Factors Affecting Adherence to Antiretroviral Therapy among HIV/AIDS Patients in Cape Coast Metropolis, Ghana

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Abstract

Background: Optimal adherence to antiretroviral therapy (ART) among HIV/AIDS patients has proved elusive despite increasing access to ART worldwide.

Methods: This analytical cross-sectional study was conducted to assess factors that influence adherence to ART among HIV/AIDS patients in Cape Coast, Ghana. Three hospitals that provide full ART services were used as study sites. Data collection was done using a semi-structured questionnaire that was interviewer administered. The primary outcome of this study was respondents' lifetime adherence to ART. Data was analyzed using SPSS version 20.0 with a p-value of 0.05 considered as statistical evidence of an association.

Results: A total of 381 patients (mean age: 43.9 ± 11.8 years) were involved in the study. Life time adherence was found to be 73.0%. Only 79.5% adhered to their ART clinic appointments. Lifetime non-adherence was predicted by male sex (AOR 2.0, 95% CI 1.1–3.5, p=0.021), more than once daily dosing ART regimens (AOR 1.7, 95% CI 1.1-2.8, p=0.024), not disclosing HIV status (AOR: 2.4, CI:1.3-4.5, p=0.005), not having a way to remember to take drugs (AOR: 1.9, CI:1.1-3.4, p=0.033) and not having a treatment monitor (AOR: 2.9, 95% CI 1.7-5.0, p=0.011).

Conclusions and Recommendation: Patients on ART in the Cape Coast metropolis, Ghana, were found to have a sub optimal life time adherence to their medications as well as a high rate of missed clinic visits. The study results suggest that clinicians should ensure that the clients are well educated on the importance of disclosing their sero-status and obtaining a treatment monitor prior to initiating ART for optimal adherence.

Keywords: Adherence; Antiretroviral therapy; Cape Coast; Ghana; HIV/AIDS

Introduction

Antiretroviral therapy is a lifelong activity that needs distinctive strategies to ensure its effectiveness and to prevent the developing of drug resistant viral strains. Treatment and support of persons living with HIV and AIDS in Ghana using antiretroviral therapy (ART) began in June 2003 [1]. HIV prevalence in Ghana for 2016 is 2.4% [2]. The HIV incidence in Ghana has been patterned along age, sex and geographic area. Over the years, the HIV incidence trend in Ghana has taken on a gendered outlook [3]. In 2016, it was estimated that of all adults and children living with HIV in Ghana, 55.2% were women aged over 15 years [4]. People accessing treatment worldwide have steadily increased over the years to 19.5 million in 2016 [4]. Reports indicate that this has led to the reduction of the numbers of new HIV infection, co-morbidities and AIDS related deaths especially in low and middle income countries [5].

Among strategies adopted by the National HIV/AIDS/ STI Control Programme (NACP) of Ghana in the battle against HIV in Ghana includes maximizing adherence to selected ART regimens [1]. Even though there is no one universally accepted definition for adherence to treatment, Bangsberg and Machtinger defined adherence as the extent to which a patient takes prescribed medications in the way intended by a health care provider [6]. The definition of adherence is complex and includes adherence to dosage, adherence to schedule and adherence to dietary instructions. Non- adherence to ART has been found to be the most important factor in the development of drug resistance and in treatment failure [7]. To ensure that optimal virologic outcomes are obtained, there is the need for clinicians to collaborate with patients to maintain continuous optimal adherence to antiretroviral therapy. Various optimal adherence thresholds have been suggested by researchers. A

