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Psychosocial Characteristics Associated with Both Antiretroviral Therapy Adherence and Risk Behaviors in Women Living with HIV

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Abstract

The purpose of this study was to identify key psychosocial characteristics of HIV-infected women who exhibit different levels of both ART adherence and risk behaviors. We analyzed baseline data from 193 predominately African American HIV-infected women participating in a behavioral clinical trial. Women were categorized into high/low groups based on levels of adherence and risky behaviors. There was a significant interaction effect for internal motivation for adherence. Women at high risk for poor health and transmitting HIV (low adherence/high risk group) had the lowest levels of internal motivation and also reported more difficult life circumstances. Gender roles, caretaking and reliance on men for economic and other support may promote external versus internal motivation as well as riskier behaviors in this group. The highest levels of internal motivation were found in those with High Adherence/High Risk behaviors. This group was highly knowledgeable about HIV and had the lowest VL. Compared to others, this group seems to tolerate risky behaviors given their high level of adherence. Adherence and risk reduction behaviors are key to individual and public health. Motivation and risk compensation should be addressed when providing interventions to women living with HIV.

Keywords

HIV/AIDS; ART; Antiretroviral medication adherence; Sexual risk behavior; Motivation; Difficult life circumstances; Self-efficacy

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Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Introduction

Advances in HIV/AIDS research have revealed that undetectable viral loads are associated with lower risks of HIV transmission through horizontal and vertical routes [1–4]. As such, treatment to maintain viral loads at an undetectable level has become a primary focus for preventing transmission. Despite the increasing effectiveness of new antiretroviral drugs, relatively high levels of adherence to antiretroviral therapy (ART) are still needed to achieve this result [5, 6]. Sexual risk reduction behavior also continues to be critically important to reduce the spread of the virus—particularly in HIV-positive individuals with sub-optimal ART adherence, which can lead to the development of resistant virus and increased viral loads [7–9]. Without risk reduction behaviors, HIV and resistant strains can be spread. Safer sex is also necessary to prevent other sexually transmitted infections (STIs) that can heighten the risk of HIV transmission. Effective prevention of HIV, therefore, depends on both high levels of ART adherence and low levels of risky behaviors.

The literature suggests that ART adherence and sexual risk behavior are related behaviors. Among a diverse sample of 2849 HIV-infected adults, Remien et al. [10] found that individuals were 46 % more likely to report either ART non-adherence or higher sexual risk (unprotected vaginal or anal sex with partners of HIV-negative or unknown status) when the other behavior was present. Similarly, Kalichman and Rompa [11] showed that HIV-infected adults who were non-adherent to ART had greater rates of unprotected vaginal sex, more sex partners, and fewer protected sexual behaviors than those who were adherent to ART. In a national study of HIV-infected women, Wilson et al. [12] concluded that women who reported less than 95 % adherence to ART had twice the risk of inconsistent condom use as those with higher adherence levels. Finally, in examining the inverse relationship, Diamond et al. [13] found that ART adherence (≥95 %) and viral load suppression were associated with fewer episodes of unprotected vaginal or anal sex. All of the above studies were limited by cross-sectional research methods and self-reported measures of adherence. Nonetheless, these findings reveal that ART adherence and practice of risk-reduction behaviors appear to be directly associated.

Compared to men, women may experience more difficulty adhering to ART and practicing safer sex. Although Remien et al. [10] could not clearly identify a participant group that was both non-adherent and high risk based on psychosocial or demographic characteristics, their study did reveal that being female was associated with high-risk sexual behavior. Peretti-Watel et al. [14] found that heterosexual women were more likely to report unprotected vaginal or anal sex with an HIV-negative or HIV-unknown partner, as compared to heterosexual and homosexual men. Dependence on male partners for condom use is one gender-related factor that may lower sexual risk reduction behavior in women. Another factor is depression, which may be higher in HIV-infected women than in HIV-infected men and appears to diminish adherence to ART [15] and risk reduction behavior, as well as increase substance use [12, 16–22]. Fear of stigma and negative consequences resulting from disclosure of HIV-positive status to a male partner may also complicate ART adherence and sexual risk behavior [23–25], especially if a woman depends on this partner for economic or other support. Finally, lower levels of adherence may result from the caretaker role (i.e., caring for children, sick and elderly adults, housework, etc.) that many women assume [15].

The complex pathways by which these and other gender-related factors may shape women's vulnerability to HIV exposure are comprehensively explored in Wingood and DiClemente's adapted model of the theory of gender and power [26]. A recent evaluation of a conceptual model based on this adapted theory supports that both direct and indirect associations exist between specific psychosocial and behavioral risk factors and use of condoms among young African American women [27].

