A case-control study of factors associated with non-adherent to antiretroviral therapy among HIV infected people in Pwani Region, eastern Tanzania

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Abstract: Non-adherence is one of the major causes of treatment failure which leads to increased morbidity and mortality caused by opportunistic infections. Optimal anti-retroviral therapy (ART) adherence is essential for maximal suppression of viral replication and long term survival of patients. In order to develop effective public health interventions in the context of scaling ART services to peripheral areas, it is important to evaluate factors associated with non-adherence among HIV-infected individuals in Pwani Region. The purpose of this study was to identify factors related to non-adherence to ART among HIV infected people in Pwani Region eastern of Tanzania. A case-control study was carried out at Tumbi Hospital and Chalinze Health Centre in Pwani Region in eastern Tanzania. A structured questionnaire was used to assess non-adherence and adherence to doses instruction and time schedule. Patients with less than 95% adherence were defined as cases while those with more than 95% adherence became controls. A structured questionnaire containing factors known to be associated with non-adherence to ART in similar settings was administered. Univariate and multivariate conditional logistic regression was performed to identify factors associated with non-adherence. A total of 79 cases and 237 controls matched by age and sex were studied. A high proportion of cases and controls (77.2% and 84.8%) had good knowledge of ART benefits, adherence and eligibility. Majority of cases (73.3%) and controls (69.2%) used public transport to access ART services. More than half of cases (53.2%) missed clinic appointments due to lack of bus fare or other reasons and was associated with ART non adherence (mOR 4.2, 95%CI, 2.2-8.1 and 2.1,95%CI 1.2-4.2). Disclosure to confidants only and failure to disclose HIV-test positive status were associated with non adherence (mOR 3.3, 95%CI 1.3-8.5 and 2.3, 95%CI 1.2-7.1). Alcohol use was associated with non adherence to ART (mOR 1.9, 95%CI 1.4-3.7). Patients who were not satisfied with providers were more likely to be non adherence to ART (mOR 2.0, 95%CI 1.2-3.8). In conclusion, these findings show that adherence is a process which is depended on local specific adherence factors. Adherence improvement strategies need to consider site specific adherence determinants, patient experiences and concerns.

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Key words: HIV/AIDS, Health Facilities, ART Adherence Factors, Tanzania

Introduction

Tanzania like many other sub-Saharan Africa countries has the greatest burden of HIV/AIDS infected people (WHO, 2006; MOHSW, 2007). The prevalence of HIV in Tanzania is estimated at 5.7% in the population segment aged 15-49 years old with women being highly infected than men (UNAIDS/WHO/UNICEF, 2010). The epidemic shows regional variations and urban residents have considerably higher infection levels at 10.9% compared with peripheral residents 5.2% (Somi *et al.*, 2006).

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Since 2004, the Tanzania National AIDS Control Programme has instituted a stepwise anti-retroviral therapy (ART) scale up implementation approach to peripheral areas and health facilities. However, concerns about poor adherence to combination antiretroviral drugs (cARV) among patients living in resource limited settings have been an important consideration in expanding universal access to ART (Attaran, 2007; Schönnesson *et al*., 2007). Mainly due to possibility of poor adherence to treatment because of inadequate resources and ARV prescription requirements that the drugs are taken on time, every time and side effects are managed accordingly (Schönnesson *et al*., 2007).

Poor adherence to ART is one of the major causes of treatment failure which leads to increases in morbidity and mortality due opportunistic diseases (Ledergerber *et al*., 2004; Zaccareli *et al*., 2005). While good adherence to ART is essential for maximal suppression of viral replication, avoidance of resistance and long term survival of patients (Zaccareli *et al*., 2005; Nachega *et al*., 2006; WHO, 2006). Adherence of more than 95% is needed to achieve the desired virologic suppression and prevention of opportunistic infections (Paterson *et al*., 2000; Zaccareli *et al*., 2005). Good adherence to ART has been shown in some settings of sub Saharan Africa (Coetzee *et al*., 2004; Byakika *et al*., 2005; Mills *et al*., 2006). However, poor adherence has been reported in areas where food is scarce and patients have to travel long distances to seek care (Coetzee *et al.,* 2004; Weidle *et al*., 2006).