recent meta-analysis conducted by Bezabhe et al. [8], suggested that patients who achieved "good enough" (≥ 80-90%) adherence did not necessarily have worse virologic outcomes compared to patients who achieved "perfect" (100%) or "near perfect" (≥ 95%) adherence. The authors however concluded that patients on ARTs should be instructed to achieve ≥ 95% adherence to medications [8]. Paterson et al. had earlier suggested that at least 95% level of adherence is needed to ensure optimal results from ART [9]. Other studies had shown that even though it can be hard to achieve 100% medication adherence, patients should strive to achieve it [10]. There are several ways of assessing adherence among clients on ART but it is generally difficult to assess adherence with absolute precision and accuracy in the outpatient setting [11]. Some methods used by researchers to assess adherence include, self-reports (including surveys and interviews), clinical assessment of patients, counting of pills, directly observed therapy (DOT), renewal of prescriptions and monitoring of biological markers [12,13]. Among these, the most commonly used is the self-reported adherence method which has been shown to correlate very well with viral load and CD4 count tests [14,15].

Despite the significant achievements in ART access, optimal treatment outcomes have not been obtained in many parts of the world because of missed appointments. In Malawi, it was revealed that almost half of the people who started ART were no longer attending clinic after 5 years. Kenya recorded about 40% discontinuity of treatment [16]. The long term effects of missed clinic visits on HIV patients have been investigated in some previous studies [17,18]. Missed clinic appointments have been associated with increased incidence of opportunistic infections, AIDS defining sickness and increased mortality [17,18]. Many studies have found the cost of transportation to antiretroviral clinics to pick monthly refills to be a potential barrier to HIV care [19,20]. In an earlier study in the Upper West region of Ghana, barriers to adherence to ART found included the presence of ailments and side effects of the drugs, whilst self perceived wellness, family support and regular follow up were positively associated with adherence [21]. It is however well documented through studies conducted worldwide that adherence to ART is influenced by several factors related to the patient, the medications being taken, the psychosocial environment and the medical care facilities available [14,22]. These factors vary across geopolitical zones of any country. We therefore sought to investigate the level of adherence to ART, assess factors that influence adherence to antiretroviral therapy and to determine rate of missed clinic visits among persons living with HIV in the Cape Coast metropolis, in the Central Region of Ghana, one of the poorest regions in the country and an area with HIV prevalence of 1.8% in 2016 [2].

Methods

This was an analytical cross sectional study conducted in the Cape Coast Metropolis in the Central region of Ghana using the Cape Coast Teaching Hospital, the University of Cape Coast Hospital and the Cape Coast Metropolitan Hospital as study sites. The Cape Coast Teaching Hospital is a tertiary level hospital and the largest referral hospital in the central and western regions of Ghana. It provides specialized services to about 1000 HIV/AIDS patients on ART across the region. The University of Cape Coast Hospital and the Cape Coast Metropolitan Hospital are primary level health facilities that provide full ART services to about 200 and 300 patients on ART respectively. The study was conducted from November 1, 2016 to March 31, 2017.

Using the total number of clients on ART in all three health facilities and the total clients on ART in each facility, the sample size for each facility was calculated. A systematic sampling technique was used to recruit participants into the study. Based on the average daily attendance at the clinics, a sampling interval of three was used. The first respondent was selected by balloting and picking a number between one and three. Every third client in the queue waiting to be seen by the attending nurse was invited to join the study.

Patients were eligible for enrolment if they had initiated ART at least three months before the study, were on ART at the time of the study and were not less than 18 years old. Patients were excluded from the study if they were found to be severely ill. Prior to the commencement of the study, a one week pilot study in all three hospitals involving 20 respondents was conducted to identify flaws in the questionnaire. After this, the questionnaire was modified as necessary and finalized. The 20 respondents were excluded from the final study.

The University of Cape Coast Institutional Review Board gave ethical approval for the study. Permission was obtained from the administrators of each hospital before study was conducted. All respondents gave informed consent.

