



Study on Medication Adherence Among Adolescents on Antiretroviral Medications in Lagos State

Sadiq Rukayyat¹, Nwanya Emmanuel^{2,*}, Omo-Eboh Francis Omokhudu³,
Nnamani Okechukwu Hosea⁴, Okunade Opeyemi Salome⁵, Ojebola Blessing⁶,
Soyemi Chinedu Emmanuella⁶

¹Department of Pharmaceutical Technology, Lagos State College of Health Technology, Lagos, Nigeria

²Department of Public Health, Federal University of Technology Owerri, Imo, Nigeria

³College of Medicine, University of Ghana Medical School, Accra, Ghana

⁴Department of Health Policy and Management, University of Ibadan College of Medicine, Oyo, Nigeria

⁵College of Health Sciences, Ogun State, Olabisi Onabanjo University Teaching Hospital/Obafemi Awolowo, Sagamu, Nigeria

⁶Faculty of Clinical Sciences, College of Health Sciences, Obafemi Awolowo University, Ile Ife, Nigeria

Email address:

nwanyaemmanuel01@gmail.com (N. Emmanuel)

*Corresponding author

To cite this article:

Sadiq Rukayyat, Nwanya Emmanuel, Omo-Eboh Francis Omokhudu, Nnamani Okechukwu Hosea, Okunade Opeyemi Salome, Ojebola Blessing, Soyemi Chinedu Emmanuella. Study on Medication Adherence Among Adolescents on Antiretroviral Medications in Lagos State. *International Journal of HIV/AIDS Prevention, Education and Behavioural Science*. Vol. 7, No. 2, 2021, pp. 54-60.
doi: 10.11648/j.ijhpebs.20210702.11

Received: March 17, 2021; Accepted: March 27, 2021; Published: July 8, 2021

Abstract: Worldwide, the rate of new HIV infections is highest among people between the ages of 15 and 24. Poor ART adherence increases the risk of viral drug-resistance, limits treatment efficacy and reduces future therapeutic choices. This study was carried out to determine the level of adherence among adolescents on antiretroviral medications. This study was carried out on adolescent 10-19 years who are HIV positive on ART in 3 health facilities in Lagos State, South West Nigeria providing comprehensive ART services. The sample size was determined using the Leslie Kish formula for cross-sectional studies. Data was collected using structured and pre-tested questionnaire. In-depth interview was also used to collect information from participant. Data were analyzed using SPSS for windows version 25.0. Finding from the study show that more 77.3% had optimal adherence for two months and 68.7% had optimal adherence for two weeks. Over twenty-five percent (25.3%) did not even take their medication the day before interview. The level of adherence is higher among adolescents older than 13 years (25.4% for optimal and 29.5% for sub-optimal). In conclusion, the study reveals there is a low rate of adherence amongst adolescents leading to poor clinical outcomes.

Keywords: Adherence, Adolescent, ART, CD4, HIV, Viral Suppression

1. Introduction

Adolescence (the period between 10 to 19 years of age), represents a growing proportion of people living with HIV around the world and have worse outcomes than all other age groups [1]. This stage is characterized by rapid changes in physical, emotional, cognitive and social characteristics take place. It has been estimated by WHO [2] that globally, 5 million young persons aged 15–25 years live with human immunodeficiency virus (HIV), the majority in low- and

middle-income settings. In 2018, 510,000 young people between the ages of 10 to 24 years were newly-infected with HIV, 40% of whom were between 10 and 19 years of age [3]. In addition to heterosexual transmission, a generation of children infected with HIV perinatally are now aging into adolescence, adding to the burden of disease in this age group [4].

There has been in substantial reductions in HIV-related morbidity and mortality attributed to the consistent use of ART. However, for ART to be effective, sustained viral

suppression must be achieved through near-perfect pill adherence of >95% on daily oral pills. Patients, especially adolescents, on ARV medication are faced with the challenges of lifelong adherence to daily. Non-adherence may result in drug resistance, treatment failure, subsequent reduced treatment options [5], limits treatment efficacy, leading to disease progression, and reduces future therapeutic options as well as increasing the risk of transmission due to unsuppressed viral replication [6].