Previous research describes other psychosocial characteristics of HIV-infected adults who adhere or do not adhere to ART and who practice or do not practice safer sex, although rarely have these behaviors been examined together using the same study sample. Besides depression and fear of stigma, characteristics associated with non-adherence or high-risk behavior among women include perceived stress, stressful life events, and binge drinking [28–30]. Characteristics associated with ART adherence include social support and disclosure of HIV-positive status to close others [31–34]. The trait of conscientiousness has also been correlated with higher adherence and lower viral loads in adults living with HIV [35]. Despite these important knowledge gains, we could find no studies that have successfully identified any psychosocial characteristics of HIV-infected women who simultaneously practice or do not practice ART adherence and risk reduction behaviors.

The purpose of this study was to identify key psychosocial and behavioral characteristics of HIV-infected women who exhibit different levels of both ART adherence and risk behavior. In a previous study of 193 HIV-infected women, we found that those who were classified as being both low adherence and high risk-taking had the lowest mean CD4 counts and highest (detectable) mean viral loads, as compared to women in the other three categories examined (i.e., low adherence/low risk, high adherence/ low risk, and high adherence/high risk) [36]. Building on this work, we sought to provide a more complete understanding of the psychosocial characteristics of women who practice high and low levels of adherence and risk behaviors. This study was exploratory and relevant theoretical/conceptual applications were dependent on the results and will be discussed later in the paper. Better knowledge regarding psychosocial factors associated with these two behavioral outcomes may lead to the design of targeted interventions that improve the long-term health of women living with HIV and prevent HIV transmission.

Methods

Study Setting and Participants

This analysis used baseline data from the Keeping Healthy and Active with Risk Reduction and Medication Adherence (KHARMA) Project, a randomized clinical trial to test the efficacy of a nurse-led, motivational group intervention compared to a health promotion group on the outcomes of ART adherence and use of risk reduction behaviors. Conducted between January 2005 and January 2008, the goal of the trial was to increase levels of both behaviors in a sample of HIV-infected women. The study enrolled women from five sites in a large urban southeastern city. After completing a baseline assessment, women were randomized to an intervention or control group and participated in an 8-week intervention. Follow-up assessments were conducted at 2 weeks and at 3, 6, and 9 months post intervention. All assessments were conducted using audio computer assisted interview

(ACASI) on laptops with touch screens. This study was approved by Emory University's Institutional Review Board and by the research committees at the recruitment sites when required. The recruitment sites, eligibility criteria, intervention, control group, and study procedures are described in previous analyses [36, 37].

For the current analysis, we examined which psychosocial characteristics contributed to ART adherence, risky behaviors, and categories of combined ART adherence and risk behaviors. We used data from the 193 of 207 enrolled participants with available adherence data from electronic drug monitoring caps at study baseline. Only baseline data were used in this analysis.

Measures

Outcome: Adherence and Risk Categories—For the primary outcome, women were categorized into groups based on levels of adherence and risky behaviors. High adherence was based on the cut-point of ≥90 versus <90 % on the "Percent of Doses Taken" from the Medication Event Monitoring System (MEMS) Track Caps report. Ninety percent was chosen as a conservative cut point due to the wide range of adherence needed for the different types of antiretroviral medications (nucleosides, nonnucleosides, boosted protease inhibitors) the participants were taking during the study time period (2005–2008). MEMS caps data were downloaded monthly during the course of the study.

Risk behavior was measured with high-low split on an 11-item risk behavior index developed from items contained in two instruments used to measure risky behavior in the KHARMA Project [36, 37]. All items were chosen because they are commonly cited outcomes in risky behavior research [38–40]. Sex during menses was included due to the high risk related to contact with menstrual blood. Similar to Susser and colleagues [38, 39], we coded each risk behavior on a 3-point scale (0 = no risk, 1 = moderate risk, 2 = high risk) relative to the level of risk associated with the behavior and scores were summed. Risk items included: sexual activity in the last 3 months (no = 0; yes = 1); number of partners (none = 0; 1 = 1; ≥2 = 2); HIV status of partners (positive = 0; negative or unknown = 1); vaginal sex in past 3 months (no = 0; yes =1); anal sex in past 3 months (no = 0; yes = 2); frequency of sex during menstrual period (never/don't have periods = 0; almost never/sometimes = 1; every month = 2); frequency of protection/condom use in past 3 months (always = 0; sometimes to never = 2); decided not to have sex at some time in past 3 months because no protection was available or you or your partner didn't want to use it (yes = 0; no = 1); in past 3 months frequency of getting high or drinking before sex (never = 0; occasionally = 1; often/ all the time = 2); in past 3 months did substance use make it difficult to practice safer sex (never = 0; occasionally = 1; often/all the time = 2); in the past 3 months using a needle to inject drugs (no = 0; yes = 2). Scores ranged from 0 to 18 where higher scores indicated higher risk behaviors. Scores of ≤3 were classified as low risk and ≥4 were classified as high risk. Given that the final 11 risk items were either dichotomously coded (0 or 1) or ordinally scaled (0, 1 or 2), internal consistency and reliability (alpha) were computed based on polychoric correlations using the psych package (v 1.5.6) [41] in R (v.3.2.2) [42]. The 11 items from which the risk index was computed had good internal consistency and reliability (alpha = 0.89). Women were categorized into four groups based on adherence and risk

scores: high adherence/low risk (HALR), high adherence/high risk (HAHR), low adherence/low risk (LALR), and low adherence/high risk (LAHR).

