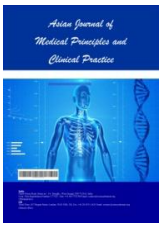

Asian Journal of Medical Principles and Clinical Practice

4(1): 34-41, 2021; Article no.AJMPCP.64645

Forgetfulness and Non-Adherence to Antiretroviral Therapy in Nigeria: A Review

Mary Obidiya Okuku[1*] and Alali Dan-Jumbo[1]

[1]Infectious Disease Unit, Rivers State University Teaching Hospital, Port Harcourt, Nigeria.

Authors' contributions

This work was carried out in collaboration among both authors. Both authors prepared and wrote the review. Both authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Suprakash Chaudhury, Dr. D. Y. Patil Medical College, Hospital & Research Centre, India.
Reviewers:
(1) Aditi Mishra, Shri Ramswaroop Memorial University, India.
(2) Henrique Pedro Bresolin Montoza, Universidade Salgado de Oliveira, Brazil.
Complete Peer review History: http://www.sdiarticle4.com/review-history/64645

Review Article

Received 05 November 2020
Accepted 10 January 2021
Published 03 February 2021

ABSTRACT

Objectives: This study seeks to ascertain if forgetfulness is a problem to non-adherence to antiretroviral therapy (ART) among people living with HIV/AIDS (PLWHA) in Nigeria.
Methodology: A comprehensive data base search was done to retrieve relevant articles for the review. Sixteen (16) primary articles met the inclusion criteria and were used for this review.
Results: The result showed that forgetfulness is a barrier to non-adherence to ART among PLWHA in Nigeria.
Conclusion: This review concludes that forgetfulness causes non-adherence to ART. Hence, the cause of patients' forgetfulness should be investigated and tackled appropriately. Counselling, education and proper assessment of patient's cognition is vital. HIV services should be inclusive. The use of mobile phones, alarms, text messaging devices and electronic reminders should be advocated to provide reminders to patients at dosing times.

Keywords: HIV/AIDS; forgetfulness; non-adherence; non-compliance; antiretroviral therapy; Nigeria.

1. INTRODUCTION

Non-adherence to ART is a major problem among PLWHA and this causes rapid progression of HIV infection [1,2]. Forgetfulness has been seen as one of the reasons behind non-adherence both in Nigeria and globally [3,4]. Based on this, it is necessary for healthcare

**Corresponding author: Email: maryokuku@yahoo.com;*

professionals to identify what causes barriers to ART adherence and ensure that it is tackled to promote viral suppression which will minimise HIV prevalence and mortality, prolong and improve the patients' quality of life.

Forgetfulness is a self-reported constant inability to remember information which hinders or interrupts a conversation or daily activities and is seen as a common cause of non-adherence to ART among PLWHA [5]. Besides the immune system, the brain and the nervous system are also affected by HIV leading to cognitive problems (disorders that affect mental health) and forgetfulness [5]. This affects the patient's activities of daily living, ranging from a reduction in the person's quality of life, and can also affect his or her adherence to medication [6,7]. [6,7] maintained that one of the cognitive domains which HIV affects adversely is the memory. Although some PLWHA may be able to give a precise and accurate account of their problems in terms of cognition, others may not be able to do so [8]. Hence, healthcare providers relying on patients' self-reporting as a means of checking and monitoring adherence to ART may not produce a valid assessment.

2. METHODOLOGY

Database search was comprehensively done in MEDLINE, BioMed Central, PubMed and Science Direct. These databases were used because: MEDLINE covers bibliographic information from academic journals such as medicine, nursing, healthy care, pharmacy [9]. BioMed Central publishes high quality open access peer-reviewed journals [10]. PubMed is a full text engine that accesses abstracts, life and biomedical sciences [11]. Science Direct provides access, based on subscription to large database of scientific and medical research [12].

The inclusion criteria were articles written in English, all adults 19 years plus, peer reviewed journals, primary articles and ovid full text available. Articles not written in English, infants, children, pregnant women and age below 19, unpublished articles, systematic reviews and secondary articles were excluded from the selection. Sixteen (16) primary articles (cross sectional studies) met the inclusion criteria and were selected for this literature review. These are studies carried out in different states in Nigeria to determine factors responsible for non-adherence to ART among PLWHA (See Table 1).

