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Abstract:
Background: Depression is the most common mental disorder and a leading cause of disability, which commonly presents unexplained psychological and physical symptoms. Depression and HIV/AIDS are commonly comorbid. This review provides an insight into the effect of depression on disease progression among people living with HIV.

Methods: A search for relevant articles was conducted using a database like MEDLINE, Scopus, PsycINFO and CINAHL. Peer-reviewed English journals published between 2015 and 2019 were included in the review.

Results: A total of eight studies conducted in different settings were included in the review. This review has found that psychosocial, neurohormonal and virologic factors associated with depression affect HIV disease progression. Yet, the chronicity of depression, absence of the hormones that have a buffer effect on depression and lack of examination if depression is a predictor, or an outcome of disease progression, were some of the gaps that require further investigation.

Conclusion: Considerably, more research is needed to better understand the effect of mental disorder, especially depression, on HIV disease progression to AIDS and future interventions should, therefore, concentrate on the integration of mental health screening in HIV clinical setup.

Keywords: Risk factors, Depression, Anxiety, Mental health, Disease progression, HIV, AIDS.

1. INTRODUCTION

Depression is a common mental illness, with constant sadness and loss of interest in things that people normally enjoy, and with an incapacity to perform day-to-day work [1 - 5]. Many psychological problems can occur as a direct consequence of HIV infection and treatment disruption since both conditions are typically comorbid [6]. Individuals with chronic illnesses are at higher risk of suffering from depression [7, 8].

People living with HIV are more frequently implicated in depression than the rest of the population worldwide [9 - 11].

Several studies around the world have found that depression occurs approximately twice as common in women than in men [3, 12, 13].

However, in HIV cases, depression remains unnoticed and it is a risky condition that may have a negative consequence not only on treatment adherence, social engagements and quality of life, but also on progression of disease and life expectancy of the HIV patients [14, 15].

Depressive symptoms of people living with HIV are associated with biological, clinical and psychosocial characteristics that affect HIV disease progression [16, 17]. Yet, there is an increasing concern in resource-limited developing countries of the world where people living with HIV do not get an early mental health screening, awareness
2.1. Inclusion and Exclusion Criteria

Eligibility criteria for the inclusion of the paper were; they should be peer-reviewed articles published in the English language and articles that study people with depression and living with HIV were included in the review. Papers on reviews, case studies, opinions and commentaries, which did not include new data, were excluded.

2.2. Search Strategies

A search for relevant articles was conducted by an electronic database like MEDLINE, Scopus, PsycINFO and CINAHL to identify articles published between 2015 to 2019 that studied HIV and depression comorbidity. To ensure the up-to-datedness of the review and avoid publication lag, only those published for the last five years were included [45].

The keywords used were HIV, AIDS, Depression, and disease progression. This mini-review adheres to and follows the PRISMA guideline [46].

The database searches retrieved a total of 766 papers that were exported to RefWorks database, while 388 duplicates and articles which did not meet the criteria were excluded. After screening the titles, abstracts and year of publication, 324 articles which were not related to depression and HIV were excluded.

On further screening of full texts, 46 papers were excluded because of ineligibility or quality criteria, resulting in 8 papers for inclusion. An outline of the search results and screening criteria are summarized in Fig. (1).

3. RESULTS

3.1. Characteristics of Studies and Participants

The selected studies were published between 2015 and 2019. Articles that examined the association of depressive symptoms on disease progression were reviewed. These studies were conducted in 8 different settings: Three studies in the USA, and five studies from Switzerland, South Korea, Thailand, China and East African countries (Kenya, Tanzania, Uganda).

The description of the studies is shown in Table 1.

3.2. Measurement of Depression

Among the reviewed studies, two studies used the Beck Depression Inventory (BDI) for the screening of depression. This tool has been commonly used to assess both somatic and cognitive aspects of depression in people living with HIV. Two studies also used the Center for Epidemiologic Study in Depression scale (CES-D). The remaining studies used the Hospital Anxiety and Depression Scale (HADS), The Generalized Anxiety Disorder 7-item (GAD), and one study used the clinical screening questions as shown in Table 1.