Adherence study findings in Tanzania are more likely to be different between urban and peripheral areas settings because most HIV care and treatment clinics are well established in urban settings. Peripheral environments have different demographic, socioeconomic and cultural characteristics. In order to develop effective public health interventions in the context of scaling ART services to peripheral areas, it is important to evaluate factors associated with non adherence among HIV-infected individuals residing in peripheral areas. The objective of this study was to identify factors related to non adherence to ART among HIV-infected individual attending Tumbi Hospital and Chalinze Health Centre in Pwani Region of eastern Tanzania.

Material and Methods

Study sites and study population

The study was conducted at Tumbi Regional Hospital and Chalinze Health Centre in Pwani Region in eastern Tanzania between May 2008 and November 2008. Majority of the inhabitants of the hospital and health centre catchments areas are subsistence farmers and petty traders. Adult patients aged 18-75 years old, who had been on ART for more than three months and agreed to participate in the interviews were recruited for the study. The inclusion and exclusion criteria for cases and controls were age above 18years,being on ART for more than 3 months; attended at same clinic in the last 6, level of ART adherence (Time schedule and dose) for case was less than 95% in all; and controls more than 95% in all . Additional criteria were patient with proved competence to respond to questions and ambulatory.

Procedures

The process of identification and selection of non adherent patients (cases) and adherent (controls) involved use of pharmacy drug refill records. Patients with one or more missed drug refills in the past three months were listed and contacted for interviews. A structured questionnaire consisting questions on adherence to doses in the past 1-4 days, within the past week; adherence to time schedule; and the 30 days visual analogy scale (VAS) was used to determine the level of adherence to ART. Adherence to doses was calculated as doses taken over those prescribed (pill count). Adherence levels assessed using VAS was defined as good adherent if the patient marked 9.5 mm (95%) to 10 mm (100%) and non-adherent marked less than 9.5 mm (<95%) of the prescribed doses taken since last refill. Only patients who were found non adherent to all by less than 95% were defined as non-adherent cases. A total of 79 non-adherent patients were identified, and consented to participate in the study and matched by age and sex to three adherent controls.

Data collection

A structured questionnaire was administered to all cases and controls during a scheduled appointment or routine clinic visits. The questionnaire was constructed using factors found to be associated with poor adherence to ART in similar settings in sub-Saharan Africa (Coetzee *et al.*, 2004; Byakika *et al.*, 2005; Weidle *et al.*, 2006). The key risk factors tested included: stigma, knowledge, provider-patient interaction, and selected social and behaviour factors. The questionnaire covered socio-demographic characteristics, social and behaviour factors. Eight items were developed to assess perceive availability of social support to cover four themes: emotional support (confidant), financial support, counselling and care during critical state. Depression was assessed using a ten items questionnaire adopted from the version of the Centres for Epidemiologic Studies Depression Scale (CES-D) (http://www.chcr.brown.edu/pcoc/cesdscale.pdf). Two groups of knowledge was assessed, knowledge of ART (benefits, adherence, eligibility, names of drugs) and basic prevention methods (condom use, abstinence, avoid multiple sexual partners, avoid needle sharing). Stigma was assessed in two themes: negative self perception and discrimination experiences at home and in their community.

Data analysis

Data were entered using Microsoft Office Access 2007, cleaned and transferred to Stata version 10 for analysis. Patient matched case-control pairs were created using Microsoft Office Excel 2007. Depression was scored as follows: 0 points rarely or none of the time (< 1 day); 1 point some or a little of the time (1-2 days); 2 points occasionally or a moderate amount of the time (3-4 days); and 3 points most or all of the time (5-7 days). A case or control was categorized to have full support if responded to have support in three or four of the themes, partial support was one to two, and no support if responded to have no one to provide any of the four support themes. Knowledge was classified as good if the respondents answered all the questions correctly. Distance was defined as the estimated distance of the patient residency from the study clinic measured in kilometres.