Antiretroviral adherence in young children and adolescents poses unique and formidable challenges. Many of them are still largely dependent on a caregiver to take their medications. Young children and adolescents may refuse to take medication especially as the reason for such medication may not have been disclosed to them. Understanding the factors that influence adherence is therefore very crucial in order for the health care provider to develop measures to support and sustain patient's adherence in the clinical care of HIV infected children. With the issue of stigma still a big issue, children in this age category undergoing rapid pubertal changes and hence the need to ensure high levels of adherence and prevent drug resistance [7].

For HIV infection, reliable viral suppression requires a near-perfect level of adherence. It is however unfortunate that maintaining these adequate levels of adherence to ARVs have proved challenging to both persons (especially children) living with HIV and healthcare providers [8]. This is because a failing regime caused by poor adherence to medication will lead to increase in occurrence of opportunistic infections, increased hospitalization and outpatient visits and thus increased work load. Treatment failure triggered by suboptimal adherence to medication is still common [9].

Inadequate adherence to treatment is associated with detectable viral loads, declining CD4 counts, disease progression, episodes of opportunistic infections and poorer health outcomes [10-12]. Non-adherence may eventually mar the dramatic improvements in HIV-related health parameters. Thus, this study seeks to determine the level of adherence and reasons for non-adherence amongst adolescents on antiretroviral in Lagos, South West Nigeria.

2. Materials and Methods

2.1. Study Design

This is a descriptive cross sectional study that measured the level of adherence and reasons for non-adherence amongst adolescents. The research was conducted between March and May, 2019. The population of study included adolescents between age 10 and 19 who are HIV positive and are enrolled to access care in the selected facility and have been on ART. This also includes care givers and treatment partners of such adolescents. Pregnant adolescents were excluded from the study. Adolescents who were unwilling or unavailable to take part in the study, as well as adolescents whose caregivers refused consent, were excluded from the study.

2.2. Sampling

Simple random sampling was used to select three facilities providing HAART to adolescents (LASUTH, Massey street children's hospital and Ajeromi General Hospital). Proportional sampling was used to select the respondents from the three facilities, based on the number of adolescents receiving ARVs in the facilities.

2.3. Sample Size

The sample size was determined using Leslie Kish formula for estimating single proportions and the formula for estimating the minimum sample size when the total sample is below 10,000 people.

$$N = \frac{Z\alpha^2(pq)}{d^2}$$

Where N= Sample Size

P (Proportion of adherence amongst adolescents) = 0.231 [4]

q= 1-P

(Z α) = 1.96

q= 1- 0.231= 0.769

P= 0.231

d (5% standard error) = 0.05

$$N = \frac{1.96^2(0.231 \times 0.769)}{0.05^2}$$

Sample Size, N= 273

There seems to be no research from Nigeria on Medication adherence in adolescents. hence, a study by [3] from Ethiopia was used as reference figure.

2.4. Instrument for Data Collection

Data was collected using structured, pre-tested questionnaire which was developed based on a review of various literature. The questions were divided into four sections: (i) socio-demographic characteristics and personal data (ii) knowledge assessment, (iii) adherence questions (iv) problems with medication. To measure adherence questions were adapted from Adapted from Morisky scale which measured adherence within a 2-weeks period as well as knowledge assessment, and NIAID AIDS Clinical trials group questionnaires which measured adherence over a 1-month period but was modified because most of the adolescents come for refill within a 2-months period and Svarstad [13], which measures problems with medications.

Clinical information was retrieved using patient medical charts. The appointment diary, another quantitative technique was also used to collect information on appointment kept and missed by the respondents. For Biological markers, a self-designed tool was used to collect viral load, clinical staging and CD4 count. In-depth interview was also used to collect information from participant.

2.5. Data Collection

Potential participants with matching study age and

treatment criteria were identified at the Adolescent clinics of each of the health facilities used. Potential participants, and their parents for those below 18 years of age, were told about the study at the clinic and were given information in full. All participants who provided voluntary written informed consent, and/or applicable assent forms, were sampled, using the questionnaire.