Data collection

A semi-structured questionnaire was used to collect data on 381 HIV/AIDS patients on ART. The questionnaire was prepared using adherence indicators adapted from the AIDS Relief Adherence Survey [23] as well as some adherence indicators used in previous studies [10,21]. These were administered by trained nurses. In order to avoid interviewing one respondent more than once, a mark was made on their hospital records after being interviewed. The dependent variable in this study was 100% medication adherence to ART among respondents. The independent variables included socio-demographic (sex, age, marital status, and level of education), psychosocial data and knowledge on ARTs. To obtain their psychosocial data, respondents were asked if they had disclosed their HIV status to anyone, if they had a treatment monitor, whether they found ART beneficial or not and if they had ways of remembering to take their drugs daily. To assess respondents' knowledge on their treatment, they were asked if they knew how ART works (whether it cures or suppresses the disease), if they could name any of their medications and how long they intend to be on

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ART. Respondents were also asked to give suggestions on how their adherence to ART could be improved.

The study assessed three adherence indicators. These were:

1. Self-report on lifetime adherence based on whether a patient had ever forgotten to take medications since being put on ART. A respondent was classified as adherent if a dose had never been missed and non-adherent if at least one dose had ever been missed.

2. Adherence to ART clinic appointments in the last 3 months prior to the study. Adherence means not missing any clinic appointments during the period whilst non-adherence means missing at least one clinic appointment within 3 months preceding the study.

3. Whether patients' have ever decided to stop taking their drugs for more than 3 consecutive days.

Hundred percent medication adherences were defined as taking all drugs at the correct time and day as prescribed. Patients who reported ever missing their doses were presented with a list of 12 possible reasons why people on ART may miss their medications and were asked to select the most likely reason for missing their medications.

Data analysis

Data collected was entered into Microsoft excel spreadsheet and analyzed using Statistical Package for Social Sciences (SSPS) version 20. The primary outcome of interest in this study was patients' lifetime adherence to ART which was defined as 100% medication adherence since starting ART. Descriptive statistics were used to summarize the data and to describe respondents' treatment adherence by demographics. Pearson's chi square was used to examine the relationship between the sex of respondents and other demographic variables. The association between lifetime adherence, demographics and other variables like HIV disclosure status, pill burden, ways of remembering to take drugs and having treatment monitors was also examined using chi-square tests. The variables that were found to be significant in bivariate analysis were entered into a multivariate logistic regression analysis, simultaneously controlling for participant's demographic characteristics and other variables like disclosure status, pill burden and ways of remembering to take drugs. Odds ratio from the multivariate logistic regression estimation were reported at 95% confidence interval. Level of significance for all tests of association was set at $p < 0.05$.

Results

There were a total of 381 respondents that gave a response rate of 99.2% (381/384). Those who did not consent were due to the fact that they did not have the time to spend answering the questions. A total of 300 (78.7%) were females and 81 (21.3%) males. The mean age of respondents was 43.9 ± 11.7 years (range: 18-84 years). Since HIV incidence in Ghana has a gendered outlook, association between respondents' socio-

demographic characteristics and gender were investigated. Marital status, educational level and occupation had strong evidence of association with gender (Table 1). About 60 (15.7%) of participants had attained at least secondary education. Among the participants, 42.5% were married. Majority of males (58.0%) were married compared to 38.3% of females. With regards to participants' health insurance status, most respondents (93.7%) were insured with the National Health Insurance Scheme of Ghana. Majority of patients (86.8%) had been on ART for 3-6 months. Both males and females had been on treatment for comparable period of time (Table 1).

Table 1: Socio-demographic characteristics of participants by gender (N=381).

