia, Ghana, Libya, Morocco, Nigeria, South Africa	(Ngoupaye et al., 2013; Hailu and Engidawork 2014; El zahaf, N. A. and Elhwuegi, A. S, 2014); (Fekadu, 2014); (Merzoug et al., 2014); (Ngoupaye et al., 2014); (Kukuia, 2015); (Bikomo et al., 2017); (El Brouzi et al., 2020); (El-Marasy et al., 2021)
Tail suspension test	Cameroon, Ghana, Egypt, Ethiopia, Morocco, Nigeria, South Africa	(Hailu and Engidawork 2014; Ngoupaye, 2014b; Kukuia et al., 2015; Akinpelu et al., 2017; Ben-Azu et al., 2018 ; Amaghnouje et al., 2020; Amin et al., 2020)
Sucrose consumption preference test	Algeria, Cameroon, Ghana, Nigeria, South Africa,	(Biney et al., 2016; Dallé et al., 2017)
Open field test	Algeria, Cameroon, Democratic Republic of Congo, Egypt, Ethiopia, Ghana, Libya, Morocco, Nigeria, South Africa, Tanzania, Tunisia, Zimbabwe	(Manning-SayI and Leonard, 1989; Sherif and Oreland, 1995; Pedersen et al., 2008; Okoli et al., 2010; Ngoupaye et al., 2013; Hailu and Engidawork 2014; Merzoug et al., 2014; Mesfin et al., 2014; Ngoupaye, 2014b; Amoateng et al., 2017; Bikomo et al., 2017; Omotoso et al., 2018; Miguel et al., 2019; Amin et al., 2020; El Brouzi et al., 2020; Smach et al., 2021)
Foot shock escape test	Egypt	(Sabry et al., 2014)
Three chamber socialbility and social novelty test	Nigeria, Ghana	(Mutiu Ajao, 2012; Mante et al., 2016)
Multivariate concentric square field test	None	None

possible number of physiological and behavioural changes common in depression and mood disorders. Behavioural tests are commonly used to assess the face validity of an animal model, which demonstrates its ability to mirror the symptoms of depression (Valvassori et al., 2013). Several behavioural tests have been widely used in much experimental work to assess drugs with antidepressant activities (Réus et al., 2011; Budni et al., 2012), but such drugs are unable to provide deep insight into the neurobiological aspects of depression (Dzirasa and Covington, 2012).

Behaviour is often regarded as the final output of CNS; thereby, behavioural tests serve as the primary basis of depression evaluation, along with genetics, electrophysiology, and histology. Altogether, these techniques serve as major tools for understanding underlying mechanisms in depression and screening for novel therapeutic targets/agents (Hånell and Marklund, 2014). Behavioural paradigms that are employed in animal models of depression are discussed below, with an indication of African countries with a proven ability to perform these tests (Table 5).

Forced swimming test (FST)

This is the most common test in evaluating depression-like behaviour in animal models of depression. It was first described by (Porsolt et al., 1977) in rats and subsequently in mice. It mostly determines the period of immobility in rats or mice, as immobility is interpreted to manifest as a result of negative mood, hopelessness, and lack of motivation. All these are established symptoms of depression (Chenu, 2005).

The procedure involves two exposures to a deep cylindrical tank in which the rats cannot touch the tank bottom, hence, forced to swim for survival. The first exposure is termed 'pre-test session', it's for 15 min. The second exposure is termed " test session", takes place after 24 h, and it is for 5 min (Belovicova et al., 2017; Porsolt et al., 1977; J.C.B., Sáenz et al., 2006).

The tail suspension test (TST)

This test is mainly used in mice, and as the name implies, the mouse is hung upside down by the tail. It was first described by (Steru et al., 1985). It manifests similar behaviours to the FST but has the advantage of being able to eliminate the risk of hypothermia brought on by the forced swim test. The procedure is such that animals are supposed to struggle to escape the stressful condition, but after a period, the animal ceases to struggle, leading to immobility. The earlier the animal ceases to struggle, and as such, the longer the immobility period, the greater the likelihood of depression (Belovicova et al, 2017).

Sucrose consumption preference test

Sucrose consumption preference test assesses the sensitivity of animals to reward (Belovicova et al., 2017). The animals are provided with water without and with different concentrations of sucrose, and the preference is analyzed. Reduction of interest in sucrose is seen as the manifestation of depression (Belovicova et al., 2017). It is a very reliable test for depression as seen in the work of (Willner et al., 1987), where prolonged administration of tricyclic antidepressants (TCA) resulted in a renewed preference for sucrose in a rat model of depression (Willner et al., 1987).

The open-field test

Hall & Ballachey developed this test in 1932. It provides a qualitative and quantitative measurement of a rodent's locomotive activity and exploratory drive, thereby testing the rodent's emotionality. The apparatus is an open field divided into squares and surrounded by high walls to prevent escape. Rodent's activities are assessed using the numbers of square crosses, rearing frequency and time spent moving. To assess anxiety, other parameters taken into consideration are; defecation, time spent in the centre of the apparatus as well as first, few minutes of activities (Berggren et al., 1978; Can et al., 2012; Gould et al., 2001; Slattery and Cryan, 2012). Currently, there are automatic open-field apparatuses that allow for easier and accurate processes through the use of software-linked infrared beams or video cameras.