2.6. Data Analysis

Data were analyzed using SPSS for windows version 25.0. Descriptive and inferential statistical tests were employed. These included logistic regression analysis to determine predictors of adherence. The dependent variable considered for this study was adherence to ART where patients who achieved 95% based on self-report had optimal adherence, 90 – 94% had sub-optimal while < 90% was termed poor adherence. The independent variables consisted of some socio-demographics. Logistic regression analysis was used to identify true predictors of adherence to ART in the study population. Variables entered into the logistic model were those which had earlier been significantly associated on bivariate analysis at 5% significance.

2.7. Ethical Considerations and Consent

Ethical approval for this study was obtained from Lagos State University Teaching Hospital's Health Research and Ethics Committee (HREC). The approval for permission to get respondents and use data from health facilities was gotten from the Lagos State Health Service Commission, (HSC). Permission was sought to conduct the study from the Medical Directors of the three hospitals. Adolescents and caregivers received information about the study. Voluntary and informed written consents were obtained from adolescents aged 18 and above. For adolescents under 18 years, written consent was obtained from their parents or legal guardians in addition to verbal assent by the young. Confidentiality of all study participants was ensured by avoiding the use of direct identifiers during the data collection, storage or report writing. All electronic documents were password protected and all paper documents were stored in a locked cabinet. Accidental disclosure of HIV status to those non-disclosed adolescents was prevented by training the interviewer on the study protocol and by collecting data regarding adherence from parent or caregiver. Permission was also sought from parent or guardian and ask if the adolescents are aware of their status from care givers.

3. Results

3.1. Socio-demographic Characteristics of the Respondents and Adherence

Table 1 shows the socio-demographic characteristics of the adolescents. Majority of the adolescent were older than 13 years of age (57.7%, mean age 14 ± 2.7 years) and females (57.3%). Majority of the adolescents were currently schooling (89.3%) and not orphans (58.7%) while 35.3%

were single orphans. For larger proportion of the adolescents, their care giver had at least a secondary education (59.3%).

Table 1. Socio-demographic characteristics of the respondents.

Parameter	Frequency	Percentage
Age category (years)		
≤ 10	18	12.0
11 – 13	50	33.3
14 – 16	49	32.7
17 – 19	33	22.0
Gender		
Male	64	42.7
Female	86	57.3
Child's education status		
Schooling	134	89.3
Not schooling	16	10.7
Academic qualification (Caregiver)		
No formal education	24	16.0
Primary	37	24.7
Secondary	53	35.3
Tertiary	36	24.0
Orphan status		
Not orphan	88	58.7
Single	53	35.3
Double	9	6.0

Table 2. Distribution of the socio-demographic characteristics and difficulty profile of the study participants by their ART adherence pattern in 2 months.

Characteristics (%)	Optimal (n=14)	Sub-optimal (n=20)	Poor (116)	Significance
Age category				
≤10	2 (11.1)	1 (5.6)	15 (83.3)	
11-13	2 (4.0)	7 (14.0)	41 (82.0)	p = 0.139
14 – 16	5 (10.2)	7 (14.3)	37 (75.5)	$\chi^2 = 0.212$
17 – 19	5 (15.2)	5 (15.2)	23 (69.7)	
Gender				
Male	8 (12.5)	7 (10.9)	49 (76.6)	p = 0.430
Female	6 (7.0)	13 (15.1)	67 (77.9)	$\chi^2 = 1.688$
Academic qualification (caregiver)				
None	2 (8.3)	3 (12.5)	19 (77.2)	
Primary	3 (8.1)	1 (2.7)	33 (89.2)	p = 0.320
Secondary	6 (11.3)	11 (20.8)	36 (67.9)	$\chi^2 = 0.134$
Tertiary	3 (8.3)	5 (13.9)	28 (77.8)	
Orphan status				
Not orphan	6 (6.8)	12 (13.6)	70 (79.5)	
Single	7 (13.2)	8 (15.1)	38 (71.7)	p = 0.494
Double	1 (11.1)	-	8 (88.9)	$\chi^2 = 0.118$
Have problem with medication				
Yes	1 (4.8)	5 (23.8)	15 (74.4)	p = 0.264
No	13 (10.1)	15 (11.6)	101 (78.3)	$\chi^2 = 2.667$

