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Relationships among Adherence and Physical and Mental Health among Women Living with HIV in Rural India

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Abstract

We conducted a cross-sectional examination of the physical and psychological factors related to ART adherence among a sample of 400 women living with HIV/AIDS (WLH/A) in rural India. Interviewer-administered measures assessed adherence, internalized stigma, depressive symptoms, quality of life (QOL), food insecurity, health history and sociodemographic information. CD4 counts were measured using blood collected at screening. Findings revealed that adherence to ART was generally low, with 94% of women taking 50% or less of prescribed medication in past month. Multivariate analyses showed a non-linear association between numbers of self-reported Opportunistic Infections (OIs) in past six months (p=0.016) and adherence, with adherence decreasing with each additional OI for 0–5 OIs. For those reporting more than 5 OIs, the association reversed direction, with increasing OIs beyond 5 associated with greater adherence.

Keywords

Women; AIDS; opportunistic infections; India

INTRODUCTION

India is estimated to have the third largest number of persons infected with Human Immunodeficiency Virus (HIV) in the world(1). As in many other Low and Middle Income Countries (LMIC), the incidence of HIV infection in India suggests that female sex workers,

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Informed Consent: All participants were provided informed consent prior to the conduct of research procedures

truck drivers, migrant workers, men who have sex with men, and injection drug users have been disproportionately affected[2–6]. In India, 39% of HIV-infected people are women; with over 90% infected via their partner[7].

Adherence to combination antiretroviral therapy (ART) is lifesaving for all persons living with HIV/AIDS (PLHIV). Benefits of ART adherence have included decreased HIV symptomatology and enhanced quality of life[8]. Further, the literature suggests physiologic benefits of ART adherence include suppression of viral load, prevention of vertical HIV transmission, reduction in HIV-related morbidity, preservation of immunologic function, and enhanced survival[9]. However, these positive results only occur when adherence to ART protocol is strictly observed.

Barriers of Adherence to ART Adherence in India

In a qualitative study of facilitators of ART adherence among 60 HIV positive men and women in Chennai, India, data suggest that better overall health and weight gain facilitate ART adherence[10]. Yet, consistent with the global literature, HIV-positive persons from India who were suboptimally adherent reported that barriers to ART adherence included side effects of ART medications, psychological distress, lack of a daily routine, and alcohol use[11–16]. Research also demonstrated that adherence rates often declined with length of time on ART, both in India[14,15] and globally[17–19], even when ART was provided at no cost.

Compared to urban women, rural women living with HIV/AIDS (WLH/A) in India face even greater challenges when trying to adhere to treatment regimens[20]. One challenge, food insecurity, defined as having limited or uncertain availability of nutritionally adequate and safe foods[21], contributes to HIV treatment interruptions and acts as a barrier to ART adherence[22]. Additional reasons for treatment interruptions, often experienced by rural WLH/A, previous research has shown, include financial limitations, pharmacy stock-outs, and transportation problems[23,24], the latter of which can be exacerbated during the monsoon season[25]. In contrast, regular clinic attendance was associated with long term stable adherence rates[26].

Globally, HIV/AIDS stigma has also been found to influence adherence to ART, health care decision-making, and caregiver attitudes[27,28]. In India's society, being HIV-positive is often perceived as a disgrace to the family, and results in disruption in family relationships[29,30]. Disclosure at the worksite likewise results in loss of jobs and vital income[31]. Further, among health care workers in India, stigmatizing behavior against HIV-positive individuals is high. For example, in a study of over 1,000 health care workers, 89% of physicians, 88% of nurses and 73% of ward staff reported they would discriminate against PLHIV in situations that involved a high likelihood of bodily fluid exposure[32]. As a result, it is not unusual for PLHIV to choose not to disclose their status[33] or delay seeking treatment fearing discrimination from health care providers[34].

Depression has also been shown to be associated with non-adherence to ART[35–37]. Among HIV-positive patients in urban Pune and New Delhi, India, severe depression placed patients at four times greater risk for non-adherence than minimal depression[38]. Further, in an ART

adherence study conducted in Chandigarh, India, non-depressed persons showed greater improvement in ART adherence compared to those who were depressed[39].

Food Insecurity (FI) is yet another factor which can impact ART adherence, both directly[40,41] as well as indirectly through poor mental health such as depression[42,43]. In a two-year longitudinal study of 372 adults on ART in Bengaluru, India, investigators revealed that over one-fifth reported moderate to severe FI[44]. Especially among men, FI was linked to depression, while moderate to severe FI was linked to poor quality of life (QOL) among both men and women. As depression and QOL are areas in which interventions can be targeted in hopes of improving ART adherence, such variables are important to assess.

Facilitators of Adherence to ART Adherence in India

Strong social support network has been shown to be effective in reducing barriers to adherence resulting from such difficulties as traveling to receive health care or financially paying for health care services[45,46]. Likewise, Kumarasamy et al.[10] reported that over half (58%) of participants undergoing ART treatment disclosed that family members encouraged adherence by providing medication reminders, giving medications directly, and offering financial assistance. In fact, about one third (32%) of participants indicated that spouses helped them to adhere to ART treatment by providing reminders and giving them the medication[10].

Another significant support to improve adherence particularly in rural areas is the engagement of lay health providers or village women who act as community health outreach workers. In a pilot randomized trial comparing engagement of trained lay health providers, or Asha (Accredited Social Health Activists) vs. enhanced usual care (n = 68), lay health providers greatly enhanced adherence of rural women by promoting education, transportation, and social support[47]. In fact at six-month follow-up, the women who were supported by the nurse- and physician-guided Asha, significantly improved ART adherence[47], and reduced their depressive symptoms compared to the women in usual care[48]. Further, women receiving the Asha intervention reported significant reductions in perceived community stigma and avoidant coping, such as withdrawing from other people or denying the need for healthcare[49].