Predictor Variables—We included measures of established variables that have been previously associated with ART adherence and/or risk behaviors (i.e., HIV knowledge, depression, stigma, social support, self-efficacy, outcome expectancy, and disclosure), as well as several exploratory variables (difficult life circumstances, spirituality, religious coping, satisfaction with one's health care, self-management, health care decision-making, and motivation). Variables specifically related to ART adherence and risk behavior were each measured in terms of three dimensions: *motivation, self-efficacy, and outcome expectancy*. We measured motivation for ART adherence and safer sex with two adapted instruments that asked about reasons for taking HIV medications and reasons for practicing safer sex [43, 44]. Both instruments had subscales that measured internal or autonomous motivation ("I take my HIV medicine because it is an important choice I really want to make" "I practice safer sex because it is an important choice I really want to make.") and external or controlled motivation ("I take my HIV medicine because I want others to approve of me" "I practice safer sex because I want others to approve of me.") and were theoretically based in self-determination theory (SDT) [45, 46]. Those with maximum scores possible on each instrument were reported as having 'perfect' scores for that scale. The scales used for self-efficacy (self-confidence to perform the behavior under specific circumstances), and outcome expectancy (attitudes concerning expectations if one performs the behavior) were based on Bandura's Social Cognitive Theory [47, 48]. All instruments (including subscales) and corresponding reliability statistics are presented in Table 1.

Analysis

All data were reviewed for completeness and normal distribution assumptions. Some outcome measures which were highly skewed or had obvious ceiling effects with 30–50 % or more of the subjects obtaining the same maximum score were dichotomized either using a median split (≤median versus >median) or using the maximum value (<max versus =max). These are noted in Table 1 when applicable. High and low adherence was defined as subjects having taken 90 % or more of their prescribed doses or below 90 % respectively. High risk was defined as having a score of 4 or higher and low risk as having a score of 3 or lower on the risk index. Two-way (2-x-2) factorial ANOVA (analysis of variance) for the continuous outcomes and generalized linear models (GLM) with binomial responses and logit-link functions (i.e. logistic regression) for the dichotomous outcomes were performed to first test the adherence-by-risk interaction effects and then the main effects of adherence and risk when no interaction effect was detected. The goal of the analyses presented here is to highlight the potential significant differences and characteristics of participants at four levels of combined adherence and risk. Thus, all models are presented as stand-alone tests—no global multivariate ANOVA model was defined a priori—no Type I error adjustment applied. Reliability statistics were computed for all measurement questionnaires and instruments including their subscales using Cronbach's alpha or the Kuder Richardson-20 (KR-20) for the dichotomously scored HIV-Knowledge test. All statistical analyses were performed using SPSS v.21 (IBM Corporation © 2012).

Results

The KHARMA Project enrolled and randomized 207 participants. The 193 participants in this analysis did not significantly differ from the original 207 on age, race, depression, years with HIV, and years on ART. The characteristics of the participants included in this analysis are presented in Table 2. Ninety-four percent were African American with an average age of 43 years. As can be seen from employment and income, the sample as a whole is socially and materially disadvantaged. On average, women had been HIV positive for almost 10 years and on ART for 6 years. Over half were sexually active in the past 3 months. Median adherence, based on the MEMS data percent of prescribed doses taken, was 89 % of doses taken per month and median VL (log) was in the undetectable range based on criteria at the time of study recruitment of <2.6 log (corresponding to <400 copies per ml). Table 2 also gives the proportion of women for each ART adherence, risk and combined adherence/risk category. Over half the participants had low ART adherence and almost 38 % practiced high-risk behaviors. Of the four adherence/risk categories, the largest proportion of women fell into the high adherence/low risk (HALR) group and the second largest proportion was women who had low adherence/low risk (LALR). It is also worth noting that adherence and risk are associated. Relative to risk level, there were 45 % low-risk participants with low adherence compared to 66 % of high-risk participants with low adherence ($\chi^2(1) = 7.845$, $p = 0.005$).

Combined Levels of Adherence and Risk Interaction Effects

Following the procedures recommended by Dawson and Trapp, we first report the significant interaction effects and then report significant main effects for variables when no interaction effects are noted [62]. The results of comparisons by levels of adherence and risk are provided in Table 3. Significant interaction effects were seen for perfect internal adherence motivation. When we closely examined the drivers of these interaction results by adherence/risk category, the HAHR group had the largest proportion (56.0 %) of those with perfect internal motivation for adherence and the LAHR had the lowest (27.1.0 %) (Fig. 1).