3. RESULTS

The Table 1 shows the primary research articles selected for the review all showing varying percentages in the number of persons who claimed forgetfulness as reasons for their non-adherence to ART.

4. DISCUSSION

In [13] a 3 months cross-sectional study to determine factors affecting adherence to ART among PLWHA in the Antiretroviral Clinic in Ibadan, Nigeria, the result showed that 120 (55.6 %) of the participants out of 318 blamed their non-adherence to forgetfulness.

According to [14] a cross-sectional study of 174 participants to determine factors responsible for non-adherence to ART in a teaching hospital in Enugu, Nigeria also reported that some of the participants (9.9 %) reported forgetting taking their drugs especially in the day time. [15] a study in a district hospital in Abuja, Nigeria reported that 15.5 % out of the 118 HIV-infected ART patients used for the study did not adhere to their medication regimen due to forgetfulness.

[16] in their study to find out factors impacting patient's adherence to ART among 461 PLWHA in University Teaching Hospital in Jos, Nigeria, for 2 months concluded that 46.1% of the participant's non-adherence to ART was as a result of forgetfulness. Also, [17] concluded in their study at the teaching hospital Nnewi, Nigeria that 53.8 % of the 221 participants did not adhere to their ART regimen due to forgetfulness.

Similarly, 31.1% out of the 411 participants studied in a teaching hospital in Calabar, Nigeria by [18] blamed their non-adherence to ART to forgetfulness. Also, in [19] a study in Keffi, Nigeria 51.5 % of the 250 participants did not adhere to their ART regimen due to forgetfulness. [20] investigated the level of adherence to ART among 502 participants in a University Teaching Hospital, Federal Capital Territory (FCT) Abuja. The result showed that 43% of the participants were non-adherent to ART due to forgetfulness which was seen as a major barrier. Furthermore, a cross-sectional study carried out by [21] in a Teaching Hospital in Nnewi, Nigeria showed that 21.2 % the 282 participants in the study attributed their non-adherence to ART to forgetfulness. Also, [22] a cross-section study in two tertiary health facilities in Bayelsa, Nigeria to determine the patients'

level of adherence to ART showed that 147 (24.5 %) out of the 601 participants linked their non-adherence to ART to forgetfulness.

According to [23] who carried out a cross-sectional study in Lagos, Nigeria to determine barriers to adherence to ART among PLWHA. The study revealed that 36.1 % of the 361 participants attributed forgetting to take their medication as the main reason for non-adherence. [24] in their cross-sectional study in Delta State, Nigeria investigated the factors affecting adherence to ART among PLWHA in the Antiretroviral Clinic of the state. The result revealed that 60.4% of the 300 participants reported forgetfulness as the reason for their non-adherence.

Similarly, [25] carried out a cross-sectional analysis to find factors responsible for non-adherence to ART among PLWHA in 2 public hospitals in Ekiti and Ondo States in Nigeria. The investigation showed that 54 % of the 225 study population listed forgetfulness as the reason for their failed adherence to ART. [26] also carried out a cross-sectional survey in the State Hospital in Osogbo, Nigeria to establish factors responsible for non-adherence among PLWHA. The survey showed that 21.5 % of the 200 PLWHA linked their non-adherence to forgetfulness.

According to Anyaike et al. [27] in their 3 months cross-sectional study to ascertain self – report treatment adherence among individuals aged 18 years above reported that 66.7% out of the 550 participants named forgetfulness as one of the reasons for their non-adherence to ART. The study reported that this group of persons who always forget to take their ART had no formal education while those who consistently took their ART had basic education. This suggests that the level of education of PLWHA may have a role to play in their adherence or non-adherence to ART.

According to Bello [28] in his cross-sectional study to assess and identify the reasons for non-adherence among 213 patients infected with HIV in an HIV/AIDS specialist hospital in Ilorin, Nigeria for 20 months discovered that about 1.4 % of the participants forgot taking their ART accordingly. Bello [28] had the lowest percentage 1.4 %, this could be because there were uninterrupted, regular and free HIV services, with medical laboratory tests and financial support made available to all attendees of the HIV clinic. This may have been a motivating factor for patient to visit the HIV clinic regularly and as such would always remember and keep to their ART regimen.