In summary, a number of factors have been noted to serve as challenges to and facilitators of ART adherence among PLHIV in India. This study is designed to further our knowledge of the specific facilitators and barriers to rural WLH/A; a population who experiences challenging issues with ART adherence. As suboptimal ART adherence can lead to treatment failure and emergent strains due to HIV drug resistance[50], greater understanding of correlates to adherence among rural women living with HIV infection is warranted[16,51]. Such information can assist health care providers and policy makers to increase support for this vulnerable population.

METHODS

Design

A cross-sectional assessment was conducted with baseline data from 400 WLH/A in Southern India, following enrollment into a 2×2 factorial clinical trial designed to assess the impact of Asha support with and without food supplementation and nutrition education on adherence to ART and improved health outcomes for the women and one target child. In this study we assessed select sociodemographic, physical, psychological, and social correlates of adherence to ART of HIV-affected women. Human Subjects Protection Committee clearances were obtained both in the US and in India.

Setting and Sample

In the rural district of Nellore, in the state of Andhra Pradesh, four high HIV prevalence sites were selected and randomly assigned to one of the four conditions of the trial. Each site had one Community Health Center and one to two Primary Care Centers (PHC) from where the women were recruited. Each PHC was affiliated with about 10 villages, and served about 30,000 villagers. Inclusion criteria included women living with HIV/AIDS who were: a) 18–50 years of age; b) receiving ART for at least three months; validated by an ART card given by the district hospital to all ART patients; c) CD4 levels > 100 cells/mm^3; and 4) reported having a child aged 3–8 living with them.

Screening and Enrollment Procedures

The recruiter informed potential participants about the study by means of approved flyers posted in the selected PHCs. Those who were interested approached the research staff stationed at the PHC for further information. After the study was presented by the staff, screening informed consent was discussed and signed by the WLH/A. Immediately thereafter, the research staff administered a brief two-minute screener assessing eligibility status. Among those eligible, HIV/CD4 testing was conducted (HIV testing not needed if ART card presented) by a trained phlebotomist. HIV-certified research staff provided HIV pretest and posttest counseling and HIV test results to the women within 3 days. After informed consent for trial participation was provided by the WLH/A, an appointment was made for the interviewer to conduct the baseline survey in a face-to-face interview. Responses were recorded via a tablet PC.

Instruments

The majority of the instruments have been previously tested with WLH/A in India[47,48] or with both male and female PLHIV in urban India[15,52].

Adherence to ART

Self-reported adherence was assessed via a Visual Analogue Scale (VAS)[53], to assess percent of pills taken in the past month. This measure has been validated with Indian patients[54] and found to predict viral load in multiple studies when dichotomized at 95% [15]. In the present study, the distribution did not warrant such a cut-off, and the results were analyzed continuously.

Sociodemographic information

Demographic information obtained included age, education, marital status, religion, and number of children.

Health History

Access to care was assessed by asking respondents how often they sought health care in the past 6 months. Respondents were further asked when they were first diagnosed with HIV, which HIV medications they were taking, as well as number of pills per day. Their self-reported ART regimen was verified via their prescription slip or medication blister pack. Pill burden was subsequently dichotomized as 1–2 vs. >2. All participants received their medication at government-run ART clinics per the guidelines of the Indian National AIDS Control Organization (NACO).

We also assessed which of 8 opportunistic infections (OI) respondents had experienced in the past 6 months and summed the number of OIs they endorsed. A similar procedure was used with a list of 18 potential ART symptoms and side effects.

CD4 Cell Count

CD4 counts were assessed during screening. Blood samples were sent to the district hospital lab for CD4 count determination by flow cytometry. The absolute numbers of CD4 cells were obtained by multiplying percent CD4 from flow cytometry by total white blood cell count (determined by Act Diff Coulter). Women with CD4 cells less than 100 cells/mm^3 were excluded from the study, since the Indian investigator was concerned about physical stamina to participate in the study. CD4 cells were categorized for our analyses using a cut-off of 350 cells/mm^3 as per Indian guidelines to determine eligibility for ART.

Psychological Variables

Internalized Stigma, also referred to as “self-stigma,” was assessed by a 10-item scale which assessed the extent to which respondents believed that, as HIV-infected people, they deserved to be stigmatized[52,55]. Each item had a 4-point response format varying from 0 (not at all) to 3 (a great deal). A sample item is, “How much do you feel guilty about having AIDS?” In our prior studies with PLHIV in India, the reliability for the scale was .83[52,55].

Depression was measured with the Center for Epidemiologic Depression Scale (CES-D), short version[56], a 10-item scale that measured frequency and severity of depressive symptoms on a 0 to 3 scale. The CES-D has well-established reliability and validity[56] including in India[57]. In the current study, internal consistency for this scale was alpha = . 43. Scores were summed, resulting in a range from 0–30, with higher scores for greater depressive symptoms. The scale was dichotomized at the suggested cut point of ≥10[58] to indicate a need for psychiatric evaluation.

Quality of life (QOL) was measured with 11 items from the short form of the Quality of Life Enjoyment and Satisfaction Questionnaire[59]. On a scale from 0 “very unsatisfied” to 3 “very satisfied”, participants indicated their satisfaction with their health, finances, etc. during the past week. An overall score was created as the mean of all items (alpha = .79).

Social Support

We asked how many friends and relatives the respondent had with whom she felt at ease and could talk about what was on her mind. Given the large amount of 0 responses, we dichotomized the measure as any (1) vs. none (0).