3.2. Distribution of the Socio-demographic Characteristics and Difficulty Profile of the Study Participants by Their ART Adherence Pattern in 2 Months

Table 2 shows the distribution of socio-demographic characteristics profile on the participants by their ART adherence pattern in two months. Though not statistically significant ($p > 0.05$), the level of adherence is higher among adolescents older than 13 years (25.4% for optimal and 29.5% for sub-optimal), in males (12.5%) while higher levels

of non-adherence were seen for adolescents whose caregivers have the maximum of primary education (77.2% and 89.2% for uneducated and primary education respectively). Also,

double orphan adolescents and those who had no problems with medication showed a very high level of non-adherence (88.9% and 78.3% respectively).

Table 3. Distribution of the socio-demographic characteristics and medical profile of the study participants by their ART adherence pattern in 2 weeks.

Characteristics (%)	Optimal (n=14)	Sub-optimal (n=20)	Poor (116)	Significance
Age category				
≤10	2 (11.1)	2 (11.1)	14 (77.8)	$p = 0.204$ $\chi^2 = 6.362$
11-13	3 (6.0)	11 (22.0)	36 (72.0)	
14 – 16	4 (8.2)	15 (30.6)	30 (61.2)	
17 – 19	-	10 (30.3)	23 (69.7)	
Gender				
Male	2 (3.1)	9 (14.1)	53 (82.8)	$p = 0.006^*$ $\chi^2 = 10.388$
Female	7 (8.1)	29 (33.7)	50 (33.7)	
Academic qualification (caregiver)				
None	2 (8.3)	5 (20.8)	17 (70.8)	$p = 0.161$ $\chi^2 = 9.255$
Primary	4 (10.8)	7 (18.9)	26 (70.3)	
Secondary	1 (1.9)	20 (37.7)	32 (60.4)	
Tertiary	2 (5.6)	6 (16.7)	28 (77.8)	
Orphan status				
Not orphan	4 (4.5)	21 (23.9)	63 (71.6)	$p = 0.528$ $\chi^2 = 3.183$
Single	4 (7.4)	13 (24.5)	36 (67.9)	
Double	1 (11.1)	4 (44.4)	4 (44.4)	
Have problem with medication				
Yes	6 (28.6)	7 (33.3)	8 (38.1)	$p < 0.001^*$ $\chi^2 = 24.675$
No	3 (2.3)	31 (24.0)	95 (73.6)	

* Significant at $p < 0.05$

3.3. Distribution of the Socio-demographic Characteristics and Medical Profile of the Study Participants by Their ART Adherence Pattern in 2 Weeks

Table 3 shows that the level of adherence in two weeks was found to be significantly higher ($p < 0.05$) in females (8.1% optimal and 33.7% sub-optimal) and in those who did not have problems with medication (28.6% optimal and 33.3% sub-optimal).

Table 4. Level of Adherence to Antiretroviral drugs.

Parameter	Frequency	Percentage
Within 2 months		
(95 - 100%) Optimal	116	77.3
(90 – 94%) Sub-optimal	20	13.3
(<90%) Poor	14	9.3
Within 2 weeks		
(95 - 100%) Optimal	103	68.7
(90 – 94%) Sub-optimal	38	25.3
(<90%) Poor	9	6.0
Took medication yesterday		
Yes	112	74.7
No	38	25.3
Have problems with medication		
Yes	21	14.0
No	129	86.0

3.4. Level of Adherence Amongst Adolescents

Table 4 shows the level of adherence to antiretroviral drugs among the adolescents. While just 9.3% and 6.0% had poor adherence to ARV drugs for two months and two weeks respectively, 77.3% had optimal adherence for two months and 68.7% had optimal adherence for two weeks. Over twenty-five percent (25.3%) did not even take their

medication the day before interview.