All the evidence suggests that forgetfulness is indeed a problem and needs to be tackled to improve adherence to ART among PLWHA in Nigeria. However, all the studies relied on patients self-reporting to determine non-adherence of patients to ART.

Some argue that the manifestation of cognitive problems in HIV could be gradual or rapid or there may not be any manifestation at all which depends on factors such as existing cognitive reserve or the severity of the disease [29,30,31]. They also maintained that metabolic and cognitive brain changes occur in varying degrees in most adults after a period of 1 year of living with HIV, with some more resistant to the changes than others.

For instance, [29] a study of 233 PLWHA plus 77-HIV negative control subjects where they carried out neuropsychological tests on them to determine cognitive function in PLWHA at various stages of HIV infection and to examine severity linked with each stage of illness. They discovered that PLWHA who at baseline perform very poorly are prone to develop cognitive problems after 1 year. They further maintained that HIV stages of infection are associated with a constant rise in the prevalence of abnormalities of neurobehaviour.

A similar study conducted by Basso and Bornstein [30] who investigated whether estimated premorbid intelligence mediates among PLWHA makes neurobehavioural function worse in HIV infection. The study population was 155 homosexual men comprising of 28 AIDS, 24 HIV+ symptomatic, 54 controls and 49 HIV+ asymptomatic. The study concluded that participants who had experienced less decline in cognition had better premorbid intelligence and that there is reduced neuropsychological function in patients whose HIV status is stable.

Additionally, a longitudinal study conducted by Baldewicz et al. [32] over 8 years, comparing the cognition of adults with HIV and those without the disease, revealed that PLWHA had a marked reduction in speed of processing and fine motor speed especially those with AIDS.

Table 1. List of the16 primary articles identifying forgetfulness as a barrier to non-adherence to ART

	Authors	Sample Size	No of persons who forgot to take their ART in percentage (%)	Mode of assessment of adherence
A	Olowookere et al. [13]	318	55.6	Patients self report
B	Uzochukwu et al. [14]	174	9.9	Patients self report
C	Agu et al. [15]	118	15.5	Patients self report
D	Bello [28]	213	1.4	Patients self report
E	Falang, Akubaka and Jimam [16]	461	41.7	Patients self report
F	Okoronkwo et al. [17]	221	53.8	Patients self report
G	Oku et al. [18]	411	31.1	Patients self report
H	Pennap, Abdullahi and Bako [19]	250	51.5	Patients self report
I	Avong et al. [20]	502	43	Patients self report
J	Onyeonoro et al. [21]	282	21.2	Patients self report
K	Suleiman and Momo [22]	601	24.5	Patients self report
L	Nduaguba et al. [23]	361	36.1	Patients self report
M	Odili, Obiechie and Amibor [24]	300	60.4	Patients self report
N	Afe, Motunrayo and Ogungbade [25]	225	54	Patients self report
O	Muoghalu [26]	200	21.5	patients self report
P	Anyaike et al. [27]	550	66.7	patients self report and pill count

Although it could be argued that the studies of [29] and that of [30] may no longer be current in line with evidence-based practice. However, other recent studies share same view with them and affirm that AIDS causes reduction in cognitive function [33-36]. As a result, there is the need to monitor the cognitive vulnerability of PLWHA especially as they are very likely to experience other medical co-morbidities such as fatigue, depression, substance abuse, diabetes and heart disease.

These medical co-morbidities according to [35] can affect the memory also hence making it difficult to ascertain the actual cause of forgetfulness with regards to non-adherence to ART among PLWHA for those who have any of the medical co-morbidity. Vance et al. [35] further argued that ART could cause metabolic syndromes (diabetes, hypertension and hypercholesterolemia) for PLWHA over time which can cause poor cognitive function. Therefore, the need for proper monitoring and follow up of these PLWHA on ART should not be neglected, as they should receive early treatment of these syndromes to prevent the onset of cognitive problems or exacerbation of forgetfulness.

The cross-sectional studies in Table 1 assessed the patients' non-adherence to ART using self-report of these patients. Based on the evidences above, one could argue that the reliance on patients' self-reporting of non-adherence should be cautiously investigated. Therefore, healthcare professionals need to ensure that PLWHA are properly assessed to ascertain if these persons have cognitive problems, underlying health problems which can predispose them to memory loss or they could have an objective forgetfulness.

