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Published in:
AIDS Care

DOI:
[10.1080/09540121.2014.963020](https://doi.org/10.1080/09540121.2014.963020)

2015

[Link to publication](#)

Citation for published version (APA):

Munene, E., & Ekman, B. (2015). Association between patient engagement in HIV care and antiretroviral therapy medication adherence: cross-sectional evidence from a regional HIV care center in Kenya. *AIDS Care*, 27(3), 378-386. <https://doi.org/10.1080/09540121.2014.963020>

Total number of authors:
2

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Running head: **Association between patient engagement in HIV care and ART medication adherence**

Association between patient engagement in HIV care and ART medication adherence: cross-sectional evidence from a regional HIV care center in Kenya

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Acknowledgement: The authors thank all the study participants for their generosity with time and effort.

	Word count
Title	21
Abstract	234
Main text	3,018

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Abstract

Consistent individual effort in engagement in HIV medical services has been associated with positive health outcomes in persons living with HIV. However, whether these benefits are facilitated by improved medication adherence has not been widely studied. This study aimed to investigate the marginal effect of engagement in HIV care on medication adherence at a public health facility in Kenya.

Between February and April 2013, 392 patients on HIV care at Nyeri Provincial General Hospital participated in the study. Data were collected using a self-administered health survey questionnaire assessing health and socio-demographic statuses. A manual stepwise general linear model was specified to measure the effect of engagement in HIV and other associated predictors on medication adherence.

Engagement in HIV care was significantly associated with log-transformed medication adherence in the sample ($100 \cdot \beta = 9.2\%$, 95% CI 3.2 – 15.1) irrespective of gender and other selected predictors. Longer duration on ART was also a significant predictor of better medication adherence ($100 \cdot \beta = 3.2\%$, 95% CI 2.3 – 4.1). Despite inter-gender differences in adherence and engagement determinants, gender's independent effect on medication adherence and engagement in care was not statistically significant.

Poor medication adherence was associated with lower patient engagement in HIV care services; suggesting that interventions which remove obstacles to regular observance of scheduled clinic appointments and eventual retention may have a beneficial impact on medication adherence and accordingly, health outcomes in people living with HIV.

Keywords: HIV; HIV care engagement; Kenya; visit constancy; medication adherence

Introduction

Patient engagement in HIV care, defined by the continuum of service utilization from initial linkage to retention in care (Gardner, McLees, Steiner, Rio, & Burman, 2011; Koch, 2014), is generally regarded as a significant prognostic indicator of HIV treatment outcomes including survival (Crawford, Sanderson, & Thornton, 2013; Gardner et al., 2011; Horstmann, Brown, Islam, Buck, & Agins, 2010). Although several analyses have supported this proposition, there have been relatively few empirical investigations of the ways through which the benefits of adherence to HIV care visit requirements accrue.

Previous investigations have found missed clinic appointments in HIV care to be associated with several critical impacts, including incomplete or protracted time-to-viral suppression (Crawford et al., 2013; Mugavero, Amico, et al., 2012; Mugavero, Westfall, et al., 2012; Sethi, Celentano, Gange, Moore, & Gallant, 2003), premature mortality (Brennan, Maskew, Sanne, & Fox, 2010; Zhang et al., 2012) and clinical therapy failure (Sullivan et al., 2011). Where the endpoint was mortality, therapy interruption explained the observation, but because HIV clinic-visit consistency is a structural constituent of engagement in care, other mediators may explain the non-mortality outcomes. Poor medication adherence has been suggested as a possible basis for the observed complications (Brennan et al., 2010; Giordano et al., 2007; Zhang et al., 2012), although few studies have tested this proposition. Giordano et al. (Giordano et al., 2007) argue that poor medication adherence may partially mediate the relationship *because* being out of care may account for the poor survival outcomes. This, however, fails to appreciate that poor adherers to HIV care services are not necessarily out of care because re-engagement following no-show visits or loss-to-follow-up is possible (Avery et al., 2013; Konkle-Parker & Barnett, 2012; Udeagu, Webster, Bocour, Michel, & Shepard, 2013) and even common (Rebeiro et al., 2013).