3.3. Depression and Psychosocial Factors

In this review, we emphasized the recent epidemiological findings which deal with the effect of depression on disease progression regarding psychosocial, neurohormonal and virologic factors in people living with HIV.
Fig. (1). Flowchart of the search process.

Table 1. Summary of study characteristics.

| Author and Date | Country        | Title of the Article                                                                 | Study Design                     | Data Collection                                      | Screening Tool                      | Sample             |
|----------------|----------------|--------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------|------------------------------------|--------------------|
| Owora (2018)   | USA            | Major depression disorder trajectories and HIV disease progression: results from a 6-year outpatient clinic cohort | Retrospective cohort study design | Secondary data abstracted from electronic medical records | Data extracted from EMRs          | 2260 HIV patients  |
| Ironson et al. (2016) | USA            | Psychosocial and neurohormonal predictors of HIV disease progression (CD4 cells and viral load): A 4-year prospective study. | A longitudinal prospective design | Clinical assessment interview and blood draw for CD4 and viral load assay | BDI                   | 177 HIV positive   |
| Taniguchi et al. (2015) | USA            | Depression severity is associated with increased Risk behaviours and decreased CD4 cell counts | Cross sectional study design     | Clinical assessment and in-depth interview            | PHQ-9                             | 624 HIV positive   |
| Anagnostopoulos A. et al. (2015) | Switzerland | Frequency of and Risk Factors for Depression among Participants in the Swiss HIV Cohort Study (SHCS) | Prospective cohort study design   | Clinical and laboratory assessment                   | DSM-Mental disorder            | 6756 HIV positive  |
| M.-K. Kee et al. (2015) | South Korea   | Anxiety and depressive symptoms among patients infected with human immunodeficiency virus in South Korea | Prospective cohort study design   | Clinical assessment & Self-administered questionnaire | BDI                   | 840 HIV patients   |
The psychosocial effects of depression on disease progress and life expectancy were particularly noticeable among HIV seropositive people with negative psychosocial related life experience in some of the studies [17, 47, 48]. People living with HIV especially women with chronic depressive symptoms were about two times more likely to die from AIDS than those who never experienced depression [49].

Through the investigation of the number of CD4 cells and viral load, variation in HIV disease progression is mostly contributed by psychosocial factors like hopelessness, depressed mood and lack of coping; regardless of the initiation of medication [17, 50].

Psychosocial factors like social support, a coping mechanism, spirituality and good personal behaviour have a positive impact on the improvement of the lifestyle of people living with HIV and may delay disease progression to AIDS [17].

Similarly, many studies support the hypothesis that psychosocial factors and depression can affect immune suppression and disease progression in people living with HIV regardless of the occurrence of opportunistic infection [51, 52]. However, to the best of our knowledge, previous reviews did not focus on the social factors and little studies have examined the biological mechanism that is associated with disease progression and depression.

Nevertheless, the mechanism of different neuroendocrine factors and whether they are mediators of the above mentioned psychosocial factors or not, remains uncertain regarding their influence in the disease progression.

### 3.4. Depression and Neurohormonal Factors

Some reviewed articles have shown that regardless of the antiretroviral medication, an increased level of hormones related to anxiety, stress or depression is mostly a source for CD4 cells decline and viral load increase, which may lead to accelerated disease progression to AIDS and short life expectancy [15, 24, 27, 29].

Among the various findings obtained from these reviews, only one study has shown that hormones such as norepinephrine, cortisol, and catecholamine exacerbate the effect of depression on immune suppression through the influence of CD4 levels and viral load [17]. In contrast, another study has presented that there is no recorded association between cortisol level and some of the disease progression markers like CD4 level [54].

Even though antiretroviral medication adherence reduces the risk of developing depression by people living with HIV [47, 51, 55], some of the treatments may have an impact on the noradrenergic effect and can cause HIV disease progression, whereas beta-blocker drugs that block adrenergic mechanism may slow down disease progression [16].

In these reviewed papers, the neurohormones were non-mediators to the association between psychosocial variables and HIV disease progression. Nevertheless, some of the results have shown that both psychosocial and neurohormones predict the progression of the disease.