Other studies conducted in developed countries and other African countries such as Ethiopia, Zambia and Malawi also maintain that forgetfulness is a major barrier to adherence to ART among PLWHA [37-41]. Furthermore, a study by [42] conducted among HIV positive African Americans reported that forgetfulness is a common reason for non-adherence to ART among them. They further argued that since HIV affects cognition and the function of the brain, that reduction in HIV viral load could reduce cognitive problems and forgetfulness. This can be achieved by ensuring that PLWHA strictly adheres to their medications.

Additionally, a literature review of 23 studies by [43] revealed that adherence to ART significantly improves attention, motor and executive function. This demonstrates that there is a link between the immune system and the nervous system.

Besides patients self-reporting of adherence, other methods that can be used to boost patients' adherence in the event of forgetfulness include pill counts, electronic monitoring, medication refill rate and determination of the therapeutic level of the drug and biologic markers assay [44,45]. A drawback to the use of biologic markers assays is that patients may find it expensive and may be unable to afford paying for the test [44]. Despite this, obtaining an accurate determination of patients' adherence to ART is very necessary and these methods should be adopted.

A literature review by Simoni et al. [46] on strategies for promoting adherence to ART advocate group or patients individualized education on ART and adherence to ART. Furthermore, a Cochrane review by Rueda et al. [47] concluded that education intervention is effective in promoting and boosting HIV patients' adherence to ART. Additionally, these authors – [48,49,50] all maintained that to improve the cognition of PLWHA to enhance their adherence to ART is to promote change in patients' lifestyle factors.

This they say includes patients' education on avoidance of substance abuse, advising the patient on diet, physical exercise and having enough sleep to minimise the co-morbidities which in turn can affect the memory.

However, [47] advised on the use of text messaging devices, alarms, pagers and mobile phones to help in maintaining adherence when patients are forgetful. Similarly, a randomized control trial conducted by Andrade et al. [51] among 58 patients who were HIV-positive on the use of electronic reminders (Disease Management Assistance System – DMAS) device to provide reminders verbally to patients at dosing times showed that a high of 77 % adherence rate was recorded among DMAS users. This demonstrates that the use of mobile phones, pagers and electronic reminders will highly likely enhance adherence to ART among PLWHA.

Although the arguments of [44,45,47,51] on the use of mobile phone, alarms, pagers and text messaging devices as reminders for PLWHA to enhance their adherence to ART is very good and will be helpful. A drawback is that many Nigerians are living in abject poverty and may not be able to afford these luxuries.

For instance, the World Poverty Clock [52] on the 25/06/2018 precisely, reported that Nigeria had topped the list as the country with the most extreme poverty rate globally with 87,008,170 million persons living in extreme poverty. World Poverty Clock [48] also shows that there is a rise in extreme poverty in Nigeria as of December 2018 bringing the total number to 91,666,269 million persons in extreme poverty. This highly suggests that many Nigerian's standard of living is very poor and many may not be able to afford electronic ART monitoring devices due to poverty.

5. LIMITATIONS

A major limitation observed is that most of the studies did not discuss what caused the forgetfulness or give reasons why patients tend to always forget taking their ART. This may impact on the conclusion. However, more research is needed to ascertain the reason behind this level of forgetfulness among PLWHA in Nigeria.

6. CONCLUSION

This review concludes that forgetfulness is one of the key problems of non-adherence to ART among PLWHA in Nigeria. Therefore, healthcare professionals should find an alternative way of monitoring and checking patients' adherence to ART besides patients self-report. Electronic monitoring, pill count, medication refill rate, determination of the therapeutic level of the drug and the use of biologic markers assay should be used to monitor patients adherence to ART.

Healthcare professionals need to educate and properly access HIV patients' cognition and counsel them to ascertain the best way of helping them to maintain adherence based on their status. The use of alarms, pagers, text messaging devices and mobile phones should be used to remind PLWHA of their dosing times. Above all, the active use of ART by patients undergoing HIV treatment should be emphasised in HIV clinics as adherence has been shown to improve the cognition of patients through viral load suppression as discussed above.