Food insecurity

Food insecurity was measured via the HFIAS (Household Food Insecurity Access Scale)[60], consisting of 9 items that assessed the frequency in the past 4 weeks of worrying about not having enough food (1 item), perceived insufficient quality (3 items) and quantity of food (5 items), due to a lack of resources. Response options ranged from 0 “Never” to 3 “Often”, and were summed over all items.

Data Analysis

All analyses were performed on the baseline data of a sample of women enrolled in an ongoing intervention trial and hence were cross-sectional in nature. Categorical variables were described with frequencies and percentages. Continuous variables were examined for normality, and means and standard deviations, if appropriate, were reported. The distribution of the VAS adherence outcome measure was located nearly entirely in the lower half of the 0 – 100% range, with an interquartile range from 20 to 40% adherence. The highest level of adherence reported was 90%, but by only 4 out of 400 participants. Hence, the often used dichotomization in optimal vs. suboptimal adherence, which typically uses a cut-off of 90 or 95% was not possible here. We chose instead to treat the adherence variable as continuous, given that it was reasonably normally distributed.

Bivariate associations of adherence with dichotomous variables were assessed via t-test, and with continuous variables via Pearson correlation coefficient. Those variables bivariately associated with adherence at $p<0.10$ were subsequently included in a multiple linear regression model. Nonlinearity of the relation between adherence and continuous predictors was examined via the addition of a quadratic term, which we maintained in the model if significant. Results were examined for multicollinearity, heteroskedasticity and influential outliers and none were found to be problematic. Due to differences between sites in mean and distribution of several of the variables in the regression, we did use cluster-robust standard errors. All significance tests were two-sided and $p<.05$ was considered significant. Analyses were performed in Stata14.

RESULTS

Sociodemographic Factors

The 400 women in our sample were on average 33.8 years old (SD = 6.6) and had a mean of 1.9 children (SD = 0.8) (Table I). Education was quite low with over half (51%) receiving no education. Less than one in five (13%) reported receiving 10 or more years of education. The majority were Hindu (73%) or Christian (19%). In terms of marital status, over half (53%) were widowed, and 39% were married; the other 8% were divorced or separated.

Health History

The mean (SD) number of OIs in the past six months was 4.7 (1.3), and the mean (SD) number of side effects was 13.3 (1.8). Symptoms experienced in the past six months by over 95% of the women included fever, lack of energy/fatigue, tingling numbness of hands or feet, diarrhea, nausea/upset stomach, and changes in body shape due to weight changes (Table I). Virtually all (95%) of the women reported they had accessed care six to ten times in the past six months.

Participants were first diagnosed with HIV between 3 months and 19 years ago with a mean (SD) time of 51 (35.3) months since their HIV diagnosis. All but three women were prescribed an NNRTI-based regimen. The most common (51%) one was TDF (Tenofovir) + 3TC (Lamivudine) + EFV (Efavirenz), with another 31% taking AZT (Zidovudine) + 3TC + NVP (Nevirapine). All were prescribed consistent with NACO guidelines. Eighty-one percent of the women had to take 2 pills/day. Adherence to ART at baseline was generally low. Ninety-four percent of women reported taking 50% or less of their prescribed medication in the past month, and none reported adherence levels over 90%. Mean adherence level in the past month was 30% (SD = 14.4). More than half of the participants (59%) had CD4 cell counts over 350 cells/mm^3.

Psychological Variables

The women reported a mean Internalized Stigma Scale score of 2.29 (SD = 0.30) out of a maximum of 3. Twenty-five percent of the women attained a score of 10 or higher on the CES-D, suggesting at least “moderate” depression, with observed scores ranging from 4 to 19. Quality of Life on average was low: mean QOL score was 0.38 on a 0–3 scale (SD = 0.30; observed range 0–3).

Perception of food insecurity was high, with the mean score of 21 on a 0–27 scale (SD = 4.0; observed range 4–27).

Social support was reported to be low among the women. Over half (57%) reported having no friends or family whom they could confide in, while slightly over one-third (36%) stated that they only had one such friend or family member. Only 8% reported having two or more supporters.

Bivariate Associations with Adherence

As shown in Table II, the only categorical variable significantly bivariately associated with our continuous measure of percent adherence over the past month was social support. Specifically, women who reported not having any close friends or relatives reported significantly lower mean adherence than those with close friends/relatives (29% vs. 32% adherence, respectively, $p<.05$). Formerly married (mean = 31%) and Hindu participants (mean = 31%) were marginally more adherent, on average, than currently married (mean = 29%, $p = .06$) and non-Hindu women (mean = 28%, $p = .07$), respectively. Education, ART pill burden, or depression showed no (marginally) significant association with percent adherence in the past month.

Significant negative correlations (Table III) were found between adherence and food insecurity (r = −.16, p = .001), internalized stigma (r = −.17, p < .001), number of OIs (r = −.17, p < .001), and number of side effects in the past six months (r = −.19, p < .001). In addition, the greater the time since HIV diagnosis, the greater the adherence to ART (r = 0.10, p = .037).

Multivariate Results

Table IV shows the results of the regression model in which all the variables with a bivariate significance level of p <.10 were entered simultaneously. Holding all else constant, greater adherence in the past month was significantly associated with having lived with the diagnosis of HIV for a longer period of time (b = 2.47, p = .033), and marginally associated with no longer being married (b = 4.38, p = .055), and being Hindu (b = 2.83, p = 0.050). The strongest association of percent adherence in the past month was found to be with number of OIs in the past 6 months, for which both the linear and the quadratic term had a significant regression coefficient (b = −6.34, p =.007; b = 0.61, p = .016, respectively). Thus, with each additional OI, adherence initially decreased, but for those reporting more than 5 OIs, the association reversed direction, and an increasing number of OIs was associated with increasing adherence levels, controlling for all other variables in the model.