Univariate and multivariate conditional logistic regression was performed to identify factors associated with non adherence. The criteria for selection of variables possible for inclusion in multivariable analysis were based on p-value of less than 5%. The strength of association was measured using matched Odds Ratios (mOR).

Ethical clearance

The study received scientific and ethical approval from the Muhimbili University of Health and Allied Sciences Research Ethics Review Board (Ref.No.MU/RP/AEC/Vol.XII/58). Permission was granted by Regional, District and hospital authorities. Verbal informed consent for participation was obtained from patients using Kiswahili language.

Results

Demographic characteristics

Three hundred and sixteen patients receiving ART participated in the study (79 cases and 237 matched controls). The mean (SD) age was 37.2 (8.5) years. About 64.2% of the participants were females, 65.8% were married or cohabiting and 71.8% were Muslims. Majority (73.4%) of the patients completed primary education. About three quarters 74.1%), were unemployed and 59.2% reported an average monthly income of less than US$50. Individuals were more often living more than 5 km away from the ART clinic (46.5% ≤5 km versus 53.5% ≥5 km).There was no significant difference between cases and controls patients with respect to socio-demographic characteristics.

Table 1: Socio-demographic determinants of ARV adherence among cases and controls

Characteristics	Response	Frequency among		Univariate
		Controls n (%)	Cases n (%)	mOR (95% CI)
All patients		237(75%)	79(25%)	-
Age (years) groups*	18-29	39(16.5)	14(17.7)	2.19(0.2-22.6)
	30-39	159(67.0)	53(67.1)	Reference
	>39	39(16.5)	12(15.2)	0.96(0.4-2.3)
Sex	Male	85(35.9)	28(35.4)	Reference
	Female	152(64.1)	51(64.6)	1.3(0.2-9.5)
Marital status	Married/cohabiting	162(68.3)	46(58.2)	Reference
	Single/divorced/widow/ separated	75(31.7)	33(41.8)	1.5(0.9-2.6)
Education level	No education	41(17.3)	15(18.9)	1.2(0.6-2.3)
	Primary	176(74.3)	56(71.0)	Reference
	Secondary/college	20(8.4)	8(10.1)	1.2(0.5-2.9)
Religion	Islam	173(73.0)	54(68.4)	Reference
	Christian	64(27.0)	25(31.6)	1.2(0.7-2.1)
Main source of income	Employed	60(25.3)	22(27.8)	Reference
	Unemployed	177(74.7)	57(72.2)	1.1(0.6-2.0)
Average monthly Income US$	<50	144(60.8)	43(54.4)	Reference
	50-150	66(27.8)	27(34.2)	1.4(0.8-2.5)
	>150	27(11.4)	9(11.4)	1.1(0.5-2.7)

*Test for trend across ordered groups Z=-0.07, p=0.95; *Adjusted to all variables

Table 2: Social and behavioural factors with their relationship to adherence to ART among cases and controls

Variable	Response	Frequency among		Univariate
		Controls: n (%)	Cases: n (%)	mOR (95% CI)
All patients		237(75%)	79(25%)	-
Taking care of <5 children	Cares no child	76(32.1)	22(27.8)	Reference
	Cares 1-2 children	96(40.5)	44(55.7)	1.5(0.8-2.7)
	Cares >2 children	65(27.4)	13(16.5)	0.7(0.3-1.5)