CONSENT

It is not applicable

ETHICAL APPROVAL

It is not applicable

COMPETING INTERESTS

Authors have declared that no competing interests exist

REFERENCES

1. Chesney MA. Factors affecting adherence to antiretroviral therapy. Clinical Infectious Diseases. 2000;30(2):171-176.
2. Centers for Diseases Control and Prevention. About HIV/AIDS. CDC; 2019. Accessed 27 December 2020. Available:https:www.cdc.gov/hiv/basics/whatishiv.html
3. Ortblad KF, Lozano R, Murray CJL. The burden of HIV: insights from the Global Burden of Disease Study 2010. AIDS. 2013;27(13):2003-2017.
4. Bashorun A, Nguku P, Kawu I, Ngige E, Ogundiran A, Sabitu K, Nashidi A, Nsubuga P. A description of HIV prevalence trends in Nigeria from 2001 to 2010: what is the progress, where is the problem?. The Pan African Medical Journal. 2014;18(1):3.
5. Vance DE, Fazeli PL, Moneyham L, Keltner NL, Raper JL. Assessing and treating forgetfulness and cognitive problems in adults with HIV. Journal of the Association of Nurses in AIDS Care. 2013;24(1):40-60.
6. Reger M, Welsch R, Razani J, Martin DJ, Boone KB. A meta-analysis of the neuropsychological sequelae of HIV infection. Journal of the International Neuropsychological Society. 2002;8(3): 410-424.
7. Hardy D, Vance D. The neuropsychology of HIV/AIDS in older adults. Neuropsychology Review. 2009;19(2): 263-272.
8. Vance DE, Ross LA, Downs CA. Self-reported cognitive ability and global cognitive performance in adults with HIV. Journal of Neuroscience Nursing. 2008; 40(1):6-13.
9. Glasper A, Rees C. How to write your nursing dissertation. West Sussex: John Wiley & Sons. 2013.
10. Coughlan M, Cronin P, Ryan F. Doing a Literature Review in Nursing, Health and Social Care. London: SAGE Publications Limited; 2013.
11. Aveyard H. Doing a Literature Review in Health and Social Care: A practical guide. 3rd ed. Maidenhead: Open University Press; 2014.
12. Jesson J, Matheson L, Lacey FM. Doing your literature Review: Traditional and Systematic Reviews. London: SAGE; 2011.
13. Olowookere SA, Fatiregun AA, Akinyemi JO, Bamgboye AE, Osagbemi GK. Prevalence and determinants of nonadherence to highly active antiretroviral therapy among people living with HIV/AIDS in Ibadan, Nigeria. Journal of Infection in Developing Countries. 2008;2(5):369-372.
14. Uzochukwu BSC, Onwujekwe OE, Onoka AC, Okoli C, Ugwu NP, Chukwuogo OI. (2009) Determinants of non-adherence to subsidized anti-retroviral treatment in Southeast Nigeria. Health Policy and Planning. 2009;24(3):189-196.
15. Agu KA, Okojie O, Oqua D, King RC, Omonaiye O, Onuoha C, Isah MA, Iyaji PG. Medication adherence and risk factors for non-adherence among patients taking highly active antiretroviral therapy. West African Journal of Pharmacy. 2011;22(1): 19-26.
16. Falang KD, Akubaka P, Jimam NS. (2012) Patient factors impacting antiretroviral drug adherence in a Nigerian tertiary hospital. Journal of Pharmacology and Pharmacotherapeutics. 2012;3(2):138-142.
17. Okoronkwo I, Okeke U, Chinweuba A, Iheanacho P. Nonadherence factors and sociodemographic characteristics of HIV-infected adults receiving antiretroviral therapy in Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria. ISRN AIDS. 2013;2013:1-8.
18. Oku AO, Owoaje ET, Ige OK, Oyo-ita A. Prevalence and determinants of adherence to HAART amongst PLHIV in a tertiary health facility in south-south Nigeria. BMC Infectious Diseases. 2013;13(401):1471-2334.
19. Pennap GR, Abdullahi U, Bako IA. Adherence to highly active antiretroviral therapy and its challenges in people living with human immunodeficiency virus (HIV) infection in Keffi, Nigeria. Journal of AIDS and HIV Research. 2013;5(2):52-58.
20. Avong YK, Wyk B, Njab J, Abimiku A, Ndembi N, Okuma J, Ogbanufe O, Ekong E, Dakum P, Blattner W. Adherence to anti-retroviral in North Central Nigeria. Current HIV Research. 2014;12(6):1-11.
21. Onyeonoro UU, Ebenebe UE, Ibeh CC, Nwamoh UN, Ukegbu AU, Emelumadu OF. Adherence to antiretroviral therapy among people living with human immunodeficiency virus / acquired