The socio-economic determinants of patient engagement in HIV care have been studied in various settings. For example, studies conducted in East Africa have suggested unemployment, lower income, transportation costs and other poverty indicators as likely barriers to retention in HIV care (Asefa, Taha, Dejene, & Dube, 2013; Namusobya et al., 2013). Similar results elsewhere indicate that women are more likely to miss appointments (Edwards, Parrish, Frieson, Crawford, & Thornton, 2011; Mugavero et al., 2009), delay seeking care (Tobias, Cunningham, Cunningham, & Pounds, 2007) and have unmet HIV-related healthcare needs (Haley et al., 2014). Moreover, qualitative findings suggest child-care, socio-economic commitments and health services access as major barriers to patient engagement in HIV care (Rao et al., 2013).

The current national policy for containing HIV/AIDS in Kenya identifies patient engagement in HIV care and subsequent retention as key pillars in the endeavor (National AIDS Control Council, 2009). But without empirical corroboration for the community partnership and other structural interventions envisaged in the policy statements, their implementation and impact evaluation may face evidentiary challenges hence the opportunity to enrich existing knowledge on the same. This is particularly warranted given the wanting situation, at the local level, for policy support through contextually relevant operational research.

Against this background, the aim of this study is to use patient-level HIV care attendance data from a regional referral hospital in Kenya to investigate the role of medication adherence as a potential pathway for the positive health outcomes associated with better patient engagement in HIV care. We postulated that greater individual commitment to continue and remain in HIV care (as a measure of patient engagement in HIV care) would result in greater contact time with the health system and consequently provide more opportunities for systematic interventions in medication adherence and other follow-up. If

this in turn results in improved medication adherence (and the attendant positive health outcomes) irrespective of socio-demographic, clinical and treatment factors, then this would strengthen the existing basis for health-system insistence on greater commitment to clinic attendance on the part of patients. In addition, the identification of the factors that facilitate patient engagement to HIV-care would have direct policy implications.

Method

Study setting

The study was conducted between February and April 2013 at Nyeri Provincial General Hospital (Nyeri PGH), a regional referral hospital in Nyeri County, Kenya. The hospital provides general care services as well as specialized HIV care facilities to a primary catchment area of about 700,000 people. Nyeri County's HIV prevalence is marginally lower than the national average (4.4% vs. 6.2%) (National AIDS and STI Control Programme, 2012).

Sampling and participation

Study participants were sampled from the single register of people living with HIV (PLHIV) managed at the hospital's comprehensive care clinic for HIV. The inclusion criteria comprised of: (1) having been on HIV treatment for at least four weeks (2) aged between 18 and 64, (3) male or female and (4) having attended at least one post-initiation scheduled appointment before the study period. Incapacitated patients or patients with cognitive difficulties were excluded. Consequently, from a total population of 1,693 PLHIV on treatment, 1,189 were eligible for inclusion. Since the HIV burden is disproportionately distributed between the genders, a final sample of 421 patients was aggregated from a proportionate simple random sample from each of the two gender-stratified groups of the sampling frame. The source population was predominantly female (69.0%).

Sample size was determined from the World Health Organization's (WHO) *Practical Manual for Sample Size Determination in Health Studies* (Lwanga & Lemeshow, 1991), where a minimum sample size of 380 would have been adequate to estimate an odds ratio (OR) of at least 1.5 at the 5% significance level.

Data collection

Individual level data on key outcome and control variables were collected using a structured questionnaire administered by one member of the study team. The questionnaire was part of a study assessing health-related quality of life in PLHIV (Mûnene & Ekman, 2014) in the same population. Both Kiswahili and English questionnaires were available and a majority of the participants preferred the Kiswahili version. Hospital pharmacy and medical records provided additional data on pre-treatment health status and all treatment-related information (see variables description).