3.5. Predictor of Adherence Among Respondents in 2 Weeks

The significant predictors of adherence to ART amongst adolescent in the centers in two weeks were; females [OR 3.63; 95% CI 0.68 – 20.73] and problem with medications [OR 4.75; 95% CI 1.78 - 11.30]. Female participants were four times more likely to adhere to their prescribed doses in two weeks compared with their male counterparts. Similarly, those that did not have problems with medications were five times more likely to adhere to their prescribed doses in two weeks compared with those who had problems (Table 5).

Table 5. Predictor of adherence among respondents in 2 weeks.

Characteristic	Odd ratio	95% confidence interval	p-value
Sex			
Female	3.63	0.68 – 20.73	<0.001*
Male	1		
Problem with medication			
Have problem	4.75	1.78 – 11.30	<0.001*
No problem	1		

* Significant at $p < 0.01$

3.6. Problems with Medications Affecting Adherence

14.0% had problems with their medications (Table 6). The problems mentioned include difficulty in closing or opening medication bottles, problems with reading the print/label on the medication bottle/sachet, not remembering to take all the pills, inability to get refills in time and inability to take so many pills at the same time. Other reasons for mentioned by

the adolescents for missing medications include sleeping, playing, watching TV, doing house chores, bitterness of drugs, not liking drugs etc.

Table 6. Problems with medications affecting adherence.

Parameter	Frequency	Percentage
Have problems with medication		
Yes	21	14.0
No	129	86.0

3.7. Clinical Factors

More than three-fourth of respondents 150 (85.5%) were either in WHO clinical stage II or III at their last visit, and 75.3% had CD4 count greater than 500 cells per ml. 40% of the participants (90) were virally suppressed at the time of the study. This is shown in table 7 below

Table 7. Clinical outcomes using Biological Markers.

Parameter	Frequency	Percentage
WHO clinical stage at last 2 clinics		
Stage I	14	9.3%
Stage II	77	51.5%
Stage III	51	34%
Stage IV	8	5.2%
CD4 count		
<100	0	0%
100-200	13	8.7%
201-500	24	16%
>500	113	75.3%
Viral Load Suppression		
Suppressed	90	60%
Unsuppressed	60	40%
Appointment met		
Yes	121	80.70%
No	29	19.30%

3.8. Stigma, Discrimination and Disclosure

Only about half 50.7% (76) of the respondents were informed of their HIV status as at the time of study. Also 65.3% of the adolescents interviewed had fear of being stigmatized either as a result of knowing their status or as a result of being on medication as shown in table 8 below.

Table 8. Stigma, disclosure affecting adherence.

Characteristic	Frequency	Percentage
Fear of Stigma		
Yes	98	50.70%
No	52	49.30%
Disclosure Status		
Disclosed	76	50.70%
Not Disclosed	74	49.30

4. Discussion

Finding from the study show that over half of the respondents were females. This is in line with the research by [4] where 52.7% of respondents were females. The mean age for the respondents was 14 years, a slight increase from [4] of 13 years of children in 3 health facilities in Ethiopia. About three quarter of respondents showed optimal adherence

(>95%) in 2 months. This is a slight deviation and improvement in adherence from the works of [14], which shows that 61% of respondents showed optimal adherence and [15], 63.4%. About one quarter of respondents did not even take their medication the day before interview. This shows the poor attitude towards drug use by this age group.

According to appointment diary showing clients meeting up with hospital visits, there is an increase in adherence. Over three quarter of respondents visited the facility on their appointment date and was marked in their hospital records. This finding is in tandem with a similar research by [16], where it was shown that about 87.1 % of patient had optimal adherence based on hospital record.

The level of adherence is higher among adolescents older than 13 years, 25.4% for optimal and 29.5% for sub-optimal. Also, a higher level of non-adherence was seen for adolescents whose caregivers have the maximum of primary education. About three quarter of respondents whose parents who were either non-educated or had only primary education were non-adherent. Education plays a primary role in understanding and conversely, adherence. Also, over three quarter of double orphan adolescents, adolescents who have lost both parents and those who had no problems with medication showed a very high level of non-adherence). This shows that the support of both parents is significant for adherence.