Variable	Male (n,%)	Female (n,%)	Total (n,%)	p-value
Age group				0.255
18-25	8(2.0)	16 (4.1)	24 (6.3)	
26-35	10 (2.6)	58(15.2)	68 (17.8)	
36-45	22 (5.8)	97 (25.4)	119 (31.2)	
46-55	26 (6.8)	78 (20.5)	104 (27.3)	
>55	15 (4.1)	51 (13.5)	66 (17.4)	
Total	81 (21.3)	300 (78.7)	381 (100)	
Marital status				*0.005*
Single	16 (4.2)	63 (16.5)	79 (20.7)	
Married	47 (12.3)	115 (30.2)	162 (42.5)	
Cohabiting	5 (1.3)	21 (5.5)	26 (6.8)	
Divorced	10 (2.6)	48 (12.6)	58 (15.2)	
Widowed	3 (0.8)	53 (13.9)	56 (14.7)	
Educational level				*<0.001*
No formal education	3 (0.8)	80 (21.0)	83 (21.8)	
Primary	12 (3.1)	73 (19.2)	85 (22.3)	
JSS	19 (5.0)	70 (18.4)	89 (23.3)	
Middle school	24 (6.3)	40 (10.5)	64 (16.8)	
Secondary	15 (3.9)	19 (5.0)	34 (8.9)	
Tertiary	8 (2.1)	18 (4.7)	26 (6.8)	
Health insurance				0.570
Yes	77 (20.2)	280 (73.5)	357 (93.7)	
No	4 (1.1)	20 (5.2)	24 (6.3)	
Occupation				*<0.001*
Trader	7 (1.8)	158 (41.5)	165 (43.3)	
Civil servant	13 (3.4)	11 (2.9)	24 (6.3)	
Health person	0	3 (0.8)	3 (0.8)	
Unskilled labour	16 (4.2)	23 (6.0)	39 (10.2)	
Unemployed	7 (1.8)	50 (13.1)	57 (14.9)	
Others	38 (10.0)	55 (14.4)	93 (24.5)	
Mode of HIV diagnosis				0.056
HIV counseling and testing	5 (1.3)	17 (4.5)	22 (5.8)	
Prevention of mother to child transmission testing	0	40 (10.5)	40 (10.5)	
Diagnostic testing	72 (18.9)	234 (61.4)	306 (80.3)	
Community based screening	2 (0.5)	11 (2.9)	13 (3.4)	
Duration on ART (months)				0.731
3-6	68 (17.8)	263 (69.0)	331 (86.8)	
7-12	5 (1.4)	18 (4.7)	23 (6.1)	
13-24	2 (0.5)	4 (1.1)	6 (1.6)	
>24	6 (1.6)	15 (3.9)	21 (5.5)	

Respondents spent an average of 9.3 cedis (± 11.1, range: 0-60 cedis) on transportation anytime they reported at the ART clinic for refill. Most of the respondents (85.3%) had disclosed their HIV status with more males (90.1%) disclosing their status compared with females (66.1%) as shown in table 2. Figure 1 shows the reasons given for missing ARV medications as given by males and females. For both groups the main reason was being away from home at the time client was supposed to take the medication.

These respondent characteristics were found to be significantly associated with 100% medication adherence: sex (p=0.022), pill burden (p=0.015), disclosure status (p=0.001), a way of remembering to take drugs (p=0.005) and having a treatment monitor (p ≤ 0.001) as shown in table 3. The study found that sex of patient, having prompts to take medicines or not, patient disclosure status, and availability of treatment monitor or not were significantly associated with respondents' lifetime adherence as shown in table 3.

Non-adherence was predicted by male sex (AOR 2.0, 95% CI 1.1–3.5, p=0.021), more than once daily dosing regimens (AOR 1.7, 95% CI 1.1-2.8, p=0.024), not disclosing HIV status (AOR: 2.4, CI:1.3-4.5, p=0.005), not having a way to remember to take drugs (AOR: 1.9, CI:1.1-3.4, p=0.033) and not having a treatment monitor (AOR: 2.9, 95% CI 1.7-5.0, p=0.011). Details are given in table 4. The rate of adherence to clinic appointments was found to be 79.5% among respondents (Table 2).

Reasons cited by respondents for missing their medications are summarized in figure 1.