### 3.5. Depression and Virologic Factors

The association between depression and high viral load has been reported in many studies [50, 51]. Lack of adherence to antiretroviral therapy, substance abuse and other risky behaviours were mentioned as mediating factors of depression on higher viral loads resulting from poor HIV disease outcomes [56].

Some of the effects of HIV on the immune system are a significant decline of CD4 count, which makes HIV seropositive people susceptible to opportunistic infection [21].

CD4 T lymphocytes count are major cell types infected by HIV. These cells, being the producer of cytokines, play a major role in the immune defence system against opportunistic infection [56].

Higher average symptomatic depression was predictive for faster degradation in CD4 count [17, 47, 55, 48]. The hormones released by the adrenaline gland during depression and anxiety influenced CD4 count, showing the existence of an association between depression and immune suppression [17].

The severity of symptomatic depression is associated with lower CD4 cell count after adjustment for race, sex and ART adherence [17, 48]. Without controlling medication adherence, findings of measurement scales on the experience of depression and stress also significantly predicted a greater decrease in CD4 cells and an increase in viral load over the same period [17].
Recently, however, these studies have shown that effective management of depression can have a possible advantage for the decline of viral load and management of HIV disease progression.

4. DISCUSSION AND CONCLUSION

Depression, which is a common psycho-social reaction found in people living with HIV, is a stressful experience and often persistent [57]. As a consequence, depression is the world’s most important source of disability [1]. As a consequence, depression is the most common primary cause of disability. To our knowledge, this is the first review examining the effect of depression on disease progression among people living with HIV across different settings.

Among the plausible similar descriptions that all these papers had in common in their findings was the significance of depression as a co-morbid disease observed in HIV patients [50, 47, 51, 55].

The studies had also consistently presented that there is a high prevalence of depression among people living with HIV/AIDS [18], and disproportionately, the number of people affected by both HIV and depression is higher than the general population. Furtherly, unlike the other reviewed findings, the study by Prasithsirikul et al. reported that anxiety and prevalence were low in people who are on antiretroviral treatment for long period of time [51]. The reason could be attributed to the different statistical test used for the analysis of the association between depression and treatment outcomes and not examining the positive effect of counselling on treatment adherence [58].

In addition, almost all the studies analysed also revealed a strong link between depression and the result of poor adherence to HIV treatment [17, 47, 51, 52, 55, 48, 53]. Yet, none of them has remarked the potential interactions of antidepressants and anti-retroviral treatments and their effects on disease progression of HIV. One of the recent pieces of evidence shows that anti-depressants are a major factor for HIV disease progression and potentially, the interaction between antidepressants and ART may result in dopamine change, which may aggravate the Neuro HIV [59, 60].

Similar findings from two of the reviewed studies carried out in a different geographical setting have shown that depression and other psychological disorders are associated with lower cellular immunity [50, 49]. However, the studies did not highlight whether depression is a predictor or an outcome of disease progression. This might be related to the different methodological limitations of these studies. Hence, their findings require to be interpreted with caution.

The effects of depression on disease progress are investigated mostly from four dimensions including psychosocial, neural, hormonal and virologic factors. As stated in the findings of many studies, a broad range of factors related to psychosocial may affect the underlying viral replication including virologic increment and immune system suppression resulting in HIV disease progression [17].

This reflects the findings that found endocrine, neural and psychosocial factors as a predictor of HIV disease progression [16, 17, 56]. However, none of these studies has highlighted the biological and behavioural mediators to the immune mechanism related with the outcome of disease progression.

People with HIV who were also depressed were more likely than people who were not depressed to advance toward AIDS. However, the identified papers for review have shown little about whether chronic or symptomatic depression was associated with disease progression to AIDS. Moreover, some studies have stated that symptomatic depression was not significantly associated with the progression of HIV.

Some of the reviewed articles [17, 50] have similarly presented that some of the neurohormones are predicting factors for HIV disease progression. They have mainly focused on the traditional neurohormonal models of stress and depression in which they examined only Sympathetic Adrenal Medullary (SAM) and Hypothalamic-Pituitary-Adrenal (HPA) axis, which is associated with the increase of cortisol, epinephrine, and norepinephrine [61].