Discussion

The findings of this study revealed that only 6% of this sample of rural WLH/A in Andhra Pradesh, India, reported greater than 50% adherence to ART. More striking, only 1% reported optimal adherence to prescribed ART at 90% or greater. These findings raise serious questions about challenges experienced by these rural women in retrieving and taking their ART medication as compared with other populations of PLHIV living in India and other LMIC.

Bivariate findings revealed a significant positive relationship of ART adherence with social support and length of time since HIV diagnosis. On the other hand, negative associations were found between ART adherence and food insecurity, internalized stigma, number of OIs, and number of side effects in the last six months. Multivariate analyses revealed only length of time since HIV diagnosis and number of OIs remained significantly related to adherence when controlling for the other variables and demographics.

Interestingly, we found that depending on the number of OIs experienced, its relation to adherence to ART varied. When the number of OIs that a woman experienced rose between 0 and 5, on average percent adherence decreased. However, when more than 5 OIs were experienced, average adherence was seen to increase again. It is conceivable that initial OIs experienced by the women may have served as a deterrent to taking their medication, and to traveling long distances monthly to get their medication[46]. However, as their health worsened beyond a certain point (as evidenced by an increasing number of OIs), the women may have attempted in greater earnest to obtain and take their ART medication.

Nevertheless, the changes in adherence found to be statistically significantly associated with length of time since diagnosis and number of OIs, need to be interpreted while keeping in

mind that the range of adherence we observed was nearly entirely situated on the lower half of the full potential 0–100 % range. The extremely low level of adherence found in this sample of 400 rural WLH/A is lower even than that reported in some of the poorest countries in the world, including Togo, Tanzania and Nepal[61–63]. In India, baseline studies of ART adherence have revealed higher adherence levels, ranging from 41% to 97% of participants reporting taking at least 95% of their medication[25,64]. In our previous study conducted among women living with HIV in a limited area of rural Andhra Pradesh[65], mean adherence at baseline was found to be 42%.

Low adherence in this sample place these women at high risk for poor health outcomes, by leading to a reduction in CD4 cells, thereby increasing their vulnerability to OIs[66], and depending on amount of drug taken, suboptimal adherence may also lead to drug resistance[67]. While the self-report level of adherence is strikingly low in this sample, other concomitant findings appear consistent with these low levels of adherence.

For example, on average, the women reported nearly five OIs in the past six months, and all of them reported experiencing side effects which may have well decreased their desire to continue taking the ART medication initially. Further, CD4 cells were on average low (nearly 60% of the sample had less than 350 cells/mm^3). These findings, which were also corroborated by the fact that all women presented with OIs at the onset of the study, demonstrate that the women indeed were experiencing serious illness. These findings are supportive and consistent with low ART adherence.

Social support has been found to encourage earlier diagnosis, successful linkage to care, and higher adherence to ART in previous studies[68]. Similarly, in our previous study of 68 rural Indian WLH/A[65], social support was also found to be positively related to ART adherence. While we found bivariate support for a positive relation between ART adherence and social support in this study, this relation did not remain significant while controlling for the other variables in our multivariate model.

Time since diagnosis was a significant correlate of ART adherence in the past month in our study. While immediate initiation of ART post diagnosis is ideal, many factors affect ART start and attrition rates post diagnosis in resource-poor communities, such as minimal CD4 testing, extended wait times at clinics, drug side effect concerns and low confidence in the effectiveness of the therapies to manage the disease[46,69]. Given that a quarter of those diagnosed with HIV in low- and middle-income settings present late, with CD4 counts of less than 100 cells/mm3 compared to those in high income countries (CD4 count range 200–300 cell/mm3), the high mortality rates observed during the first months of ART may worsen this lack of confidence[69].

Findings of our study also revealed that on average, the women experienced a high number of OIs, high FI and internalized stigma, and low QOL and social support. The ongoing intervention study from which these baseline data were taken, considers these factors and is designed to not only support the rural women in seeking regular health care and decrease current and future number of OIs, but also to improve these other factors such as FI, low social support, low QOL and depression. Clearly OIs can be quite debilitating, which along

with internalized stigma and low social support, can easily result in women feeling depressed, and not wanting to reach out for help.

The limitations of this study include the fact that only one percent of the participants report adherence levels that would typically be classified as optimal. Thus, we lack the statistical power to identify correlates of optimal vs sub-optimal adherence. The analyses were also cross-sectional, hence we cannot comment on the direction of the associations found, and the potential causal mechanism we suggest to explain the observed relation between number of OIs and adherence. Furthermore, our eligibility criteria restricting the study population to women with children living in rural South India, may limit our capacity to generalize these findings to a fuller range of Indian populations living with HIV, including those living in Northern India or in urban settings.

CONCLUSIONS

The implications of these findings are that there is an urgent need to develop, implement and test interventions that can help improve ART adherence as well as the physical and emotional health of these women. Clearly these women have a very low QOL, live with internalized HIV stigma, have very few friends, and are doing poorly clinically. Support in improving adherence is an important piece of improving the overall health of these women. However, support is also needed to help in other areas of their lives, such as improving FI, and QOL in general.