Ethical considerations

Institutional approval of the study protocol was obtained in writing from the hospital management. Respondents provided individual consent prior to participation, which was fully voluntary. All participants were assured of confidentiality and continued receipt of hospital services whether they elected to participate or not. No personally identifying information was collected or used and interviews were conducted in a private office.

Dependent variable

The dependent variable of the study is mean medication adherence. This was computed for each individual participant's period spanning from enrollment through the study date, and for all the medicines taken during the period, including any therapy changes. The variable was log-transformed to ease interpretability of the regression coefficients, so that a one unit change in an independent variable would correspond to a percentage-change in the magnitude of the medication adherence variable.

Independent variable

The independent variable of analytical interest is a measure of patient engagement, termed visit constancy (VC). VC was computed as the ratio of scheduled visits made on time

to total visits expected over the course of treatment ($VC = \text{number of timely} \div \text{visits number of scheduled visits}$). These data were obtained from clinic attendance records at the hospital pharmacy. A visit was considered made on time if it fell within three days of the appointment date (an institutional policy). Pre-appointment date visits were negligible. This ratio was then weighted with the inverse of the log number of re-engagements in the same period to generate an engagement index ($EI = VC \div \log(\text{number of re-engagements}) \times 2$). Multiplying the denominator with a constant eliminated $\log 1$ so that the denominator of 1 was reserved for individuals who had never been re-engaged. A re-engagement was defined as a clinic visit occurring outside a ninety-day period from the scheduled appointment date (again, an institutional policy). This weighting was an intuitive construct in that it ensured that a large number of breaks in the treatment course amplified the reduction in visit constancy non-linearly, irrespective of its magnitude, thus transforming visit constancy into a more robust definition of engagement in HIV care.

Control variables

Three groups of control variables selected based on their hypothetical and known association with the primary independent and dependent variables were defined:

Socio-demographic factors: Current marital status, typical monthly income, current religion, occupation in the previous four weeks, highest education level achieved, gender and age were obtained from the self-administered questionnaire. Categorical variables' levels were combined (see table 1) to produce theoretically relevant levels as well as improve the numerical stability of the parameterized general linear models.

Health-status factors: Pre-treatment health status data (captured by the symptomatic staging of HIV using WHO guidelines) were obtained from patients' clinical records. Current chronic

co-morbidities and symptoms of acute illnesses in the previous four weeks were obtained from self-report through the study's questionnaire.

Treatment-related factors: Data on duration of treatment, therapy regimen changes and adverse drug reactions were collected from the electronic pharmacy database.

Statistical analyses

One-way ANOVA and independent Student's t-test were used to assess the unadjusted associations between the independent and dependent variables across the categorical predictor levels. Pearson's chi-squared test assessed gender differences in the predictor variables' levels. To investigate the effect of engagement in HIV care services on medication adherence while controlling for the selected confounders, a three-step ANCOVA model was specified. Socio-demographic factors were added first, followed by health-status factors and treatment-related factors (including engagement) last. Parameter estimates (β) and model fit statistics test results were obtained from the models. All parameter estimates are presented as percentage changes ($100 \cdot \beta$) to ease interpretability. Changes in significance and effect sizes were used to identify probable statistical mediation. Analyses were performed with STATA®/SE v12 and IBM® SPSS® Statistics v19. An alpha-level of 0.05 was used for all hypothesis tests.

Results

Socio-demographic characteristics

Three hundred and ninety two patients participated in the study representing a 93.1% response rate. Table 1 describes the participants' socio-demographic, health-status and treatment variables in relation to the medication adherence, HIV care engagement index and gender variables.