Currently, it is found that these investigations were inadequate as some of the hormonal responses to stress or depression mechanism are not mentioned in these articles like oxytocin, which has a buffering effect on stress and depression and the immune function of people living with HIV [22].

The screening tools, study design, data collection instruments and the language used for the validated questionnaire, are one of the remarkable discrepancies in these reviewed studies. Similarly, differences in the definition regarding whether chronic or symptomatic depression are a source for the predictors for disease progression are debatable.

One of the drawbacks of this study was the limited number of studies meeting the criteria for inclusion in a systematic search.

Consequently, more research is needed to better understand the effect of mental disorder especially depression on HIV disease progression to AIDS and future interventions should, therefore, concentrate on the integration of mental health screening in HIV clinical setup.

AUTHORS’ CONTRIBUTION

AY and SR performed literature search, data extraction and analysis, RM and ML contributed substantial input in the analysis, reviewed the manuscript and approved the final draft for submission.

CONSENT FOR PUBLICATION

Not applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.
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AO performed literature search, data extraction and analyses, AO and OG wrote the first draft of the paper. Both authors approved the final draft for submission.

REFERENCES

[1] Depression and other common mental disorders global health estimates. 2017.
[2] Al Jarad A, Al Hadi A, Al Garatli A, et al. Impact of cognitive dysfunction in the middle east depressed patients: The ICMED Study. Clin Pract Epidemiol Ment Health 2016; 12:120.
[3] Fantahun A, Cherie A, Berdie L. Clin Pract Epidemiol Ment Health 2016; 19:196-206.
[4] Alvaredo-esquivel C, Sifuentes-alvarez A, Salas-martinez C. The Use of the edinburgh postpartum depression scale in a population of teenager pregnant women in mexico: A Validation Study. Clin Pract Epidemiol Ment Health 2014; 10:129-32.
[5] Bianchini V, Giusti L, Salza A, Cofini V, Cifone MG, Casacchia M, et al. Moderate depression promotes posttraumatic growth [Pg]: A Young population survey 2 years after the 2009 I' aquila earthquake. Clin Pract Epidemiol Ment Health 2017; pp. 10-9.
[6] WHO. Depression, A global public health concern 2012 . http://www.who.int/mental_health/management/depression/who_pape r_depression_wfhb_2012.pdf
[7] Osso LD, Pini S. What did we learn from research on comorbidity. In: Psychiatry: advantages and limitations in the forthcoming DSM-5 era. clin prat epidemiol ment health 2012; pp. 180-4.
[8] Claudia A, Maia CDO, Braga ADA, Pues F, Machado S, Carta MG, et al. Comorbidity of Depression and Anxiety: Association with Poor Quality of Life in Type 1 and 2 Diabetic Patients. Clin Pract Epidemiol Ment Health 2013; pp. 136-41.
[9] Mohammed M, Mengistie B, Dessie Y, Godana W. Prevalence of depression and associated factors among hiv patients seeking treatments in art clinics at harar town, eastern ethiopia. AIDS Clin Res 2015; 6(6): 1-6.
[10] Eshteh DA, Meseret SW, Kebede MA, Techane GN, Gizachew KD, Tegegne MT, et al. Prevalence of depression and associated factors among hiv / aids patients attending art clinic at debrebirhan referral hospital, north showa, amhara region, ethiopia. Ann Clin Psychiatry 2015; 1(1): 3.
[11] Gupta R, Dandu M, Pachl L, et al. Depression and HIV in Botswana: A population-based study on gender-specific socioeconomic and behavioral correlates. PLoS One 2010; 5(12)e14252 [http://dx.doi.org/10.1371/journal.pone.0014252] [PMID: 21703848]
[12] Dejesus RS, Angstman KB, Cha SS, Williams MD. Antidepressant[12] behavior correlates. PLoS One 2010; 5(12)e14252
[13] Antelmann G, Kaaya S, Wei R, et al. Depression, substance use, viral load, and CD4+ count among patients who continued or left antiretroviral therapy for HIV in St. Petersburg, Russian Federation. AIDS Care 2015; 27(1): 86-92. [http://dx.doi.org/10.1080/09540121.2014.959464] [PMID: 25264710]