Discussion

Of the 381 participants, 78.7% were females reflecting the sex distribution of HIV/AIDS in Ghana as shown by previous studies [21]. The study found that 100% medication adherence among participants was 73.0% and a non-adherence rate of 27%. The level of adherence found in this study is however higher than that of a similar studies conducted in the Upper

**Table 2:** HIV specific characteristics of participants by gender.

Variable	Male (n,%)	Female (n,%)	Total (n,%)	p-value
Amount spent on transportation to and from ART site (cedi)				
Mean (9.3 ± 11.1)				
0-<5	20 (5.2)	109 (28.6)	129 (33.8)	0.145
5-10	41 (10.8)	129 (33.8)	170 (44.6)	
>10	20 (5.2)	62 (16.3)	82 (21.5)	
Have you disclosed your HIV status to anyone?				
Yes	73 (19.2)	252 (66.1)	325 (85.3)	0.167
No	8 (2.1)	48 (12.6)	56 (14.7)	
Do you have treatment supporter?				
Yes	67(17.6)	234 (61.4)	301 (79.0)	0.380
No	14 (3.7)	66 (17.3)	80 (21.0)	
How does ART work?				
Don't know	5 (1.3)	26 (6.8)	31 (8.1)	0.305
Suppress the virus	62 (16.3)	203 (53.3)	265 (69.6)	
Cure the infection/disease	14 (3.7)	71 (18.6)	85 (22.3)	
Can you name one ARV medication?				
Yes	10 (2.6)	44 (11.5)	54 (14.2)	0.595
No	71 (18.6)	256 (67.3)	327 (85.8)	
What method do you use to remind you to take your ARV?				
No specific method	16 (4.2)	49 (12.9)	65 (17.1)	0.279
Alarm clock	58 (15.2)	199 (52.2)	257 (67.5)	
Other people to prompt	6 (1.6)	46 (12.1)	52 (13.6)	
Other methods	1 (0.3)	6 (1.6)	7 (1.9)	
How long is a person on ART?				
Life long	62 (16.3)	76 (19.9)	138 (36.2)	0.256
Till they are better	19 (5.0)	215 (56.4)	234 (61.4)	
Till they get tired of it	0 (0)	9 (2.4)	9 (2.4)	
Ever missed/skipped a dose?				
Yes	30 (7.9)	73 (19.2)	103 (27.0)	***0.022***
No	51 (13.4)	227 (59.5)	278 (73.0)	
Missed ART clinic appointments in the last 3 months?				
Yes	19 (5.0)	59 (15.5)	78 (20.5)	0.453
No	62 (16.3)	241 (63.3)	303 (79.5)	
Ever decided to stop taking drugs for more than 3 days?				
Yes	6 (1.6)	39 (10.2)	45 (11.8)	0.166
No	75 (19.7)	261 (68.5)	336 (88.2)	

Table 3: Distribution of patient characteristics relative to adherence of medication regimens.

Characteristic	100% medication adherence			
	Yes (n)	No (n)	Total n (%)	p-value
Sex				*0.022*
Male	30	51	81 (21.3)	
female	73	227	300 (78.7)	
Occupation				0.382
Trader	38	127	165 (43.3)	
Civil servant	7	17	24 (6.3)	
Health professional	0	3	3 (0.8)	
Unskilled labour	9	30	39 (10.2)	
Unemployed	18	39	57 (15.0)	
others	31	62	93 (24.4)	
Marital status				0.823
Single	19	55	74 (19.4)	
Married	45	123	168 (44.1)	
Co-habiting	6	21	27 (7.1)	
Divorced	15	43	58 (15.2)	
Widowed	18	36	54 (14.2)	
Education				*0.053*
No formal	22	51	73 (19.2)	
Primary	18	78	96 (25.2)	
JSS	22	66	88 (23.1)	
Middle School	16	48	64 (16.8)	
Secondary	13	21	34 (8.9)	
Tertiary	12	14	26 (6.8)	
Prompts to take drugs				*0.005*
Yes	76	239	315 (82.7)	
No	27	39	66 (17.3)	
Disclosure status				*0.001*
Yes	78	247	325 (85.3)	
No	25	31	56 (14.7)	
Treatment monitor				*<0.001*
Yes	67	234	301 (79.0)	
No	36	44	80 (21.0)	
Pill burden				*0.015*
Once daily	40	147	187 (49.1)	
>once daily	63	131	194 (50.9)	

Table 4: Bivariate and multivariate logistic regression analysis between participants' non-adherence and some of their characteristics.