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References

1. Joint United Nations Programme on HIV/AIDS. The GAP Report. Geneva: 2014.
2. Dandona L, Dandona R, Gutierrez JP, Kumar GA, McPherson S, Bertozzi SM. Sex behaviour of men who have sex with men and risk of HIV in Andhra Pradesh, India. Aids. Mar 24; 2005 19(6): 611–619. [PubMed: 15802980]
3. Dandona R, Dandona L, Gutierrez JP, et al. High risk of HIV in non-brothel based female sex workers in India. BMC Public Health. 2005; 5:87. [PubMed: 16111497]
4. Dandona R, Dandona L, Kumar GA, Gutierrez JP, McPherson S, Bertozzi SM. HIV testing among female sex workers in Andhra Pradesh, India. Aids. Nov 18; 2005 19(17):2033–2036. [PubMed: 16260912]
5. Brahmam GN, Kodavalla V, Rajkumar H, et al. Sexual practices, HIV and sexually transmitted infections among self-identified men who have sex with men in four high HIV prevalence states of India. Aids. Dec; 2008 22(Suppl 5):S45–57.
6. Talukdar A, Khandokar MR, Bandopadhyay SK, Detels R. Risk of HIV infection but not other sexually transmitted diseases is lower among homeless Muslim men in Kolkata. Aids. Oct 18; 2007 21(16):2231–2235. [PubMed: 18090051]
7. Marfatia YS, Naik E, Singhal P, Naswa S. Profile of HIV seroconcordant/discordant couples a clinic based study at Vadodara, India. Indian J Sex Transm Dis. Jan; 2013 34(1):5–9. [PubMed: 23919047]
8. Savini CJ, James CW, DiGuglielmo DJ. Survey of patient and clinician attitudes on adherence in a rural HIV clinic. J Assoc Nurses AIDS Care. May-Jun;2003 14(3):72–75. [PubMed: 12800813]

9. Moir S, Buckner CM, Ho J, et al. B cells in early and chronic HIV infection: evidence for preservation of immune function associated with early initiation of antiretroviral therapy. Blood. Dec 16; 2010 116(25):5571–5579. [PubMed: 20837780]
10. Kumarasamy N, Safren SA, Raminani SR, et al. Barriers and facilitators to antiretroviral medication adherence among patients with HIV in Chennai, India: a qualitative study. AIDS Patient Care STDS. Aug; 2005 19(8):526–537. [PubMed: 16124847]
11. Batavia AS, Balaji K, Houle E, et al. Adherence to antiretroviral therapy in patients participating in a graduated cost recovery program at an HIV care center in South India. AIDS Behav. Aug; 2010 14(4):794–798. [PubMed: 20052529]
12. Venkatesh KK, Srikrishnan AK, Mayer KH, et al. Predictors of nonadherence to highly active antiretroviral therapy among HIV-infected South Indians in clinical care: Implications for developing adherence interventions in resource-limited settings. AIDS Patient Care STDS. Dec; 2010 24(12):795–803. [PubMed: 21091232]
13. Kleinman NJ, Manhart LE, Mohanraj R, et al. Antiretroviral therapy adherence measurement in non-clinical settings in South India. AIDS Care. 2015; 27(2):248–254. [PubMed: 25119585]
14. Ekstrand ML, Chandy S, Heylen E, Steward W, Singh G. Developing useful highly active antiretroviral therapy adherence measures for India: the Prerana study. J Acquir Immune Defic Syndr. Mar; 2010 53(3):415–416. [PubMed: 20190588]
15. Ekstrand ML, Shet A, Chandy S, et al. Suboptimal adherence associated with virological failure and resistance mutations to first-line highly active antiretroviral therapy (HAART) in Bangalore, India. Int Health. Mar 1; 2011 3(1):27–34. [PubMed: 21516199]
16. Vallabhaneni S, Chandy S, Heylen E, Ekstrand M. Reasons for and correlates of antiretroviral treatment interruptions in a cohort of patients from public and private clinics in southern India. AIDS Care. 2012; 24(6):687–694. [PubMed: 22107044]
17. Mannheimer S, Friedland G, Matts J, Child C, Chesney M. The consistency of adherence to antiretroviral therapy predicts biologic outcomes for human immunodeficiency virus-infected persons in clinical trials. Clin Infect Dis. Apr 15; 2002 34(8):1115–1121. [PubMed: 11915001]
18. Byakika-Tusiime J, Crane J, Oyugi JH, et al. Longitudinal antiretroviral adherence in HIV+ Ugandan parents and their children initiating HAART in the MTCT-Plus family treatment model: role of depression in declining adherence over time. AIDS Behav. Jun; 2009 13(Suppl 1):82–91. [PubMed: 19301113]
19. Horne R, Cooper V, Gellaitry G, Date HL, Fisher M. Patients' perceptions of highly active antiretroviral therapy in relation to treatment uptake and adherence: the utility of the necessity-concerns framework. J Acquir Immune Defic Syndr. Jul 1; 2007 45(3):334–341. [PubMed: 17514019]
20. Sinha G, Peters DH, Bollinger RC. Strategies for gender-equitable HIV services in rural India. Health Policy Plan. May; 2009 24(3):197–208. [PubMed: 19244284]
21. Anderson SA. Core indicators of nutritional state for difficult-to-sample populations. J Nutr. 1990; 120(11):1559–1599. [PubMed: 2243305]
22. Hardon AP, Akurut D, Comoro C, et al. Hunger, waiting time and transport costs: time to confront challenges to ART adherence in Africa. AIDS Care. May; 2007 19(5):658–665. [PubMed: 17505927]
23. Pence BW. The impact of mental health and traumatic life experiences on antiretroviral treatment outcomes for people living with HIV/AIDS. J Antimicrob Chemother. Apr; 2009 63(4):636–640. [PubMed: 19153077]
24. Sabin LL, Desilva MB, Hamer DH, et al. Barriers to adherence to antiretroviral medications among patients living with HIV in southern China: a qualitative study. AIDS Care. Nov; 2008 20(10): 1242–1250. [PubMed: 19012083]
25. Joshi B, Chauhan S, Pasi A, et al. Level of suboptimal adherence to first line antiretroviral treatment & its determinants among HIV positive people in India. Indian J Med Res. Jul; 2014 140(1):84–95. [PubMed: 25222782]
26. Cauldbeck MB, O'Connor C, O'Connor MB, et al. Adherence to anti-retroviral therapy among HIV patients in Bangalore, India. AIDS Res Ther. 2009; 6:7. [PubMed: 19400929]