[14] Dianatnassab M, Fararouei M, Padehban V, et al. The effect of a 12-week combinational exercise program on CD4 count and mental health among HIV infected women: A randomized control trial. J Exerc Sci Fit 2018; 16(1): 21-5. [Internet].
[15] [http://dx.doi.org/10.1016/j.jesf.2018.02.001] [PMID: 30662488]
[16] Fekete EM, Antoni MH, Lopez C, et al. Stress buffering effects of oxytocin on stress in low-income ethnic minority women. Psychoneuroendocrinology 2011; 36(6): 881-90. [http://dx.doi.org/10.1016/j.psyneuen.2010.12.003] [PMID: 21215526]
[17] Schuster R, Bornovalova M, Hunt E. The influence of depression on the progression of HIV: Direct and Indirect Effects. Behav Modif 2012; 36(2)
[18] Lee AM, Lam SK, See Mun Lau SM, Chong CSY, Chiu HW, Fong DYT. Prevalence, course, and risk factors for antenatal anxiety and depression. Obstet Gynecol 2007; 110(5): 1102-12. [http://dx.doi.org/10.1097/01.AOG.0000287065.59491.70] [PMID: 17978126]
[19] Hanlon C, Medlin G, Alem A, et al. Impact of antenatal common mental disorders upon perinatal outcomes in Ethiopia: The P-MaMe population-based cohort study. Trop Med Int Health 2009; 14(2): 156-66. [http://dx.doi.org/10.1111/j.1365-3159.2008.02198.x] [PMID: 19187514]
[20] Accort E, Cheadle ACD, Dunkel Schetter C. Prenatal depression and adverse birth outcomes: An updated systematic review. Maternal and Child Health Journal 2015; 19: 136-37.
[21] Kapatansovic S, Christensen S, Karim R, et al. Correlates of perinatal depression in HIV-infected women. AIDS Patient Care STDs 2009; 23(2):101-8. [http://www.liebertonline.com doi/abs/10.1089/apc.2008.0125] [PMID: 19196032]
[22] Kinser PA, Lyon DE. A conceptual framework of stress vulnerability, depression, and health outcomes in women: Potential uses in research on complementary therapies for depression. Brain Behav 2014; 4(5): 665-74. [http://dx.doi.org/10.1002/bbr3.249] [PMID: 25328843]
[23] Venkatesh KK, NadeI H, Blewett D, Freeman MP, Kaimal AJ, Riley LE. Implementation of universal screening for depression during pregnancy: Feasibility and impact on obstetric care. Am J Obstet Gynecol 2016; 214(6): 517.e1-8. [Internet].
[24] [http://dx.doi.org/10.1016/j.aiojg.2016.05.024] [PMID: 27210067]
[25] Arseniou S, Arvaniti A, Samakouri M. HIV infection and depression. Psychiatry Clin Neurosci 2014; 68(2): 96-109. [http://dx.doi.org/10.1111/jpcn.12097] [PMID: 24552630]
[26] Abebe H, Shumet S, Nissi Z, Agidew M, Abebe D. Prevalence of depression symptoms and associated factors among hiv-positive youth attending art follow-up in addis ababa, ethiopia. 2019. [http://dx.doi.org/10.1155/2019/4610458]
[27] Adams LM, Wilson TE, Merenstein D, Milam J, Cohen J, Elizabeth T, et al. Using the Center for Epidemiologic Studies Depression Scale to Assess Depression in Women With HIV and Women at Risk for HIV: Are Somatic Items Invariant. Am Psychol Assoc. 2017.
[28] Tebikew Yenehatab AB, Amare T. Factors associated with depressive symptoms in people living with HIV attending antiretroviral clinic at Fitche Zonal Hospital, Central Ethiopia: Cross-sectional study conducted in 2012. Dovepress 2017; pp. 2125-31.
[29] Psychiatry G, Duko B, Geza E, Zewude M, Mekonen S. Prevalence and associated factors of depression among patients with HIV / AIDS in Hawassa, Ethiopia. cross - sectional study 2020(2018): 1-7.
[30] Pelzr K, Rodriguez VJ, Jones D. Prevalence of prenatal depression and associated factors among HIV-positive women in primary care in Mpuuma la ga province, South Africa. SAHARA J Soc Asp HIV/AIDS [Internet] 2016; 16(1): 60-7. [http://www.tandfonline.com/doi/full/10.1080/17209376.2016.1189847]
[31] Bailey H, Malyuta R, Senemenko I, Townsend CL, Cortina-borja M, Thorne C. Prevalence of depressive symptoms in pregnant and...
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postnatal HIV-positive women in Ukraine: a cross-sectional survey 2016; 1-11. [http://dx.doi.org/10.1186/s12978-016-0150-z]