Availability of support	Full support	115(48.5)	32(40.5)	Reference
	Partial support	92(38.8)	38(48.1)	1.5(0.9-2.5)
	No support	30(12.7)	9(11.4)	1.1(0.8-1.6)
Depression in the past week	Rarely (<1 day)	171(72.2)	52(65.8)	Reference
	Some days (1-2 days)	26(10.9)	14(17.7)	1.8(0.9-3.7)
	Occasionally (3-4 days)	23(9.7)	8(10.2)	1.1(0.5-2.6)
	Most days (5-7 days)	17(7.2)	5(6.3)	1.0 (0.4-2.9)
Disclosure Status	Disclosed to many people	61(25.7)	17(21.5)	Reference
	Disclosed to 1-2 relatives	146(61.6)	42(53.2)	1.0(0.5-1.9)
	Disclosed not to relatives	19(8.1)	14(17.7)	3.3(1.3-8.5)
	Not disclosed to anyone	11(4.6)	6(7.6)	2.3(1.2-7.1)
Drinks alcohol	No	206(76.9)	31(64.6)	Reference
	Yes	62(23.1)	17(35.4)	1.9(1.4-3.7)

*Adjusted to all variables

Univariate analysis

In a univariate analysis none of the socio-demographic determinants was found to be associated with non adherent to ART (Table 1). Persons with undisclosed HIV-positive status and those who used alcohol were more likely to be non adherent (Table Table 2). Failure to disclose ones' sero status was significantly associated with non adherence to ART (mOR 2.3, 95%CI 1.2-7.1). Similarly, individuals who did not disclose their statuses to their relatives were more than three times (mOR 3.3, 95%CI (1.3-8.5) likely to be non adherent to ART. The odds of patients who take alcohol was almost two times greater compared to that of non alcohol drinkers (mOR 1.9, 95%CI 1.4-3.7). Taking care of under-five children, having episodes of depression and lack of support were not significantly related to non adherence. The proportion of patients without support was very low in both cases (12.7%) and controls (11.4%). The majority of cases (65.8%) and controls (72.2%) rarely experienced episodes of depression.

Majority of patients (73.3% cases and 64.9% controls) used public minibuses to access ART services. A very small proportion of cases (8.9%) compared to controls (44.7%) were residing within a walking distance to the ART clinic (Table 3). A high proportion of controls (73.0%) never missed clinic appointments in the past three months. While more than half of cases (53.2%) missed clinic appointments due to lack of bus fare or other reasons. Failure to adhere to clinic appointment due to lack of bus fare and other reasons was found to be associated with non adherence to treatment (mOR 4.2, 95% CI 2.2-8.1 and mOR 2.1(1.2-4.2), respectively.

Table 3: Treatment and care seeking influencing factors and their association with adherence to ART

Variable	Response	Frequency in controls (%)	Frequency in cases (%)	Univariate mOR (95%CI)
Self perceived stigma	Yes	129(54.4)	35(44.3)	Reference
	No	108(45.6)	44(55.7)	0.9(0.6-1.6)
ART knowledge	Good	201(84.8)	61(77.2)	Reference
	Poor	36(15.2)	18(22.8)	1.6(0.9-3.0)
Knowledge of basic prevention methods	Good	162(68.3)	40(50.6)	Reference
	Poor	75(31.7)	39(49.4)	2.1(1.3-3.6)
Distance from ART clinic (Km)	Less than 6 km	106(44.7)	41(51.9)	Reference
	6 km and more	131(55.3)	38(48.1)	0.7(0.4-1.2)
		24(10.1)	7(8.9)	Reference