The sample was mostly female (68.9%) which was in congruence with the source population (69.0%), Kenyan (two in three PLHIV are women) (National AIDS Control Council, 2005), Sub-Saharan Africa (57%) (Joint United Nations Programme on HIV/AIDS (UNAIDS), 2013, p. 78) and global (52%) (Joint United Nations Programme on HIV/AIDS (UNAIDS), 2013, p. 78) gender distribution of PLHIV who are on treatment. The mean age was 41.4 years (95% CI 40.6 – 42.2).

More women reported earning lower individual monthly income than men (83.7% women vs. 71.3% men earning < KES 10,000, $\chi^2(2, N=392) = 9.55, p < 0.05$) and being in non-formal occupations (58.1% women vs. 31.1% men not in the employed bracket, $\chi^2(2, N=392) = 37.10, p < 0.05$), confirming a poverty gradient based on gender.

The sample's mean medication adherence was 84.3% (95% CI 83.1 – 88.2) with participants in higher income bands having significantly lower medication adherence ($F(2, 389) = 6.977, p < 0.05$) and the lower educated participants more likely to have higher medication adherence measures ($F(1, 390) = 5.04, p < 0.05$). Medication adherence differences between the genders were not statistically significant.

On average, the participants made 75.5% timely clinic visits (95% CI 74.1 – 77.0) and had 0.98 treatment breaks (95% CI 0.89 – 1.07). Combining these data (as described earlier), the HIV care engagement index was significantly lower in participants with chronic co-

morbidities (49.5% with at least one vs. 41.8% without any, $F(1, 390) = 6.25, p < 0.05$) as well as those participants initiated to HIV care at worse pre-treatment clinical status (52.2% WHO stage ≤ 2 vs. 41.0% WHO stage > 2 , $F(1, 390) = 16.18, p < 0.05$), suggesting a possible association between pre-treatment health status and ability to consume HIV care services consistently. Women had poorer pre- and in-treatment health status (acute illnesses, chronic co-morbidities and pre-initiation WHO stage) when compared to men (see table 1).

Patient engagement in HIV care vs. medication adherence

In the initial model (see step 1 of table 2), comprising of the socio-demographic factors against medication adherence; income, religion and age were significant predictors of medication adherence. A negative medication adherence gradient with movement to higher income bands was noted (with the highest income band having 6.6% poorer medication adherence compared to the lowest band [95% CI -10.7 to -2.5]). This significance persisted across the models suggesting a significant association.

Addition of health-status factors to the initial model (see step 2 of table 2) improved the model performance marginally (0.9% change in R^2). Income, age and religion remained significant predictors of medication adherence, implying that health-status factors did not substantially mediate the relationships noted in the previous step. Among the health-status factors, only the pre-treatment clinical status (measured by the pre-initiation WHO stage) was significantly associated with medication adherence (movement from one stage to the next was associated with a 3.6% (95% CI 0.6 – 6.6) increase in medication adherence).

The final model, that now included the treatment-related factors and the HIV care engagement index, was a significant improvement from the previous (an 18% increase in R^2). It was noted that a one unit-increase in the HIV care engagement index was associated with a 9.2% (95% CI 3.2 – 15.1) increase in medication adherence. In this model, all health-status and socio-demographic factors (except income) ceased being significant predictors of medication adherence. This suggests that the variance in medication adherence attributed to these factors could be statistically explained away by one or a combination of treatment-related factors. It was also noted that the longer a participant had been on treatment the better the medication adherence irrespective of health-status, socio-demographic status or other treatment-related factors (one additional year on treatment was associated with 3.2% greater medication adherence [95% CI 2.3 – 4.1]).

Discussion

This study found that higher individual engagement in HIV care services was significantly associated with better medication adherence (with a unit increase in the HIV care engagement index predicting a 9.2% increase in medication adherence [95% CI 3.2 – 15.1]). Given that better medication adherence has been associated with optimal health and treatment outcomes (Musiime et al., 2011; Sethi et al., 2003), this study's results support the hypothesis that, in addition to other mechanisms, individual consistency in utilization of HIV care services may result in the same, feasibly through its association with improved medication adherence.