27. Messer LC, Pence BW, Whetten K, et al. Prevalence and predictors of HIV-related stigma among institutional- and community-based caregivers of orphans and vulnerable children living in five less-wealthy countries. BMC Public Health. 2010; 10:504. [PubMed: 20723246]
28. Spaar A, Graber C, Dabis F, et al. Prioritising prevention strategies for patients in antiretroviral treatment programmes in resource-limited settings. AIDS Care. Jun; 2010 22(6):775–783. [PubMed: 20473792]
29. Norman A, Chopra M, Kadiyala S. Factors related to HIV disclosure in 2 South African communities. Am J Public Health. Oct; 2007 97(10):1775–1781. [PubMed: 17761582]
30. Patel SV, Patel SN, Baxi RK, et al. HIV serostatus disclosure: experiences and perceptions of people living with HIV/AIDS and their service providers in Gujarat, India. Industrial Psych J. Jul; 2012 21(2):130–136.
31. Sarna A, Sebastian M, Bachani D, Sogarwal R, Battala M. Pretreatment loss-to-follow-up after HIV diagnosis from 27 counseling and testing centers across India: findings from a cohort study. J Int Assoc Provid AIDS Care. May-Jun;2014 13(3):223–231. [PubMed: 23418205]
32. Ekstrand ML, Ramakrishna J, Bharat S, Heylen E. Prevalence and drivers of HIV stigma among health providers in urban India: implications for interventions. J Int AIDS Soc. 2013; 16(3 Suppl 2):18717. [PubMed: 24242265]
33. Madi D, Gupta P, Achappa B, et al. HIV status disclosure among people living with HIV in the era of combination antiretroviral therapy (cART). J Clin Diagn Res: JCDR. Aug.2015 Oc14-16.9(8)
34. Steward WT, Bharat S, Ramakrishna J, Heylen E, Ekstrand ML. Stigma is associated with delays in seeking care among HIV-Infected people in India. J Int Assoc Phys AIDS Care (Chicago, Ill: 2002). Jan 26.2012
35. Dworkin MS, Douglas GW, Sabitha Rani GP, Chakraborty A. Adherence to highly active antiretroviral therapy in Hyderabad, India: Barriers, facilitators and identification of target groups. Int J STD & AIDS. Mar; 2016 27(3):186–195. [PubMed: 25801316]
36. Harries AD, Nyangulu DS, Hargreaves NJ, Kaluwa O, Salaniponi FM. Preventing antiretroviral anarchy in sub-Saharan Africa. Lancet. Aug 4; 2001 358(9279):410–414. [PubMed: 11502341]
37. Nemes MI, Carvalho HB, Souza MF. Antiretroviral therapy adherence in Brazil. Aids. Jun; 2004 18(Suppl 3):S15–20. [PubMed: 15322479]
38. Sarna A, Pujari S, Sengar AK, Garg R, Gupta I, Dam J. Adherence to antiretroviral therapy & its determinants amongst HIV patients in India. Indian J Med Res. Jan; 2008 127(1):28–36. [PubMed: 18316850]
39. Cook JA, Burke-Miller JK, Grey DD, et al. Do HIV-positive women receive depression treatment that meets best practice guidelines? AIDS Behav. Jun; 2014 18(6):1094–1102. [PubMed: 24402689]
40. Tsai AC, Hung KJ, Weiser SD. Is food insecurity associated with HIV risk? Cross-sectional evidence from sexually active women in Brazil. PLoS Med. 2012; 9(4):e1001203. [PubMed: 22505852]
41. Weiser SD, Palar K, Frongillo EA, et al. Longitudinal assessment of associations between food insecurity, antiretroviral adherence and HIV treatment outcomes in rural Uganda. Aids. Jan 2; 2014 28(1):115–120. [PubMed: 23939234]
42. Tsai AC, Bangsberg DR, Frongillo EA, et al. Food insecurity, depression and the modifying role of social support among people living with HIV/AIDS in rural Uganda. Soc Sci Med. Jun; 2012 74(12):2012–2019. [PubMed: 22513248]
43. Vogenthaler NS, Hadley C, Rodriguez AE, Valverde EE, del Rio C, Metsch LR. Depressive symptoms and food insufficiency among HIV-infected crack users in Atlanta and Miami. AIDS Behav. Oct; 2011 15(7):1520–1526. [PubMed: 20099017]
44. Heylen E, Panicker ST, Chandy S, Steward WT, Ekstrand ML. Food insecurity and its relation to psychological well-being among south indian people living with HIV. AIDS Behav. Aug; 2015 19(8):1548–1558. [PubMed: 25488171]
45. Nyamathi AM, William RR, Ganguly KK, et al. Perceptions of women living with AIDS in rural India related to the engagement of HIV-Trained accredited social health activists for care and support. J HIV AIDS Soc Serv. Oct; 2010 9(4):385–404. [PubMed: 21331322]