[37] Logie C, James L, Tharao W, Loutfy M. Associations between HIV-related stigma, racial discrimination, gender discrimination, and depression among HIV-positive African, Caribbean, and Black women in Ontario, Canada. AIDS Patient Care STDs 2013; 27(2): 114-22.http://www.ncbi.nlm.nih.gov/pubmed/2373665 [http://dx.doi.org/10.1089/apc.2012.0296] [PMID: 23373665]

[38] Ajinkya S, JadHAV P, Srivastava N. Depression during pregnancy: Prevalence and obstetric risk factors among pregnant women attending a tertiary care hospital in Navi Mumbai. Ind Psychiatry J 2013; 22(1): 37-40.

[39] Kemigisha E, Zanoni B, Bruce K, et al. Prevalence of depressive symptoms and associated factors among adolescents living with HIV/AIDS in South Western Uganda. AIDS Care 2019; 31(10): 1297-303. [http://dx.doi.org/10.1080/09540121.2019.1565611] [PMID: 30621430]

[40] Gaynes BN, O’Donnell J, Nelson E, et al. Psychiatric comorbidity in depressed HIV-infected individuals: Common and clinically consequential. Gen Hosp Psychiatry 2015; 37(4): 277-82. [http://dx.doi.org/10.1016/j.genhospsyc.2015.03.021] [PMID: 25892152]

[41] Wroe EB, Hedd-Gauthier BL, Franke MF, Nuanzimana S, Turinimana J, Drobac P. Depression and patterns of self-reported adherence to antiretroviral therapy in Rwanda. Int J STD AIDS 2015; 26(4): 257-61. [http://dx.doi.org/10.1177/0956462414535206] [PMID: 24828554]

[42] VR M, Mohite RV GJ. Correlates of perceived stigma and Depression among the women with HIV/AIDS infection. Bangladesh J Med Sci 2013; 14(2): 151-8.

[43] Gebrzegiabher BB, Abruha TH, Hailu E, Siyum H, Zeru GM, Gidey B, et al. Depression among Adult HIV / AIDS Patients Attending ART Clinics at Asokum Town, Asokum. Ethiopia: A Cross-Sectional Study Clin Pract Epidemiol Ment Heal 2014; pp. 166-71.

[44] Leserman J. Role of Depression, Stress, and Trauma in HIV Disease Progression. Psychosom Med 2008; (15): 539-45.

[45] Dawid Pieper. 2013; 17(6): 1012-7.

[46] Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. Ann Intern Med 2009; 151(4): 264-9. [http://dx.doi.org/10.7326/0003-4819-151-4-20090818-00135] [PMID: 19622511]

[47] Wang YY, Zhao J, Zhang Q, et al. Prevalence of depressive syndrome and their association with demographic and clinical characteristics in Chinese HIV patients. AIDS Care 2018; 30(11): 1388-92. [http://dx.doi.org/10.1080/09540121.2018.1465172] [PMID: 29690783]

[48] Taniguchi T, Shacham E, Onen NF, Grubb JR, Overton ET. Depression severity is associated with increased risk behaviors and decreased CD4 cell counts. AIDS Care 2014; 26(8): 1004-12. [http://dx.doi.org/10.1080/09540121.2014.880399] [PMID: 24479743]