The secondary finding that longer duration on treatment was significantly associated with better medication adherence (since an additional year on treatment was associated with a 3.2% [95% CI 2.3 – 4.1] increase in medication adherence) lends support to the contention that better engagement in HIV care is prognostic of favorable treatment outcomes. This is because longer exposure to HIV care services (with frequent visits) allows for more contact time with medication adherence and health-status monitoring services, which in turn, by encouraging lifestyle, behavioral and other changes, possibly result in improved medicine use and the consequent optimal health outcomes.

The social status indicators were, except for individual income, not independently associated with medication adherence. This is in contrast with studies that have found the converse (Nemes, Carvalho, & Souza, 2004). One reason may be the use of variance analysis with covariates in this study which improves the statistical power of the study as opposed to probability-based analyses. Other than that, the population studied is rural or semi-urban with high poverty levels therefore income generation should understandably occupy a significant amount of an individual's time resulting in relatively inconsistent use of HIV care services.

A notable strength of this study is the use of “kept-appointments” in-lieu of “missed-visits” as part of the engagement measure, which is the typical case (Mugavero et al., 2009; Traeger, O’Cleirigh, Skeer, Mayer, & Safren, 2012; Zhang et al., 2012). There are a number of advantages of assessing engagement in HIV care through “kept-appointments” and the index used in this study. For one, incorporating re-engagement (that is, technical therapy stoppage and subsequent re-initiation) as part of the variable defining engagement, this study was able to statistically harness the theoretical progression from poor attendance to eventual defaulting in a single measure. And by using institutional definitions of “kept-appointments” and re-engagement, the results have a practical application in the study setting and other similar sites. Additionally, since the purpose of retention in HIV care is to maximize socio-clinical contact between patients and the health system while minimizing the likelihood of therapy termination, it eases interpretability and is asymptotically representative of WHO’s definition of adherence (World Health Organization, 2003), to think of patient engagement as the extent to which an individual succeeds in keeping scheduled clinic appointments.

One of the limitations of this study is the use of a limited set of proxy variables for significant psycho-social determinants of medication adherence and engagement in HIV care e.g. psychological status (Badiee et al., 2012), other depression symptoms (Waldrup-Valverde, Guo, Ownby, Rodriguez, & Jones, 2013) and social support . This is because they may potentially explain the contrarian socio-economic findings presented in the results since psychological status, personal preferences and other factors that may enable or impede the patient-provider relationship may act in one way or more to influence an individual’s ability to continue and stay in care.

Another limitation is the cross-sectional design of the study, especially given the dynamic nature of engagement, and the possible time dependent characteristic of serial adherence measures. While causal relationships are not statistically expected from study

designs such as this, the results presented herein open opportunities for further research. For instance a qualitative inquiry on how engagement in HIV care responds to individual and group relationships with HIV care providers, should enrich the study's contention that positive health outcomes from better engagement may accrue from contact that intervenes in poor adherence situations.

Conclusion

The results suggest that PLHIV who are sub-optimally engaged in care, may be at a greater risk of poor medication adherence, and the health consequences that may result from that.

For HIV program managers and policy makers, this study's results provide an epidemiologic context for current and future efforts intended to improve patient-provider engagement in HIV management. By instituting such measures as personal reminders (through technologies such as the now ubiquitous and tested mobile telephony in Kenya (Odeny et al., 2012)), socio-economic incentives (e.g. expanding the food-for-prescription program in Kenya (NACC & NASCOP, 2012)) and psycho-social support groups, all aimed at raising the average population retention rate in HIV care, this study shows the feasibility of improved treatment outcomes in PLHIV with better medication adherence as a putative intermediary.

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Tables

Table I: Demographic, medication adherence and HIV care engagement data for 392 patients receiving HIV care at Nyeri PGH as of January 2013 with gender stratification.