Main Effects for Adherence and Risk Behaviors

Main effects associated with *adherence* are also shown in Table 3. Significant effects were found for HIV self-management, medication self-efficacy, external motivation for adherence, and prevention efficacy of condom use. We examined the scores of high and low adherers (data not shown in table) and note that high adherers had higher self-management (74.4, SD = 8.2, vs 69.4, SD = 11.4) and adherence self-efficacy (169.5, SD = 17.6, vs 159.5, SD = 26.0) scores. A larger proportion of high adherers had the strongest beliefs in the effectiveness of condoms to prevent HIV transmission (59.3 vs 41.6 %). Also, high adherers had lower mean scores of external motivation for adherence (50.0, SD = 21.3, vs 57.2, SD = 20.2).

Related to *risk*, there were significant main effects identified for several variables: physical hedonism for condom use, positive and negative self-evaluation for condom use, internal motivation for safer sex and disclosure to the main partner (see Table 3). We examined the mean scores of low and high risk women on these variables (data not shown in table). Low-

risk women perceived less reduction in pleasure related to condom use ("sex doesn't feel as good when you use a condom") as evidenced by mean subscale scores of 18.3 (SD = 4.1) vs 16.9 (SD = 3.8). A greater proportion of the low-risk women had higher levels of negative self-evaluation outcomes for condom use (disappointed in self if didn't use a condom; 70.3 vs 45.1 %) and positive self-evaluation (pleased with self for using condom; 57.3 vs 39.7 %). A larger proportion of low-risk women also had maximum scores on internal motivation for safer sex (53.8 vs 31.9 %). Surprisingly a significantly smaller proportion of low-risk women reported disclosing their HIV status to their main partner (60.0 vs 78.1 %).

Two variables, HIV knowledge and difficult life circumstances differed significantly by levels of adherence and risk respectively. Of interest is that significantly higher scores on HIV knowledge were seen in high risk takers compared to low (77.4, SD = 14.3, vs 71.1, SD = 15.9) and as one might expect in high adherers (75.1, SD = 4.7, vs 72.0, SD = 16.2) compared to low. A review of the data (not shown) by adherence/risk category revealed that those in the HAHR group had the highest mean knowledge scores (81.7, SD = 9.3) compared to the LALR group (69.1, SD = 16.0) which had the lowest scores.

We also found that significantly higher levels of difficult life circumstances were reported in both the low adherers (9.2, SD = 4.5, vs 7.5, SD = 4.4) and those with more risky behaviors (9.8, SD = 5.0, vs 7.5, SD = 4.0) (data not shown). When we examined this by adherence/risk category (data not shown) the HALR group reported the fewest (7.0, SD = 3.9) and the LAHR group reported the highest (10.4, SD = 4.7) occurrence of difficult circumstances.

Discussion

We sought to examine the characteristics associated with various levels of both adherence and risky behaviors in a group of highly vulnerable women (impoverished, HIV-infected, and predominantly African American) participating in a large behavioral clinical trial. Women who had low levels of adherence and reported high risk behaviors (the LAHR group) had the significantly lowest levels of internal motivation for adherence. This group was also plagued by difficult life situations.

An unexpected finding was that the HAHR group—and not the HALR group as expected—had the highest levels of internal motivation for adherence. They also had the highest HIV knowledge scores. This group also had the lowest median viral load log (1.81) putting them at lower, but not impossible risk for HIV transmission. Given the findings, the HAHR group may have consciously chosen to maintain high levels of ART adherence that resulted in low viral load, perhaps to compensate in some way for their high risk behaviors. In other words, the women may have practiced high adherence in an effort to compensate for not wanting to use condoms. The HAHR group may be less risk averse (i.e., more risk tolerant) than the HALR group. Kalichman has noted this phenomenon and describes a pathway that might describe how those highly adherent persons may perceive less infectivity and thus practice riskier behaviors [63].

Women who had low levels of adherence tended to score significantly lower on key characteristics associated with adherence such as HIV self-management, ART adherence

self-efficacy, HIV knowledge, and were more externally motivated (i.e., influenced by others) to adhere. Women with higher risk behaviors also differed significantly from low-risk women on these variables; they also had significantly lower levels of internal motivation for safer sex and, though not statistically significant, higher levels of external motivation for safer sex. High-risk women tended to have more negative attitudes about various aspects of condom use, including a reduction in pleasure associated with condoms, less disappointment in themselves if didn't use a condom, and fewer positive feelings if did use condoms. However, these women also had higher levels of HIV knowledge and disclosed their HIV status to their main partner more often than women practicing low-risk behaviors. The precise cause of this result is unknown, but perhaps it indicates that women in the high-risk category made educated decisions to practice risky behaviors, and/or were responding to demands from their partners (who were aware of their status).