Variable	Non-adherence, n	Crude OR (95%CI), p-value	AOR (95%CI), p-value
Gender			
Female	227	reference	
Male	51	1.8 (1.1-3.1), *p=0.002*	2.0 (1.1-3.5), *p=0.021*
ARV dosing			
Once daily	147	reference	
>once daily	131	1.8 (1.1-2.8), *p=0.015*	1.7 (1.1-2.8), *p=0.024*
Disclosure status			
Yes	247	reference	
No	31	2.6 (1.4-4.6), *p=0.015*	2.4(1.3-4.5), *p=0.005*
Prompts to taking drugs			
Yes	239	reference	
No	39	2.2 (1.3-3.8), *p=0.006*	1.9(1.1-3.4), *p=0.033*
Treatment monitor			
Yes	234	reference	
No	44	2.8 (1.7-4.8), *p<0.001*	2.9 (1.7-5.0), *p=0.011*
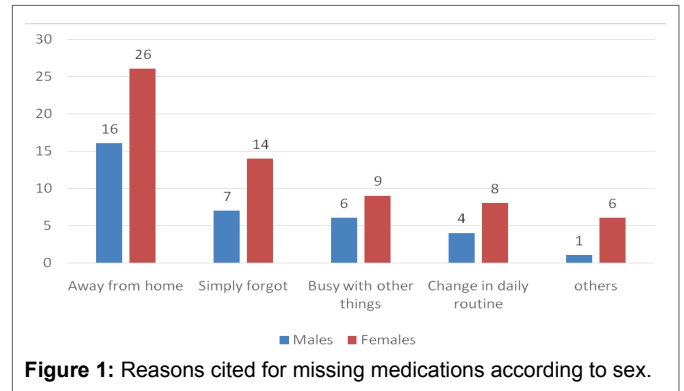
Figure 1: Reasons cited for missing medications according to sex.

West region of Ghana that found a 100% medication adherence of 62.2% [21] and in India that recorded an adherence rate of 60.4% [10]. Another study in the Volta region of Ghana found the rate of high optimal adherence to ART to be 51.4% [24]. Whilst the Upper West and Indian studies made use of patients' self-report of lifetime adherence as used in this study, the Volta region study employed the pill identification tests and the visual analogue scale to measure adherence. The findings of this study therefore suggest an improved adherence to ART among Ghanaian patients possibly due to increased education on the importance of adherence to medications. Lifetime adherence was significantly associated with sex, with males being more likely to miss their doses as compared to women. This finding is consistent with that of some previous studies [14]. This is probably because most males (91.4%) in this present study were employed and most likely may spend a lot of their time away from home. This is evidenced by the finding that about 53.3% of all men who missed their medications in this study said it was because they were away from home.

The dosing regimen of a respondent was found to predict 100% medication adherence in this study. A patient on more than once daily dosing regimen was 1.74 times more likely to miss a dose compared to those on once daily dosing regimen. This finding is consistent with that of a meta-analysis study [25] that found that adherence was higher with once-daily regimens compared to twice-daily regimens. This therefore suggests that reducing the frequency of dosing or pill burden will improve adherence. Among respondents in this study, there was a status disclosure rate of 85.5% higher than what were found in previous studies in Ghana [21,26]. Disclosure status of respondents was found to be significantly associated with lifetime adherence. This is consistent with what was found in a Thai study [27] where HIV disclosure was significantly associated with ART adherence and another study in South Africa [28] that showed that HIV disclosure facilitates ART adherence. In their mixed methods study on the fears associated with disclosure of HIV status to partners, Obiri-Yeboah et al. found that clients who had not disclosed had significant challenges with ART adherence [22].

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Having a treatment monitor was also a significant predictor of adherence in this study. Previous studies have shown that family support and communication contributed significantly to ART adherence [29,30]. It is therefore essential that before initiating ART, clinicians should encourage HIV/AIDS patients to disclose their sero status and to choose reliable treatment monitors to increase their adherence to ART.