46. Nyamathi AM, Sinha S, Ganguly KK, et al. Challenges experienced by rural women in India living with AIDS and implications for the delivery of HIV/AIDS care. Health Care Women Int. Apr; 2011 32(4):300–313. [PubMed: 21409663]
47. Nyamathi A, Hanson AY, Salem BE, et al. Impact of a rural village women (Asha) intervention on adherence to antiretroviral therapy in southern India. Nurs Res. Sep-Oct;2012 61(5):353–362. [PubMed: 22872107]
48. Nyamathi A, Salem B, Meyer V, Ganguly K, Sinha S, Ramakrishnan P. Impact of an ASHA intervention on depressive symptoms among rural women living with AIDS in India: Comparison of the ASHA life and usual care program. AIDS Educ Prev. 2012; 24(3):280–293. [PubMed: 22676466]
49. Nyamathi A, Ekstrand M, Salem BE, Sinha S, Ganguly KK, Leake B. Impact of Asha intervention on stigma among rural Indian women with AIDS. West J Nurs Res. Aug; 2013 35(7):867–883. [PubMed: 23539322]
50. Nischal KC, Khopkar U, Saple DG. Improving adherence to antiretroviral therapy. Indian J Dermatol, Venereol Leprol. Sep-Oct;2005 71(5):316–320. [PubMed: 16394454]
51. Langebeek N, Gisolf EH, Reiss P, et al. Predictors and correlates of adherence to combination antiretroviral therapy (ART) for chronic HIV infection: a meta-analysis. BMC Med. 2014; 12:142. [PubMed: 25145556]
52. Steward WT, Chandy S, Singh G, et al. Depression is not an inevitable outcome of disclosure avoidance: HIV stigma and mental health in a cohort of HIV-infected individuals from Southern India. Psychol Health Med. Jan; 2011 16(1):74–85. [PubMed: 21218366]
53. Giordano TP, Guzman D, Clark R, Charlebois ED, Bangsberg DR. Measuring adherence to antiretroviral therapy in a diverse population using a visual analogue scale. HIV Clin Trials. Mar-Apr;2004 5(2):74–79. [PubMed: 15116282]
54. Ekstrand, M., Solomon, D., Gopalkrishnan, S., Krishnan, AK., Kumarasamy, N. Alcohol use, partner violence and sexual risk among south India female sex workers: implications for interventions. 2nd International Conference on Alcohol and HIV; New Delhi. 2010;
55. Ekstrand ML, Bharat S, Ramakrishna J, Heylen E. Blame, symbolic stigma and HIV misconceptions are associated with support for coercive measures in urban India. AIDS Behav. Feb 3; 2012 16(3):700–710. [PubMed: 21290175]
56. Radloff L. The CES-D scale: A self-report depression scale for research in the general population. Applied Psych Meas. 1977; 1:385–401.
57. Nyamathi A, Heravian A, Zolt-Gilburne J, et al. Correlates of depression among rural women living with AIDS in Southern India. Issues Ment Health Nurs. 2011; 32(6):385–391. [PubMed: 21692578]
58. Zhang W, O'Brien N, Forrest JI, et al. Validating a shortened depression scale (10 item CES-D) among HIV-positive people in British Columbia, Canada. PloS one. 2012; 7(7):e40793. [PubMed: 22829885]
59. Endicott J, Nee J, Harrison W, Blumenthal R. Quality of life enjoyment and satisfaction questionnaire: a new measure. Psychopharmacol Bull. 1993; 29(2):321–326. [PubMed: 8290681]
60. Coates, J., Swindale, A., Bilinsky, P. Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide. Vol. 3. Washington, D.C: 2007.
61. Potchoo Y, Tchamdja K, Balogou A, Pitche VP, Guissou IP, Kassang EK. Knowledge and adherence to antiretroviral therapy among adult people living with HIV/AIDS treated in the health care centers of the association "Espoir Vie Togo" in Togo, West Africa. BMC Clin Pharmacol. 2010; 10:11. [PubMed: 20849595]
62. Lyimo RA, Stutterheim SE, Hospers HJ, de Glee T, van der Ven A, de Bruin M. Stigma, disclosure, coping, and medication adherence among people living with HIV/AIDS in Northern Tanzania. AIDS Patient Care STDS. Feb; 2014 28(2):98–105. [PubMed: 24517541]
63. Bam K, Rajbhandari RM, Karmacharya DB, Dixit SM. Strengthening adherence to Anti Retroviral Therapy (ART) monitoring and support: operation research to identify barriers and facilitators in Nepal. BMC Health Serv Res. 2015; 15:188. [PubMed: 25939593]
64. Shet A, Decosta A, Heylen E, Shastri S, Chandy S, Ekstrand M. High rates of adherence and treatment success in a public and public-private HIV clinic in India: potential benefits of

standardized national care delivery systems. BMC Health Serv Res. 2011; 11:277. [PubMed: 22004573]

65. Nyamathi A, Salem B, Ernst E, Keenan C, Suresh P, Sinha S, Ganguly K, Ramakrishnan P, Liu Y. Correlates of adherence among rural indian women living with HIV/AIDS. J HIV/AIDS Soc Serv. 2012; 11:327–345.
66. Chow JY, Alsan M, Armstrong W, del Rio C, Marconi VC. Risk factors for AIDS-defining illnesses among a population of poorly adherent people living with HIV/AIDS in Atlanta, Georgia. AIDS Care. 2015; 27(7):844–848. [PubMed: 25660100]
67. Pinoges L, Schramm B, Poulet E, et al. Risk factors and mortality associated with resistance to first-line antiretroviral therapy: Multicentric cross-sectional and longitudinal analyses. J Acquir Immune Defic Syndr. Apr 15; 2015 68(5):527–535. [PubMed: 25585301]
68. Kelly JD, Hartman C, Graham J, Kallen MA, Giordano TP. Social support as a predictor of early diagnosis, linkage, retention, and adherence to HIV care: results from the steps study. J Assoc Nurses AIDS Care. Sep-Oct;2014 25(5):405–413. [PubMed: 24508174]
69. World Health Organization. Health Sector Response to HIV in the South-East Asia Region. New Delhi, India: 2013.