Foot shock escape task

Réus et al. (2011) and Maier and Watkins (1984), proposed foot shock escape task as a model of learned helplessness in mice and an essential preclinical test. The foot shock test evaluates the ability of animals to escape when subjected to an escapable foot shock after having previously been exposed to an inescapable footshock. It has since become one of the important preclinical tests for evaluating learned helplessness that is behavioural evidence of depression (Maier and Watkins, 1984).

Three-chamber sociability and social novelty test

The test assesses cognition in the form of general sociability and interest in social novelty in rodent models of CNS disorders. It is well established that rodents usually socialize by spending more time with another rodent, and they investigate a novel intruder more so than a familiar one (social novelty). Based on these inclinations, rodents with deficits in sociability and/or social novelty (potentially due to depression)can be easily identified using the Three Chamber Test (Lundberg et al., 2019).

After a period of acclimation in the empty box, the subject encounters a never-before-met intruder under one pencil cup and an empty pencil cup in the "sociability" session. The subject then encounters the first intruder as well as a second never-before-met intruder under another pencil cup in the "social novelty" session. The time spent sniffing each pencil cup, the time spent in each chamber, and the number of entries into each chamber is recorded. The data obtained from this test is useful for quantifying deficits in social behaviour of rats such as that experienced during depression as well as evaluating novel chemical entities for their effect on social behaviour (Lundberg et al., 2019).

The multivariate concentric square field (MCSF) test

The Multivariate concentric square field (MCSF) test is used to assess depression which manifests as deficits in risk assessment, elevated anxiety and shelter seeking behaviour in rodents. It consists of a large square field of 100 cm by 100 cm, surrounding a smaller central square field of 70 cm by 70 cm with walls of 25 cm height. The arena is divided into zones: which include risk areas and shelter/ hoard areas (Meyerson et al., 2006; Ekmark-Lewén et al., 2010; Kaidanovich-Beilin, 2011). Furthermore, MCSF allows the subjects free choice with respect to choosing the area to explore, Unlike other behavioural paradigms for assessment of depression, the MCSF is a forced exploration task involving inescapable novelty that evokes risk performance and also allows for investigation of different variables of behaviour in the same apparatus in the same session. The test is carried out using a ceiling mounted video and tracking software. Usually, the experiment is initiated by placing the subject in the central arena. The recording is started immediately, and the session lasts for at least 20 min. Data can be collected for the following parameters: Latency to leave the central arena, Latency to visit a certain zone, Frequency of visits, Total duration of time spent in each zone, Duration of time spent per visit in each zone, Distance moved, Velocity of the subject and Number of animals visiting each zone.

Recommendations

As previously stated, the reported prevalence of depression in SSA is most likely an under-estimation. It can also be noted that only thirteen African countries report the use of basic animal behavioural tests typically used in depression research. This highights the limitation in research capacity needed to drive the developmental of contextual solutions. The following recommendations which focus on clinical interventions rather than basic science, could potentially bridge the knowledge gap that has been exposed.

1. Researchers and clinicians working in each country could collaborate towards the development of contextually relevant tools for depression diagnosis. The formation of consortiums across countries could allow lessons learnt in the development of such tools to be easily transferred from one setting to another. It is expected that, the development of such tools within a country, will allow easy deployment across the country especially where national health agencies are involved in the development process.
2. As mobile and digital technology continues to experience high penetration rates across the continent, this could be leveraged to collect, analyse and store data. Such tools have the potential to collect live data from multiple locations which is then housed in a centralized database. Such a database may then be queried by researchers for analysis and reporting purposes. This could be combined with the use of the aforementioned diagnostic tools.
3. African governments could work towards investing 1% of their GDP in research as recommended by the African Union. This could make available more funds to support research teams in the collection and reporting of data from all parts of their respective countries. Such funds could also go towards training of front line staff or health professionals in remote parts of their respective countries to identify “at risk” patients and flag them up for further investigation.
4. There is the need for African neuroscientists to engage in education and advocacy campaigns. This will shed light on the realities of depression and create room for conversations around mental health. It will also empower people to identify signs of depression and by so doing, be encouraged to seek help either for themselves or their family. Lastly, such campaigns could be leveraged to raise funds from local philanthropic organisations for the purposes of supporting research.

Conclusion

Although different studies give varying reports of the prevalence of depression, a recent WHO’s Global health estimate for depression reports the highest prevalence of 5.4% (Depression and Other Common Mental Disorders Global Health Estimates, 2015). The SSA region, as a result, represents about 10% of the global burden of mental disorders. These reports are fraught with challenges of misdiagnosis, underdiagnoses, and unpublished data, which results in under-estimation of the real number of patients. The region remains behind in the search for novel approaches to manage the disorder. However, the region has a huge potential that can be harnessed to enhance our understanding and management of the disorder as well as contribute to the global drug discovery process.

Ethical statement

The authors affirm that the above is an original piece of work which has not been submitted anywhere else for publication.

Conflict of interest

There are no conflicts of interest to declare.

Acknowledgements

The authors of this review wish to express their profound gratitude to the International Brain Research Organisation for availing them the opportunity to attend the pre conference IBRO-ARC school on Depression and Mood disorder in Sub-Saharan Africa.

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