Another interesting finding was the significant association of lower numbers of difficult life circumstances with those who had both better adherence and lower risk behaviors. There have been numerous reports describing particular difficult life circumstances of HIV infected women however, to the best of our knowledge, difficult life circumstances as a quantitative variable has not been examined with respect to adherence or safer sex behaviors in HIV infected women. In other samples, difficult life circumstances have been associated with abortion decision-making [64], poor pregnancy outcomes [65, 66] and negative depression coping in low income African American women [67]. Clinicians who care for HIV infected women and regularly listen to their stories will likely find this result to be understandable.

Surprisingly, depression was not significantly associated with either adherence or risk or adherence/risk group. A recent report found similar results in a diverse sample of men and women [68]. Depression has been consistently associated with poor adherence [15, 20], and in some studies higher risk behaviors among people with or at risk for HIV [69, 70]. One explanation for the non-significant finding in this study could be that depression was a common characteristic of the sample (i.e., a mean CES-D score of 16.4, just above the 16.0 cut point). Notably, the HALR group did have the lowest mean CES-D scores and their LAHR peers had the highest (15.3, SD = 12.6, vs 19.3, SD = 11.7).

Taken together, the findings suggest internal motivation for adherence plays an important role in behaviors associated with both adherence and risk. Also HIV-infected women with characteristics of low intrinsic motivation, low self-management, low self-efficacy, high external motivation, low HIV knowledge, negative attitudes about condoms, and more difficult life circumstances may be more likely to put their own health and/or that of others at risk. Theoretical concepts that might explain these results deserve more consideration. Self-determination theory (SDT) focuses on self-regulation and sources of motivation and may help to explain these motivations [45, 71–73]. SDT argues that conditions supporting individuals' experiences of *autonomy, competence*, and *relatedness* promote high quality forms of intrinsic (internal) motivation that allow for sustained engagement in healthy behavior, including enhanced performance, perseverance, and creativity [73]. Internal or autonomous motivation, that which comes from one's inner self, is driven by an intrinsic desire or value of the importance of a behavior. Whereas externally controlled motivation is

driven by the expectations of others, or externally imposed pressures to partake in the behavior. Relying on external forces for motivation was associated with lower adherence in the LAHR group. Women in the HAHR group exhibited significantly higher levels of intrinsic motivation for adherence, which often stems from the inherent desire to do well in important behaviors. Those with ≥90 % adherence had lower levels of extrinsic motivation, higher levels of HIV self-management, and self-confidence in their ability to adhere (self-efficacy) compared to the low adherers. Self-efficacy has consistently been associated with higher levels of ART adherence.

Ego strength, another concept relevant to our findings and perhaps the inner source of intrinsic motivation, self-efficacy, and effective disease self-management, may also help explain our results. Conceptually, ego strength refers to an individual's inner resource to cope and adapt, to be resilient in the face of adverse/stressful circumstances, to exert self-control and self-regulate, and to make appropriate choices relevant to the self [74]. Ego strength can be "measured" externally based upon one's level of coping and adaptation (low versus high), the degree of self-control and self-regulation one is able to exert under given circumstances or conditions (depleted/decreased versus preserved/increased), and the quality of one's choices (poor versus healthy).

For individuals with low adherence and/or high-risk behaviors, maladaptive coping and behavioral patterns are likely to emerge when ego strength and internal locus of control are diminished. In this case, coping and adaptation skills and mechanisms are more likely to be decreased, the capacity of self-control and self-regulation is more likely to fail, and poorer choices are more likely to be made, ultimately resulting in negative consequences/outcomes (such as poor adherence and engaging in high risk behaviors, and possibly more difficult life circumstances) [54]. Giola et al. [75] found that factors such as low ego strength and poor compulsion control (as well as depression and anxiety) were strongly associated with poor ART adherence. Furthermore, in patients with chronic kidney disease undergoing hemodialysis, Settineri et al. [76] found that the lower presence of assessed "ego strength" was linked to poor adherence with hemodialysis treatments, as well as the worsening of psychiatric symptoms such as demoralization and depressed mood. These authors concluded that ego strength should be increased to promote greater adherence. The maladaptive coping and behavioral patterns displayed in women in our sample with low adherence and/or high risk behaviors are consistent with low ego strength and poor intrinsic control mechanisms. Finally, risk compensation is another important issue that deserves attention and theoretically may explain the riskier behaviors despite high adherence in the high scoring intrinsically motivated HAHR group [77]. Risk compensation theory proposes that persons adjust their behavior based on their perceived level of risk. For example, behaviors that increase risk (such as unsafe sexual practices) may be offset by or compensated through behaviors intended to reduce risk (such as higher levels of ART adherence). In this manner, individuals may self-regulate to maintain a tolerable level of risk [78]. Women in the HAHR group of our study may have made a conscious, internally controlled decision to maintain high adherence (with resultant low viral loads) as a form of HIV prevention and forego other preventive behaviors.