Patients with ways of remembering to take their drugs were more likely to adhere to their drugs in this study. It is not surprising that both having treatment monitors and having prompts to take medications were positive predictors of adherence since one of the main functions of treatment monitors are to serve as medication reminders. Most respondents (81.6%) who had medication prompts used the alarm of clocks in this study. The effectiveness of the use of the clock alarm in reminding patients on when to take their drugs was tested in a study involving 49 patients on ART [31]. The clock alarm was found to be very effective in increasing adherence. Therefore clinicians at ART clinics can suggest the use of a simple alarm to patients on ART as medication prompts.

The rate of missed clinic appointments among respondents was found to be high (20.5%). Even though this rate is lower than the 29.2% found in a Ugandan study [23], it is still alarming. This is because a study conducted by Walburn et al. found that there was a 33% increase in the risk of a CD4 drop of >50 cells/mm^3 for each 10% increase in the proportion of missed appointments [32]. The rate of missed clinic visits found in this study could probably be due to the high cost of transportation to ART sites of about 9.5 cedis ($2) found in this study. In an earlier African study [23], some patients on ART said they spend as much as $11.75 a month on transportation for refill. Since a significant proportion of respondents (14.9%) in this study were unemployed, the high cost of transportation could be a real barrier to accessing healthcare.

Reasons cited by respondents for missing their doses included being away from home, simply forgetting, being busy with other things and having enough money for transportation for monthly refill. These reasons have been cited as common reasons for poor adherence to therapy in many other studies [14]. Thus in order to enhance adherence, clinicians should establish comprehensive treatment alliance with their patients so that all these social barriers to adherence can be addressed. In other words, medication should be tailored to the patient's lifestyle.

The commonest suggestion given by respondents on how care givers and society can help them improve on their adherence was the reduction of side effects. Some previous studies have shown that side effects of antiretroviral medications are associated with poor adherence [21,33]. ARVs with fewer side effects should be used more often as well as improvement in the management of known side effects of ARVs by clinicians. Other respondents suggested the provision of a system for reminding them of their medications and especially clinic appointments. ART clinics can adopt the use of reminder calls or text messages to improve adherence.

Limitations and Strengths of Study

There are a few limitations associated with this study. Data collected was based on patients' self-reports which may be affected by recall bias and the provision of socially acceptable answers. Since, this was a cross sectional study, causal relationship cannot be established from our findings, even though it could be used to identify associations. This study did not investigate in detail the various side effects of the antiretroviral drugs and how these influence adherence in the study population. Despite these limitations, the current study has a number of strengths that make it an important contributor to the scientific literature. The study is the first of its kind in the Central region of Ghana an area of high HIV prevalence and one of the poorest regions of Ghana. The study highlights the complex and multidimensional nature of ART adherence in our setting.

Conclusions

The study found that lifetime adherence and adherence to clinic appointments were all suboptimal in the study population. Barriers to adherence found in this study are all amenable to behavioral change and health interventions. Therefore in order to maximize benefits of ART, among other things, patients should be encouraged to disclose their HIV status, and obtain for themselves treatment monitors and medication prompts such as alarms. Health care providers should tailor treatment to the life style of each patient. Pharmaceutical companies that manufacture antiretroviral medications should continue to explore the possibility of developing novel compounds with relatively longer half-lives so that the dosing frequencies and pill burdens of ART will reduce. Further studies should be conducted to explore into details the high rate of missed clinic visits among participants.

Acknowledgements

Conflict of Interest

We all authors declare that we have no conflicts of interest.

Authors' Contribution

JKP contributed to the conception of the research idea, designing study, data analysis, and paper drafting, DOY designed the research, analyzed data and provided critical revision of the paper. AHB, MNA, and YN contributed to collection of data, and revision of paper. OUL contributed to data analysis, interpretation of results and paper reviewing. All authors reviewed the final manuscript.

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