[49] Antelman G, Kaaya S, Wei R, et al. Depressive symptoms increase risk of HIV disease progression and mortality among women in Tanzania. J Acquir Immune Defic Syndr 2007; 44(4): 470-7. [http://dx.doi.org/10.1097/QAI.0b013e31802f1318] [PMID: 1719766]

[50] Carrico AW, Riley ED, Johnson MO, et al. Psychiatric risk factors for HIV disease progression: The role of inconsistent patterns of antiretroviral therapy utilization. J Acquir Immune Defic Syndr 2011; 56(2): 146-50. [http://dx.doi.org/10.1097/QAI.0b013e31820d5f3] [PMID: 21116186]

[51] Pratissirikul W, Chongchhuvanonsat S, Ohata PJ, Keapduda S, KLINBAYAEM V, RERKSIRIKUL P, et al. Depression and anxiety were low amongst virally suppressed, long-term treated HIV-infected individuals enrolled in a public sector antiretroviral program in Thailand. AIDS Care 2016; 29(3): 299-305. [PMID: 27683940]

[52] Lee SY, Kim NY, et al. Anxiety and depressive symptoms among patients infected with human immunodeficiency virus in South Korea. AIDS Care 2015; 27(9): 1174-82. [http://dx.doi.org/10.1080/09540121.2015.1035861] [PMID: 26197063]

[53] Meffert S M, Neylan T C, McCulloch C E, et al. C.S. Polyk AAA and VGG. East African HIV care: depression and HIV outcomes. Glob Ment Heal 2019; 6: eg.

[54] Odeniyi IA, Faasamande OA, Ajala MO, Ohwovorie AE. CD4 count as a predictor of adrenocortical insufficiency in persons with human immunodeficiency virus infection: How useful? Indian J Endocrinol Metab 2013; 17(6): 1012-7. [http://dx.doi.org/10.4103/2230-8210.122615] [PMID: 24381877]

[55] Owora AH. Major depression disorder trajectories and HIV disease progression: Results from a 6-year outpatient clinic cohort. Medicine [Baltimore] 2018; 97(12e0252 [http://dx.doi.org/10.1097/MD.0000000000010252] [PMID: 29561455]

[56] Amanor-Boadu S, Hipolito MS, Rai N, et al. Poor CD4 count is a predictor of untreated depression in human immunodeficiency virus-positive African-Americans. World J Psychiatry 2016; 6(1): 128-35. [http://dx.doi.org/10.5498/wjp.v6.i1.128] [PMID: 27014603]

[57] Francesca MM, Efissa LM, Alessandra GM, Marianna A, Giovanni CM. Misdiagnosed Hypomanic Symptoms in Patients with Treatment-Resistant Major Depressive Disorder in Italy: Results from the Improve Study. Clin Pract Epidemiol Ment Heal 2014; pp. 42-7.

[58] Santos V, Paez F, Pereira V, Arias-carrion O, Silva AC, Carta MG, et al. The Role of Positive Emotion and Contributions of Positive Psychology in Depression Treatment: Systematic Review. Clin Pract Epidemiol Ment Heal 2013; pp. 221-37.

[59] Matt SM, Gaskill PJ. Dopaminergic impact of cART and anti-depressants on HIV neuropathogenesis in older adults. Brain Res 2019; 1723146398 [http://dx.doi.org/10.1016/j.brainres.2019.146398] [PMID: 31442412]

[60] Nagaraja SB, Valikayath A, Jha S, Jadhav B, Ladomirska J. HIV, Depressive symptoms increase risk of HIV disease progression and mortality among women in Tanzania. J Acquir Immune Defic Syndr 2007; 44(4): 470-7. [http://dx.doi.org/10.1097/QAI.0b013e31802f1318] [PMID: 1719766]

[61] Pasquini M, Berardelli I, Biondi M. Ethnopathogenesis of Depression Disorders. Clin Pract Epidemiol Ment Heal 2014; pp. 166-71.