		16(6.8)	7(8.9)	1.5(0.4-5.4)	
		33(13.9)	7(8.9)	0.7(0.2-2.4)	
		164(69.2)	58(73.3)	1.2(0.5-2.9)	
Type of transport used	Walk	24(10.1)	7(8.9)	Reference	
	Bicycle	16(6.8)	7(8.9)	1.5(0.4-5.4)	
	Motorcycle	33(13.9)	7(8.9)	0.7(0.2-2.4)	
	Bus	164(69.2)	58(73.3)	1.2(0.5-2.9)	
Duration from HIV +test to seeking ART services	Within month of test	154(64.9)	47(59.5)	Reference	
	1-12 month after test	67(28.3)	23(29.1)	1.1(0.6-1.9)	
	>12 months after test	16(6.8)	9(11.4)	1.8(0.8-4.2)	
Adherence to clinic attendances	Never missed	173(73.0)	37(46.8)	Reference	
	Missed due to lack of fare	33(13.9)	28(35.5)	4.2(2.2-8.1)	
	Missed due to other reasons	31(13.1)	14(17.7)	2.1(1.2-4.2)	
Duration on ART (in months)	3-12	76(32.1)	33(41.8)	Reference	
	13-24	71(29.9)	21(26.6)	0.7(0.4-1.3)	
	≥25	90(38.0)	25(31.7)	0.6(0.3-1.2)	

*Adjusted to all variables

The proportion of patients with good knowledge of HIV-prevention was high (68.3%) among controls compared to cases (50.6%). Patients with poor knowledge of basic HIV prevention were two times more likely to be non adherence compared to patients with good knowledge of ART (mOR 2.1, 95%CI 1.3-3.6). A large proportion of cases (77.2%) and controls (84.8%) had good knowledge of ART benefits, ART adherence and ART eligibility. Self perceived stigma was not associated with non adherence to ART (mOR 0.9, 95%CI 0.6-1.6) (Table 3).

Only one variable on patient-provider interaction; satisfied with providers, was related to suboptimal adherence to ART. Patients who reported not to be satisfied with health care providers were two times more likely to have poor adherence to ART (mOR 2.0, 95%CI 1.2-3.8). Spending long time with providers and frequent meetings with counsellors were not associated with adherence to ART (Table 4).

Table 4: Patient-provider interaction factors and their relationship with Antiretroviral Therapy adherence status

Variable	Response	Frequency in Controls	Frequency in Cases	Univariate mOR (95%CI)
Meeting with counsellors in past 6 months	Not at all	179(75.5)	58(73.4)	Reference
	1-5 times	49(20.7)	18(22.8)	1.2(0.6-2.2)
	>5 times	9(3.8)	3(3.8)	1.2(0.3-4.7)
Time spend with provider	<10 minutes	68(28.8)	18(22.8)	Reference
	> 10 minutes	168(71.2)	61(77.2)	0.7(0.4-1.3)
Satisfied with providers	Yes	195(83.0)	57(72.1)	Reference
	No	40(17.0)	22(27.9)	2.0(1.2-3.8)

*Adjusted to all variables

Multivariable analysis

In the final multivariate conditional logistic regression =the following were identified as risk factors for non adherence: Missed clinic attendance due to lack of bus fare (adjusted mOR 6.4, 95%CI 2.6-15.9), missed clinic due to other reasons (adjusted mOR 1.9, 95%CI 1.1-4.8), disclosure of HIV-positive status to other than relatives (adjusted mOR 5.2, 95%CI 1.4-19.5) and failure to disclose (adjusted mOR 2.8, 95%CI 0.6-13.5). Other factors included poor knowledge of basic HIV prevention methods (adjusted mOR 1.9, 95%CI 1.1-3.8), alcohol intake (adjusted mOR 1.8, 95%CI 0.7-5.2) and unsatisfied with services provided (adjusted mOR 1.8, 95%CI 1.1-4.2) (Table 5).