Variable	n	Mean ^a (F-test p-value)				Gender ^b (n)		
		Adherence (mean %, SD)		Engagement index (mean %, SD)		M	F	χ^2 p-value
All	392	84.3 (11.3)	-	47.2 (27.7)		122	270	-
<i>Socio-demographic factors</i>								
Marital status								
Never married	63	85.7 (10.3)		52.5 (29.2)		15	48	
Married	166	83.4 (11.5)	NS	46.1 (27.1)	NS	64	102	<0.05
Previously married	163	84.5 (11.6)		46.4 (27.7)		43	120	
Monthly income (KES) ^c								
<5,000	194	86.4 (9.6)		46.0 (27.8)		49	145	
≥5,000 to <10,000	119	82.3 (11.4)	<0.05	48.4 (26.3)	NS	38	81	<0.05
≥10,000	79	82.1 (14.0)		48.5 (29.5)		35	44	
Religion								
Non-Christian	58	87.1 (9.8)		40.7 (25.6)		24	34	
Catholic	138	84.3 (11.4)	NS	48.7 (27.6)	NS	51	145	NS
Protestant	196	83.4 (11.6)		48.1 (28.2)		47	91	
Occupation								
Seeking or student	76	82.7 (12.0)		50.7 (27.2)		26	50	
Employed	197	84.4 (11.8)	NS	47.4 (28.2)	NS	84	113	<0.05
Homemaker	119	85.0 (10.0)		44.6 (27.1)		12	107	
Highest education level								
Primary or lower	192	85.6 (9.8)		48.7 (28.3)		55	137	NS
Higher	200	83.0 (12.5)	<0.05	45.8 (27.1)	NS	67	133	NS
Gender								
Male	122	85.1 (12.1)	NS	44.9 (26.9)	NS	122	0	-
Female	270	83.9 (11.0)		48.3 (28.0)		0	270	
Age ^d			<0.05		NS	43.0	40.7	<0.05
<i>Pre- and in-treatment health-status factors</i>								
Acute illness symptoms								
None	183	83.5 (11.9)	NS	46.7 (27.3)	NS	67	116	<0.05
At least one	209	84.9 (10.8)		47.7 (28.1)		55	154	
Chronic co-morbidity								
None	277	83.6 (12.0)	NS	49.5 (28.2)	<0.05	95	182	<0.05
At least one	115	85.8 (9.7)		41.8 (25.7)		27	88	
WHO stage								
1 or 2	218	82.8 (11.8)	<0.05	52.2 (29.6)	<0.05	58	160	<0.05
3 or 4	174	86.1 (10.5)		41.0 (23.8)		64	110	
<i>Treatment related factors</i>								
Duration of ART ^d			<0.05		<0.05	4.7	4.2	<0.05
Therapy changes								
None	102	77.1 (13.2)	<0.05	72.4 (24.7)	<0.05	23	79	<0.05
At least one	290	86.8 (9.4)		38.4 (22.8)		99	191	
Adverse drug reactions ^d			<0.05		NS	1.8	1.7	NS

^a – Mean and standard deviation

^b – Gender: M=male, F=female

^c – Individual monthly income. Kenya Shillings (USD 1 ≈ KES 84.85 as of 2013-04-07)

^d – Continuous or discrete variable (mean in gender column; gender association determined with T-test; F-test on medication adherence and engagement index decays to a linear regression problem)

NS – Not statistically significant at 95% CI

Bold – Statistically significant at 95% CI

Table II: Stepwise ANCOVA models for ART medication adherence and its predictors for the 392 patients sampled from those receiving HIV care at Nyeri PGH as of January 2013.