The poorer adherence recorded among adolescents living with widowed parents could be attributed to the fact that emotional and economic stability is more common among married parents and they may also get support from their partner in giving care and support to the adolescent. Moreover, it can also be due to the fact the adolescent may be living with a single parent who may be dealing with his or her own HIV status or could not provide care for the adolescent due to illness. This is in line with findings by [4]. Other reasons mentioned by the adolescents for non-adherence includes wanting to avoid side effects, being away from home, too many pills lost or stolen pills. Forgetfulness was one of the most reported reasons for missing medications. Eighty-four (84%) of respondents have missed their medications in two months due to forgetfulness.

Stigma and discrimination strongly affects adherence. Ability to freely use medication without fear of losing favor, support or being stigmatized or being made fun of by others was one of the reasons stated for not using medication by the respondents. This study has shown that three quarter of the respondents missed their medications due to fear of stigma. This is in line with the study by [17], where Fifty percent of respondents indicated that they skipped doses because they feared family or friends would discover their status. These results suggest that HIV stigma impacts treatment for adolescents. And thereby affects subsequent health outcomes.

Using biological markers, only a little above half of the respondents who had viral load results were virally suppressed (viral load below 1000 u/ml). According to the research by figure [18], adherence rate of 80% and above can give a viral suppression of 80-85%. But with this research,

with just 71% showing adherence, only a little above half of the respondents were virally suppressed. The low level of adherence has been associated with adherence level at above 90% in clients on antiretroviral might be a reason for viral unsuppression. Although, some of the adolescents who claimed to be adherent were still virally unsuppressed, this might be due to errors in self-reporting, provision of wrong information, concomitant use of herbs with ARVs and use of low dose of ARVs. Most of the poorly adherent adolescents (below 80%) were all virally unsuppressed. This is well understood as poor adherence will lead to poor viral load and subsequently, poor health outcome. For CD4 also, over three quarter had CD4 values above 500.

Furthermore, using Clinical staging, about two third of the adolescents were adherent. This group of adolescents formed the bulk of adherent respondents. This is in line with a study by [4] which revealed that two third of adolescents in WHO stage III/IV were adherent. This might be due to pill burden from second line medication, more symptoms and sometimes being critically ill before being brought to the hospital. The drugs sometimes for the group of adolescents serve as a life saver. The poorer adherence level among adolescents in earlier disease stage (Stage I and Stage II) is consistent with finding from studies from [4]. This could be because those who are relatively healthy will be reluctant about taking their medications.

5. Conclusion

This study concludes that there is a low rate of adherence amongst adolescents leading to poor clinical outcomes. Stigma and discrimination plays a big part in adherence, as well as the level of education of care givers also affects adherence.

Conflict of Interest

The authors hereby declare that there is no conflict of interest in relation to this research and/or its publication.

Authors Contribution

1. Rukayyat Sadiq: original author, principal investigator and protocol development
2. Emmanuel Nwanya: Supporting author, research assistant and manuscript development
3. Francis Omo-Eboh Omokhudu: Research assistant, manuscript development and proofreading
4. Okechukwu Nnamani Hosea: Research assistant, manuscript development and proofreading
5. Okunade Opeyemi Salome: Research assistant, manuscript development and proofreading
6. Ojebola Blessing: Research assistant, manuscript development and proofreading
7. Soyemi Chinedu Emmanuella: Research assistant, manuscript development and proofreading

Acknowledgements

The authors wish to acknowledge the management of Lagos State University Teaching Hospital, Massey street children's hospital and Ajeromi General Hospital. The authors also acknowledge all authors whose works were cited in this research.