Table 5: Final multivariable conditional logistic regression model for the factors associated with non-adherence to Antiretroviral Therapy

Factors	Response	Adjusted mOR (95% CI)*	P-value
Adherence to clinic attendances	Never missed	Reference	
	Missed due to lack of fare	6.4 (2.6-15.9)	<0.001
	Missed due to other reasons	1.9 (1.1-4.8)	0.05
Disclosure Status	Disclosed to many people	Reference	
	Disclosed to 1-2 relatives	1.2 (0.5-2.7)	0.642
	Disclosed not to relatives	5.2 (1.4-19.5)	0.015
	Not disclosed to anyone	2.8 (0.6-13.5)	0.201
Drinks alcohol	**Drinks alcohol**		
	No	Reference	
	Yes	1.8 (0.7-5.2)	0.043
Knowledge of basic prevention methods	Good	Reference	
	Poor	1.9(1.1-3.8)	0.050
Satisfied with providers services, time spent and issues discussed	Yes	Reference	
	No	1.8(1.1-4.2)	0.034

*Adjusted to all variables

Discussion

Previous studies on ART adherence in Tanzania have utilized cross-sectional and qualitative designs and were mostly done in urban settings (Ware *et al.*, 2009; Roura *et al.*, 2009; Minzi *et al.*, 2009). This case control study design was chosen and applied with the understanding that non-adherence is an infrequent (rare) event in rural settings where adherence is reported to be more than 95% (Minzi *et al.*, 2009; Mugusi *et al.*,2009).

In this study, we did not find an association between adherence to ART and socio-demographic characteristics. Consistent with another study which did not find any association between adherence to ART and sex, age and education levels (Ammassari *et al.*, 2002). The possible explanation for this finding is because we studied a homogeneous population with little socio-demographic and economic variations.

Social support may enhance adherence through encouragement, reassurance, reinforcement, systematic cues, bolstering of competence, and motivation or by masking the effect of stress, anxiety and depression. Social support was not significantly associated with adherence to ART in this study. This is in contrast to other previous studies where lack of

support was related to sub optimal adherence to ART (Sanjobo *et al*., 2008; Dahab *et al*., 2008). However, the proportion of cases and controls without social support in this study population was very low which possibly overshadowed the effect of lack of social support. Equally, depression was not associated with poor adherence, most likely because of low proportion of cases that occasionally experienced depressive symptoms (3-4 days) and in most days (5-7 days). In other settings depression has been an important predictor of poor adherence (Ammassari *et al*., 2002; Sanjobo *et al*., 2008; Dahab *et al.*, 2008).   The low proportion of patients without social support and those who experienced depression symptoms can be explained by the common phenomenon and sometime is a requirement for ART patients in peripheral care and treatment clinics to have treatment assistants. A treatment assistant reminds the patient about drug intake times, collecting drugs from health facility and reporting side effects to the clinicians (Attaran, 2007).

Stigma and discrimination against HIV-infected people was limited to perceived stigma in both cases and controls. Stigma was reported as self blame and fear to disclose one's HIV-positive status to other people which may result into gossips and loss of friends. Though we found no significant relationship between such perceived stigma and their treatment adherence, such stigma may lead to patients' unwillingness or fear to take medicine when other people were present. None of the study participants reported to have experienced stigma and social exclusion because of HIV-positive status. Other studies has highlighted stigma to be a barrier to adherence (Mostashari *et al*., 1998; Peltzer *et al*., 2010). The high burden of HIV-infection and decades of AIDS related deaths in the study population have created awareness and perception evolution that reduced the magnitude of stigma which was experienced in first decade of HIV-epidemic (Unpublished hospital data) In this study, majority of patients disclosed their HIV-positive status to few family members and close relatives. Disclosure was significantly related to adherence, and this can explain the perceived stigma in this study population. Fear of disclosure has been documented to be among the barriers to adherence in African settings (Mills *et al.*, 2006).

Alcohol consumption is one of the known barriers to ART adherence in both rural and urban settings (Sanjobo *et al*., 2008; Dahab *et al*., 2008; Pelter *et al*., 2010). In some communities alcohol use is believed to temporarily alleviate HIV related psychological problems (Mostashari *et al*., 1998). Alcohol use can result into forgetfulness of the dose timing and dietary instructions that accompany some antiretroviral medications. Excessive alcohol use can cause liver damage, increase liver enzymes which lead to short drug's half life than expected. Besides, alcohol exacerbates antiretroviral drug side effects. In agreement with these studies alcohol use was a significant predictor of non adherence to ART in the present study. The assessment of alcohol intake in this study was limited to self-report of consumption of alcoholic beverages two or more times in a week. There were no questions to quantify the amount consumed. This can limit the strength of association between alcohol intake and adherence to ART. However, these findings indicate the importance of regular alcohol counselling and education related to ART adherence among HIV-patients on ART.