Table I

Sample Characteristics (N=400)

Measure	Mean	(SD)
Age	33.77	(6.57)
Number of Children	1.88	(0.80)
Quality of Life	0.38	(0.30)
Internalized Stigma	2.29	(0.30)
Percent adherence past month	30.2	(14.4)
Food Insecurity	21.0	(3.96)
Number of side effects past 6 mo	13.26	(1.75)
Number of OI * past 6 mo	4.69	(1.29)
Time since HIV diagnosis, months	50.9	(35.3)
	N	%
Education		
None	204	51.0
<5 years	66	16.5
5–9 years	78	19.5
≥10 years	52	13.0
Marital Status		
Married	157	39.3
Widowed	211	52.8
Divorced/Separated	32	8.0
Religion		
Hindu	290	72.5
Christian	76	19.0
Muslim	34	8.5
Depressive Symptoms: CES-D short score ≥10	102	25.5
ART Regimen[a]		
AZT[b] + 3TC[c] + NVP[d]	124	31.0
AZT + 3TC + EFV[e]	11	2.8
TDF[f] + 3TC + NVP	59	14.8
TDF + 3TC + EFV	203	50.7
TDF + 3TC + Ritonavir + Atazanavir or Lopinavir	3	0.8
CD4 count > 350 cells/mm^3	235	58.8
Pill burden		
1 pill	2	0.5
2 pills	324	81.0
≥3 pills	74	18.5
Percent adherence to ART past month (VAS)		
0–25%	173	43.3

Measure	Mean	(SD)
26–50%	203	50.8
51–75%	15	3.8
75–100%	9	2.3
Number of close friends/family		
0	227	56.8
1	143	35.8
≥2	30	7.5
Access to Care: # Visits in Past Six Months		
0–5	12	3.0
6–10	380	95.0
≥11	8	2.0
Symptoms in the Past		.
Six Months endorsed by >50% of participants		
Fever	399	99.8
No energy/fatigue	397	99.3
Tingling numbness in hands/feet	389	97.3
Diarrhea	387	96.8
Nausea/Upset Stomach	385	96.3
Change body shape due to weight gain or loss	383	95.8
Dizziness	379	94.8
Vomiting	377	94.3
Skin Rashes	366	91.5
Stomach pain, cramps	356	89.0
Frequent headaches	356	89.0
Depression, mood swings	335	83.8
Trouble sleeping	303	75.8

[a] ART: Anti-retroviral therapy

[b] AZT (Zidovudine)

[c] 3TC (Lamivudine)

[d] NVP (Nevirapine)

[e] EFV (Efavirenz)

[f] TDF (Tenofovir)

[*] Opportunistic infection

Table II

Association of categorical Variables with Adherence (VAS) Past Month

	N	Mean Adherence	(SD)	t-test (df=398)	p-value
Marital status				1.89	0.060
Currently married	157	28.54	(14.47)		
Formerly married	243	31.32	(14.34)		
Religion				−1.83	0.069
Hindu	290	31.03	(14.51)		
Other	110	28.09	(14.09)		
Education				−0.80	0.423
No (none)	204	29.66	(14.35)		
Yes	196	30.82	(14.54)		
Pill burden				−0.92	0.357
1–2pills/day	326	29.91	(14.15)		
>2 pills/day	74	31.62	(15.68)		
Depressed (CES-D ≥10)				−1.37	0.172
No	298	29.65	(13.98)		
Yes	102	31.91	(15.66)		
Any close friends/relatives				−1.97	0.049
No	227	28.99	(12.76)		
Yes	173	31.85	(16.28)		

Table III

Pearson correlations between VAS (% adherence past month) and continuous variables

	VAS	Food In-security	Intern. Stigma	# OIs	# Side Effects	Mo. since diagnosis
VAS, Percent adherence	1.00					
Food Insecurity	−.162**	1.00				
Internalized Stigma	−.173***	.398***	1.00			
# OIs (past 6 mo)	−.172***	.424***	.336***	1.00		
# Side Effects (past 6 mo).	−.186***	.290***	.260***	.354***	1.00	
Months since diagnosis	.104*	−.157**	.043	−.021	.016	1.00
Age	.093†	.075	.041	.063	.034	.121*

† p<.10;

* p<.05;

** p<0.01;

*** p<.001

Table IV

Multiple linear regression model for adherence past month

	Regression coefficient	Robust Standard Error[a]	t-statistic	p-value
Married	−4.38	1.44	−3.05	0.055
Hindu	2.83	0.89	3.17	0.050
Age	0.17	0.07	2.32	0.103
Any close friends/relatives	3.08	2.13	1.45	0.244
Number of OIs past 6 mo	−6.34	0.94	−6.77	0.007
Number of OIs squared	0.61	0.12	4.94	0.016
Internalized stigma	−4.80	4.70	−1.02	0.382
Number of Side effects past 6 mo	−0.86	0.45	−1.93	0.149
Food insecurity	−0.05	0.20	−0.26	0.813
Time since Diagnosis., ln transformed	2.47	0.66	3.74	0.033

[a]Standard errors are cluster-robust with regard to site