Study Strengths and Weaknesses

The predominately African American sample, though reflective of the HIV epidemic among women in the U.S. South, may not be reflective of other HIV infected women and thus our results may not be generalizable to other non-African American HIV infected women. This study is limited by the potential for social desirability bias in reporting risky behaviors and to ameliorate this factor, we used ACASI to conduct interviews. There is also potential for ambiguity or measurement error in categorizing women as 'high' or 'low' in risk behaviors measured by self-report using the study developed risk index. Scores were visualized to avoid gross misclassification errors. The study is also limited by the cross sectional design and the fact that the original study was not designed and powered to specifically test for differences between participants in terms of their adherence and risk. Rather, the analyses presented here are observational based comparisons across a number of potential characteristics and measures in this population relative to their adherence and risk levels. Additionally, for this secondary data analysis, adherence and risk were significantly associated with each other. To fully explore the interaction effects (moderation effect) of adherence on risk, future studies might stratify for these effects during randomization.

Summary and Conclusion

We conducted a comprehensive assessment of factors related to ART medication adherence and risk behaviors in HIV infected women, both independently and combined. Based on the results presented, a pattern emerges. The women at high risk for poor health and transmitting HIV to others (LAHR) had the lowest levels of intrinsic motivation for adherence and reported more difficult life circumstances. Women's gender roles and frequent social positioning, including caretaking and reliance on men for economic and other support [26] may promote or enhance external versus internal motivation as well as riskier behaviors.

There is also a subgroup of women (HAHR) who are highly internally motivated to adhere, highly knowledgeable about HIV transmission, yet report practicing risky behaviors. Compared to others, this group may be able to tolerate the high level of risk given their high level of adherence. Risk compensation is a persistent complication in HIV prevention and treatment as prevention efforts [77] and could be present in the HAHR group.

SDT offers an explanation for how sociocultural forces can facilitate or undermine one's sense of motivation. SDT has been used to develop a number of interventions that assisted people to adopt healthier behaviors [44, 46, 79, 80] but only recently has it been applied to behaviors involving HIV/AIDS. Ego strength may also represent an important concept that reflects these behaviors. While it may not be possible to change an individual's level of ego strength, it may certainly be possible to modify one's behaviors and actions within the framework of his/her ego strength through modalities such as education, psychosocial support, counseling, psychotherapy, behavioral therapy, and motivational interviewing [75, 76]. Using these modalities to address motivations (i.e., motivational interviewing) as well as risk compensation is also possible. Based on these findings, motivation and ego strength should be emphasized and tested in future research interventions that promote adherence to ART and risk reduction behaviors for HIV infected women. Interventions could be tailored based on motivators (intrinsic vs extrinsic) and levels of key psychosocial variables.

Managing potential risk compensation will also be important. Lastly, the effects of life events and circumstances can't be ignored in this group of very vulnerable women. Interventions that include assistance with coping and social services are needed to help women cope with these significant barriers to adherence and safer behaviors.