immunodeficiency syndrome in a tertiary health facility in South Eastern Nigeria. Journal of HIV & Human Reproduction. 2016;1(2):58-62.
22. Suleiman IA, Momo A. Adherence to antiretroviral therapy and its determinants among persons living with HIV/AIDS in Bayelsa state, Nigeria. Pharmacy Practice. 2016;14 (1):631-637.
23. Nduaguba SO, Soremekun RO, Olugbake OA, Barner JC. The relationship between patient-related factors and medication adherence among Nigerian patients taking highly active anti-retroviral therapy. African Health Sciences. 2017;17(3):738-745.
24. Odili VU, Obieche AO, Amibor KC. adherence to antiretroviral therapy and its determinants among HIV-infected patients in Nigeria. Journal of Pharmacy Practice. 2017;30 (3):291-295.
25. Afe AJ, Motunrayo O, Ogungbade GO. Factors influencing adherence to HAART among patients living with HIV infection in Southwest Nigeria: A Cross-Sectional Analysis. Journal of HIV & Retro Virus. 2018;4(1):1-9.
26. Muoghalu CO. Factors influencing adherence to anti-retroviral therapy among people living with HIV/AIDS attending the State Hospital, Osogbo, Nigeria. HIV & AIDS Review. 2018;17(4):288-298.
27. Anyaike C, Atoyebi OA, Musa OI, Bolarinwa OA, Durowade KA, Ogundiran A, Babatunde OA. Adherence to combined Antiretroviral therapy (cART) among people living with HIV/AIDS in a Tertiary Hospital in Ilorin, Nigeria. Pan African Medical Journal. 2019;32(10):1-12.
28. Bello SI. HIV/AIDS patients' adherence to antiretroviral therapy in Sobi Specialist Hospital, Ilorin Nigeria. Global Journal of Medical Research. 2011;11 (2):17-26.
29. Bornstein RA, Nasrallah HA, Para MF, Whitacre CC, Rosenberger P, Fass RJ. Neuropsychological performance in symptomatic and asymptomatic HIV infection. AIDS. 1993;7 (4):519-524.
30. Basso MR, Bornstein RA. Estimated premorbid intelligence mediates neurobehavioural change in individuals infected with HIV across 12 months. Journal of Clinical and Experimental Neuropsychology. 2000;22 (2):208-218.
31. Lentz MR, Kim WK, Kim H, Soulas C, Lee V, Venna N, Gonzalez RG. Alterations in brain metabolism during the first year of HIV infection. Journal of Neurovirology. 2011;17 (3):220-229.
32. Baldewicz TT, Leserman J, Silva SG, Petitto JM, Golden RN, Perkins DO, Evans DL. Changes in neuropsychological functioning with progression of HIV-1 infection: Results of an 8-year longitudinal investigation. AIDS and Behavior. 2004;8 (3):345-355.
33. Valcour V, Yee P, Williams AE, Shiramizu B, Watters M, Selenes O, Sacktor N. Lowest ever CD4 lymphocytes count (CD4 nadir) as a predictor of current cognitive and neurological status in human immunodeficiency virus type 1 infection – The Hawaii Aging with HIV Cohort. Journal of Neurovirology. 2006;12 (5):387-391.
34. Heaton RK, Clifford DB, Franklin DR, Woods SP, Ake C, Vaida F, Ellis RJ, Letendre SL, Marcotte TD, Atkinson JH, Rivera-Mindt M, Vigil OR, Taylor MJ, Collier AC, Mara CM, Gelman BB, McArthur JC, Morgello S, Simpson DM, McCutchan JA, Abramson I, Gamst A, Fennema-Notestine C, Jernigan TL, Wong J, Grant I. HIV-associated neurocognitive disorders persist in the era of potent antiretroviral therapy: CHARTER study. American Academy of Neurology. 2010; 75(23):2081-2096.
35. Vance DE, Larsen KI, Eagerton G, Wright MA. Comorbidities and cognitive functioning: Implications for nursing practice and research. Journal of Neuroscience Nursing. 2011;43(4):215-224.
36. Vance DE, Fazeli PL, Moneyham L, Keltner NL, Raper JL. Assessing and treating forgetfulness and cognitive problems in adults with HIV. Journal of the Association of Nurses in AIDS Care. 2013;24(1):40-60.
37. Reynolds NR, Testa MA, Marc LG, Chesney MA, Neidig JL, Smith SR, Vella S, Robbins GK, Protocol Teams of ACTG 384, ACTG 731, A5031s. Factors influencing medication adherence beliefs and self-efficacy in persons naive to antiretroviral therapy: a multicenter, cross-sectional study. AIDS Behaviour. 2004; 8(2):141-150.
38. Mills EJ, Nachega JB, Bangsberg DR, Singh S, Rachlis B, Wu P, Wilson K, Buchan I, Gill CJ, Cooper C. Adherence to HAART: A systematic review of developed and developing nation patient-reported barriers and facilitators. PLoS Medicine. 2006;3(11):438.
39. Amberbir A, Woldemichael K, Getachew S, Girma B, Deribe K. Predictors of