The World Health Organization included free access to ART at the point of service delivery as a component of its public health approach for reaching universal access in low income countries (UNAIDS/WHO/UNICEF, 2010). Although coverage rates continue to increase but most rural residents still have to travel long distances to access ART services. Transport costs can pose an important barrier to clinic attendances and ultimately poor adherence to ART (Ware *et al.*, 2009). In this study, most of the patients needed some form of transport to reach ART clinic. Majority of cases and controls used public minibuses and

therefore had to pay for the transport. Lack of transport money coupled with other reasons significantly associated with non adherence in this study. Adaptation of the tuberculosis Direct Observed Therapy as a strategy to improve adherence to ART in settings like this need to address transport cost challenges.

Knowledge of basic HIV-infection prevention measures was significantly associated with adherence to treatment. But knowledge of ART benefits, adherence requirements and eligibility was not related to adherence to ART. This contrasting finding is explained by the high level of HIV-infection prevention awareness in the communities, and acts as a motivation of ART adherence. To remember the complicated names of ARVs, a high level of education is required; no wonder in some settings education level is associated with adherence (Nachega *et al.,* 2006). However, in practice lack of information and communication about treatment is the actual barrier to treatment. Although delivery of ART counselling and education in our study population is done in local spoken language, but there is a need to explore the content of Information, Education and Communication (IEC) materials used and how local disease concepts are communicated. Understanding and incorporating local peoples' perception and feelings towards HIV/AIDS in developing IEC materials is one of the ways to impact ART knowledge to People Living with HIV and AIDS and improve communication between patients and providers.

Good patient-provider relationship and patients' satisfaction with health care services have shown positive correlation with adherence to ART in some settings (Mostashari *et al.,* 1998; Watt *et al.,* 2010). Regular contact with either counsellors or long time spend with providers were not associated with adherence. But, patients who felt not satisfied with the time they spend with providers were non adherent to treatment. Such patients probably were unable to express their concerns about medications. In this setting continued patients counselling tailored to individual needs would improve adherence.

ART patients taking care of children below 5 years may forget to take medications due to being busy or stressed of caring for the children. The lack of statistical significant relationship between caring of under-five children and adherence to ART is because the study sample was not big enough to segregate this variable between male and females.

Based on our study findings, the ongoing decentralization of ART services to peripheral or peripheral health facilities need to consider a combination of strategies in order to achieve optimal adherence. Dispensing of ARVs in quarterly bases after the first three months of monitoring adherence and toxicity can reduce the transport costs and encourage adherence success for patients residing far from ART clinics. Where feasible government subsidized transport can reduce costs to the patients substantially. In addition regular scheduled repeated patient counselling on alcohol use and other individual patient needs should be encouraged.

Interpretation of our study findings must be taken in the light of its limitations. The time set of three months adherence was too short to capture non adherence risk factors dynamics. Temporary changes of risk factors making cases or controls become controls or cases might have affected the analysis but we had to set the time limit considering the possibility of recall bias.

In conclusion, these findings explain that adherence is a dynamic process that varies depending on region or cohort specific adherence factors. Adherence improvement strategies need to take into consideration site specific adherence determinants, patient experiences and concerns.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

BI Participated in conception and design of the study. He also coordinated all activities pertaining to collection and management of data, analysis and interpretation of data. He has been involved in drafting the manuscript and revising it. MT has been involved in conception and design of the study; drafting the manuscript and revising it critically. BJ has been involved in drafting the manuscript and revising it critically. FM has been involved in drafting the manuscript and revising it critically

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