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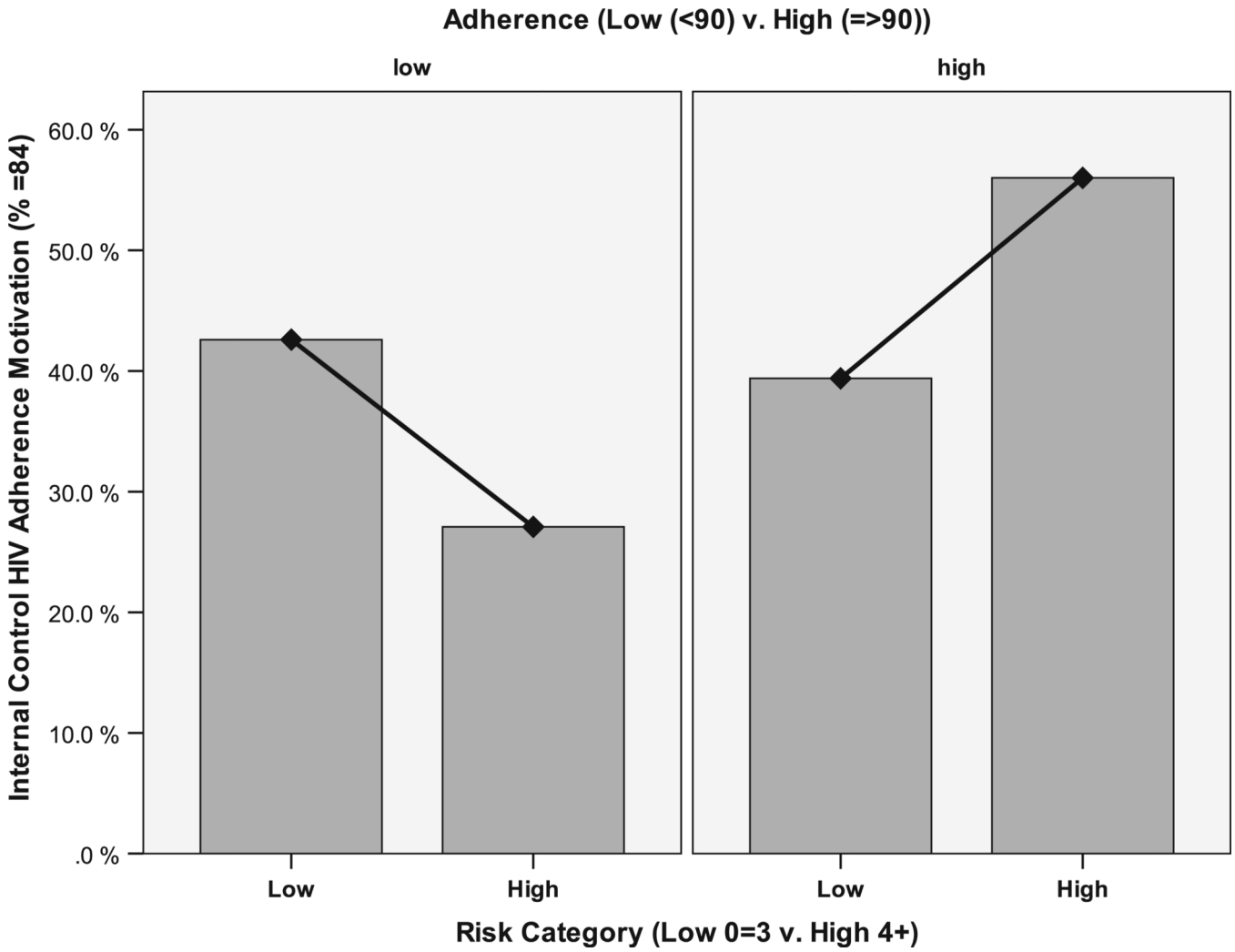

Fig. 1.
Internal HIV adherence motivation (=84 %) by adherence and risk levels (low vs high)

Table 1

Study instruments and measures of reliability and descriptive statistics

	# items	Alpha coefficient	n	Mean (SD) (%)	Median	[Min, max]
HIV Knowledge [49, 50] (% correct out of 45)	45	0.875[a]	193	73.5 (15.6)	75.6	[4.4, 100.0]
CESD depression [51]	20	0.899	193	16.7 (11.8)	13.0	[0, 48.0]
Personal stigma [52]	24	0.869	190	46.0 (10.5)	47.5	[24.0, 76.0]
Spiritual wellbeing (EWB) [53, 54]	10	0.812	188	46.3 (8.2)	46.0	[20.0, 60.0]
Spiritual wellbeing (RWB) [53, 54]	10	0.838	188	51.6 (7.9)	54.0	[22.0, 60.0]
Spiritual wellbeing (SWB) [53, 54]	20	0.885	189	97.4 (15.4)	98.0	[40.0, 120.0]
Difficult life circumstances [55]	33	0.789	192	8.4 (4.5)	8.0	[0.0, 22.0]
PRQ social support [56]	25	0.903	189	134.6 (22.9)	138.0	[45.0, 175.0]
PSQIII total satisfaction [57, 58]	50	0.935	191	193.5 (30.0)	198.0	[87.2, 250.0]
HIV self-management	22	0.809	191	71.8 (10.3)	74.0	[38.0, 88.0]
Brief RCOPE—positive [59, 60] (≤18 vs >18)	7	0.920	191	17.3 (4.2)	19.0	[3.0, 21.0]
(% scored >18)			99	51.8 %		
Brief RCOPE—negative [59, 60] (≤2 vs >2)	7	0.847	180	4.0 (4.5)	3.0	[0.0, 21.0]
(% scored >2)			93	51.7 %		
Condom self-efficacy[b] [47]	34	0.949	154	4.0 (0.7)	4.0	[1.6, 5.0]
HIV medication self efficacy [48]	19	0.860	192	164.2 (22.9)	169.0	[67.0, 190.0]
Outcome expectancy for HIV adherence [48]	22	0.910	192	86.2 (14.0)	86.0	[30.0, 110.0]
Condom outcome expectancy [47]						
Partner reaction	7	0.808	187	26.8 (5.3)	27.0	[11.0, 35.0]
Physical hedonism	5	0.821	192	17.8 (4.1)	18.0	[6.0, 25.0]
Positive self evaluation (≤30 vs >30)	7	0.882	190	29.9 (4.9)	31.0	[11.0, 35.0]
(% scored >30)			96	50.5 %		
Prevention efficacy (<10 vs =10)	2	0.750	192	8.7 (1.8)	9.5	[2.0, 10.0]
(% score =10)			96	50.0 %		
Social approval (≤ 15 vs >15)	4	0.923	173	16.6 (3.6)	16.0	[4.0, 20.0]
(% scored >15)			140	80.9 %		
Negative self evaluation (≤11 vs >11)	3	0.828	189	11.6 (3.0)	12.0	[3.0, 15.0]
(% scored >11)			115	60.8 %		