adherence to antiretroviral therapy among HIV-infected persons: a prospective study in Southwest Ethiopia. BioMed Central Public Health. 2008;8:265.

40. Sanjobo N, Frich JC, Fretheim A. Barriers and facilitators to patients' adherence to antiretroviral treatment in Zambia: a qualitative study. Sahara Journal. 2008; 5(3):136-143.
41. Tabatabai J, Namakhoma I, Tweya H, Phiri S, Schnitzier P, Neuhann F. Understanding reasons for treatment interruption amongst patients on antiretroviral therapy – a qualitative study at the Lighthouse Clinic, Lilongwe, Malawi. Global Health Action. 2014;7(24795):1-12.
42. Harzke AJ, Williams ML, Nilsson-Schonnesson L, Ross MW, Timpson S, Keel KB. Psychosocial factors associated with adherence to antiretroviral medications in a sample of HIV-positive African American drug users. AIDS Care. 2004;16 (4):458-470.
43. Al-Khindi T, Zakzanis KK, van Gorp WG. Does antiretroviral therapy improve HIV-associated cognitive impairment? A quantitative review of the literature. Journal of the International Neuropsychological Society. 2011;17(6):956-969.
44. Bangsberg DR, Hecht FM, Charlebois ED. Adherence to protease inhibitors, HIV-1 viral load and development of drug resistance in an indigent population. AIDS. 2000;14(4):357-366.
45. Arnsten J, Demas P, Farzadegan H. Antiretroviral therapy adherence and viral suppression in HIV-infected drug users: comparison of self-report and electronic monitoring. Clinical Infectious Disease. 2001;33(8):1417-1423.
46. Simoni JM, Amico KR, Pearson CR, Marlow R. Strategies for promoting adherence to antiretroviral therapy: A review of the literature. Current Infectious Diseases Reports. 2008;10(6):515-521.
47. Rueda S, Park-Wyllie LY, Bayoumi AM, Tynan AM, Antoniou TA, Rourke SB, Glazier RH. Patient support and education for promoting adherence to highly active antiretroviral therapy for HIV/AIDS. The Cochrane Database of Systematic Reviews. 2006;19 (3).
48. Atkins JH, Rubenstein SL, Sota TL, Rueda S, Fenta H, Bacon J, Rourke SB. Impact of social support on cognitive symptom burden in HIV/AIDS. AIDS Care. 2010;22(7):793-802.
49. Foster PP, Rosenblatt P, Kuljis RO. Exercise-induced cognitive plasticity, implications for mild cognitive impairment and Alzheimer's disease. Frontiers in Neurology. 2011;2(28):1-15.
50. Malaspina L, Woods SP, Moore DJ, Depp C, Letendre SL, Jeste D, Grant I. Successful cognitive aging in persons living with HIV infection. Journal of Neurovirology. 2011;17 (1):110-119.
51. Andrade AS, McGruder HF, Wu AW, Celano SA, Skolasky RL, Selnes OA, Huang IC, McArthur JC. A programme prompting device improves adherence to highly active antiretroviral therapy in HIV-infected subjects with memory impairment. Clinical Infectious Diseases. 2005;41(6):875-882.
52. World Poverty Clock. World Poverty Clock. 2018. Accessed 23 December 2020. Available:https://www.worldpoverty.io/index.html.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/64645