Variable	100·β ^a (95% CI)		
	Step 1	Step 2	Step 3
<i>Socio-demographic factors</i>			
Marital status	-1.1 (-3.2 – 1.1)	-1.0 (-3.1 – 1.1)	-1.2 (-3.1 – 0.8)
Never married	Ref.	Ref.	Ref.
Married	-3.2 (-7.7 – 1.3)	-3.1 (-7.6 – 1.3)	-2.1 (-6.1 – 2.0)
Previously married	-2.8 (-7.3 – 1.7)	-2.6 (-7.1 – 1.8)	-2.7 (-6.8 – 1.4)
Monthly income	-3.4 (-5.5 – 1.4)	-3.3 (-5.3 – -1.3)	-2.1 (-3.9 – -0.3)
<5,000	Ref.	Ref.	Ref.
≥5,000 to <10,000	-4.6 (-8.2 – -1.1)	-4.4 (-8.0 – -0.9)	-1.9 (-5.2 – 1.3)
≥10,000	-6.6 (-10.7 – -2.5)	-6.5 (-10.6 – -2.4)	-4.8 (-8.6 – -1.1)
Religion	-2.2 (-4.2 – -0.1)	-2.1 (-4.2 – 0.0)	-1.3 (-3.2 – 0.6)
Non-Christian	Ref.	Ref.	Ref.
Catholic	-4.0 (-8.6 – 0.6)	-4.0 (-8.6 – 0.6)	-2.6 (-6.7 – 1.6)
Protestant	-5.1 (-9.6 – -0.6)	-5.0 (-9.5 – -0.5)	-3.3 (-7.4 – 0.8)
Occupation	1.4 (-0.9 – 3.7)	1.2 (-1.1 – 3.5)	0.9 (-1.2 – 2.9)
Seeking or student	Ref.	Ref.	Ref.
Employed	3.3 (-0.9 – 7.5)	3.1 (-1.2 – 7.3)	3.5 (-0.3 – 7.3)
Homemaker	3.3 (-1.3 – 7.9)	2.9 (-1.7 – 7.5)	2.4 (-1.8 – 6.6)
Highest education	-1.6 (-4.8 – 1.6)	-1.2 (-4.4 – 2.0)	-2.0 (-4.8 – 0.9)
Primary or lower	Ref.	Ref.	Ref.
Sec. or higher	-1.7 (-4.9 – 1.5)	-1.3 (-4.4 – 1.9)	-2.1 (-5.0 – 0.8)
Gender	-1.5 (-4.9 – 1.9)	-1.2 (-4.7 – 2.2)	0.3 (-2.8 – 3.4)
Male	Ref.	Ref.	Ref.
Female	-1.4 (-4.9 – 2.1)	-1.2 (-4.7 – 2.4)	0.6 (-2.6 – 3.8)
Age	0.3 (0.1 – 0.5)	0.2 (0.0 – 0.4)	0.1 (0.0 – 0.3)
<i>Pre- and in-treatment health-status factors</i>			
Acute illness		0.5 (-2.6 – 3.6)	0.7 (-2.1 – 3.5)
None		Ref.	Ref.
At least one		0.6 (-2.5 – 3.7)	0.9 (-1.9 – 3.7)
Chronic illness		1.5 (-1.9 – 5.0)	-1.8 (-5.0 – 1.4)
None		Ref.	Ref.
At least one		1.6 (-1.8 – 5.1)	-1.6 (-4.8 – 1.6)
WHO stage		3.6 (0.6 – 6.6)	-0.5 (-3.4 – 2.3)
1 or 2		Ref.	Ref.
3 or 4		3.5 (0.5 – 6.5)	-0.7 (-3.6 – 2.2)
<i>Treatment related factors</i>			
Duration of ART			3.2 (2.3 – 4.1)
Therapy changes			3.7 (-1.0 – 8.4)
None			Ref.
At least one			3.5 (-1.2 – 8.2)
Engagement			9.2 (3.2 – 15.1)
Adverse drug reactions			-0.1 (-0.7 – 0.4)
ΔR ² _{adj}		0.9%	18.0%
F-test [Pr(>F)]	<0.05	<0.05	<0.05

^a – Interpreted as a percentage-change in magnitude of medication adherence.

Ref. – Reference category of multinomial variable.

Bold – Statistically significant at 95% CI