References

- [1] Adejumo OA, Malee KM, Ryscavage P, Hunter SJ, Taiwo BO. (2015). Contemporary issues on the epidemiology and antiretroviral adherence of HIV-infected adolescents in sub-Saharan Africa: a narrative review. *Journal International AIDS Society*; 18: 20049.
- [2] World Health Organization (WHO) 2018. HIV and youth, https://www.who.int/maternal_child_adolescent/topics/adolescence/hiv/en/ (accessed January 2019).
- [3] UNICEF. Adolescent HIV Prevention. UNICEF Data. 2018. Available from <https://data.unicef.org/topic/hiv/aids/adolescent-s-young-people/>. Accessed 15 Aug 2019.
- [4] Firdu, N., Enquoselassie, F. and Degu Jerene, D. (2017). HIV infected adolescents have low adherence to antiretroviral therapy: a cross sectional study in Addis Ababa, Ethiopia. *The Pan African Medical Journal*; 27: 80.
- [5] Hornschuh, S., Dietrich, J. J., Tshabalala, C., & Laher, F. (2017). Antiretroviral Treatment Adherence: Knowledge and Experiences among Adolescents and Young Adults in Soweto, South Africa. *AIDS Research and Treatment*, 2017, 5192516.
- [6] Kim, S. H., Gerver, S. M., Fidler, S. & Ward, H. (2014). Adherence to antiretroviral therapy in adolescents living with HIV: systematic review and meta-analysis. *AIDS (London, England)*, 28 (13), 1945–1956.
- [7] Ugwu, R and Eneh, A. (2013). Factors influencing adherence to paediatric antiretroviral therapy in Portharcourt, South-South Nigeria. *Pan African Medical journal*; 16 (30): 1-9.
- [8] Watson, D. C. and Farley, J. J. (1999). Efficacy of and adherence to highly active antiretroviral therapy in children infected with human immunodeficiency virus type 1. *Paediatric Infectious Disease Journal*; 18 (8): 682-689.
- [9] Steele, R. G. and Grauer, D. (2003). Adherence to antiretroviral therapy for pediatric HIV infection: review of the literature and recommendations for research. *Clinical Child Family Psychology Review*; 6 (1): 17-30.
- [10] Gifford, A. L., Bormann, J. E, Shively, M. J., Wright, B. C., Richman, D. D. & Bozzette, S. A. (2000). Predictors of self-reported adherence and plasma HIV concentrations in patients on multidrug antiretroviral regimens. *Journal of Acquired Immune Deficiency Syndromes*. 23: 386–395.
- [11] Murphy, D. A., Wilson, C. M., Durako, S. J., Muenz, L. R. and Belzer, M. (2001). Antiretroviral medication adherence among the REACH HIV-infected adolescent cohort in the USA. *AIDS Care*. 13 (1): 27-40.
- [12] Reddington, C., Cohen, J., Baldillo, A. et al. (2000). Adherence to medication regimens among children with human immunodeficiency virus infection. *Paediatric Infectious Disease Journal*; 19 (12): 1148-1153.

- [13] Svarstad, B. L., Chewning, B. A., Sleath, B. L. and Claesson, C. (1999). The Brief Medication Questionnaire: a tool for screening patient adherence and barriers to adherence. *Patient Education and Conselling*; 37 (2): 113-24.
- [14] Belzer, M. E., Fuchs, D. N., Luftman, G. S., and Tucker, D. J. (1999). Antiretroviral adherence issues among HIV-positive adolescents and young adults. *Journal of Adolescent Health*, 25 (5), 316-319.
- [15] Bezabhe, W. M., Chalmers, L., Bereznicki, L. R., and Peterson, G. M. (2016). Adherence to Antiretroviral Therapy and Virologic Failure: A Meta-Analysis. *Medicine*, 95 (15), e3361.
- [16] Nabukeera-Barungi, N., Elyanu, P., Asire, B. et al. *BMC Infect Dis* (2015) 15: 520. <https://doi.org/10.1186/s12879-015-1265-5>.
- [17] Rao, D., Kekwaletswe, T. C., Hosek, S., Martinez, J., and Rodriguez, F. (2007). Stigma and social barriers to medication adherence with urban youth living with HIV. *AIDS care*, 19 (1), 28-33.
- [18] Viswanathan, S., Detels, R., Mehta, S. H., Macatangay, B. J. C., Kirk, D. G. & Jacobson, L. P. (2015). Level of adherence and HIV RNA suppression in the current era of highly active antiretroviral therapy (HAART). *AIDS Behaviour*, 19 (4): 601-611.