	# items	Alpha coefficient	n	Mean (SD) (%)	Median	[Min, max]
Multidimensional desire for control [61]						
Internal	7	0.813	190	18.8 (7.7)	19.0	[7.0, 35.0]
External (≤ 24 vs >24)	6	0.813	190	23.6 (6.1)	25.0	[6.0, 30.0]
(% scored >24)			100	52.6 %		
Shared (<20 vs =20)	4	0.873	192	17.9 (3.8)	20.0	[4.0, 20.0]
(% score =20)			110	57.3 %		
Safer sex motivation [43, 44]						
Internal (<91 vs =91)	13	0.860	188	86.1 (8.9)	90.0	[25.0, 91.0]
(% score =91)			86	45.7 %		
External	10	0.901	187	45.3 (17.9)	46.0	[10.0, 70.0]
HIV adherence motivation [43, 44]						
Internal (≤84 vs =84)	12	0.759	193	78.8 (7.5)	82.0	[44.0, 84.0]
(% score =84)			76	39.4 %		
External	13	0.889	193	53.8 (21.0)	55.0	[13.0, 91.0]
HIV status disclosure to main partner						
No, don't know, refused to answer, not applicable or missing[c]			64	(33.2 %)		
Yes			129	(66.8 %)		

Cα is Chronbach's alpha reliability

[a] Cα reported for HIV Knowledge is the Kuder-Richardon-20 (KR-20) statistics since the knowledge items are dichotomously scored (correct/ incorrect)

[b] 39 subjects did not respond completely to the Condom Self-Efficacy instrument

[c] Only 1 subject did not respond to the HIV Status Disclosure question

Table 2

Demographics and sample characteristics (n = 193)

Variable	**n**	**Mean (SD)**
Age	193	43.4 (9.1)
Years HIV+	190	9.6 (6.3)
ARV years	193	6.3 (5.0)
Variable	n	Median (range)
Income	186	$7494 ($0, $126,000)
CD 4 count	138	285.5 (7, 2000)
CD 4 percent	137	17.0 (1.0, 61.3)
Viral load (log10)	148	2.16 (1.7, 5.5)
Risk index	193	2.0 (0, 14)
Percent prescribed doses taken	193	88.9 % (0, 100 %)
CESD	193	13.0 (0, 48)
Variable	n	%
Ethnicity		
Black	181	93.8
White	7	3.6
Other	5	2.5
Education		
HS or less	143	74.1
College or more	50	25.9
Employment (%yes)	30	15.5
Marital status		
Married/committed	52	27.1
Never married	52	27.1
Separated/div/wid	88	45.8
Children (% yes) (range 1–9)	160	82.9
Sexual identity		
Straight/heterosexual	153	79.3
Gay/homosexual	4	2.1
Bisexual	8	4.1
None of above/unsure	28	14.5
Sexually active (last 3 months) (% yes)	106	54.9
Income		
≤$10 K	125	67.2
>$10 K	61	32.8
Variable	n	%
Adherence		

Variable	n	Mean (SD)
Low adherence (LA) (<90 %)	102	52.8
High adherence (HA) (≥90 %)	91	47.2
Risk index		
Low risk (LR) (≤3)	120	62.2
High risk (HR) (>4)	73	37.8
Adherence/risk groups[a]		
HALR	66	34.2
HAHR	25	13.0
LALR	54	28.0
LAHR	48	24.9

[a]Adherence and risk are associated—(percent conditional on risk) 45.0 % low risk subjects with low adherence compared to 65.8 % of high risk subjects with low adherence: $\chi^2(1) = 7.845$, $p = 0.005$

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Table 3

Interaction and main effects for adherence and risk

F-statistic (df1, df2); p value Or Wald Chi square (df = 1)[a], p value	df1	df2	Main effects[b] Adherence	Main effects[b] Risk	Interaction effect Adherence-x-risk
HIV knowledge (% correct out of 45)	1	189	4.556, p = 0.034 *	10.461, p = 0.001 ***	0.393, p = 0.531
CESD depression	1	189	0.363, p = 0.547	2.580, p = 0.110	0.121, p = 0.729
Personal stigma	1	186	1.147, p = 0.286	0.000, p = 0.998	1.182, p = 0.278
Spiritual wellbeing (EWB)	1	184	0.501, p = 0.480	0.448, p = 0.504	0.090, p = 0.765
Spiritual wellbeing (RWB)	1	184	1.396, p = 0.239	0.047, p = 0.828	0.086, p = 0.770
Spiritual wellbeing (SWB)	1	185	1.132, p = 0.289	0.029, p = 0.865	0.004, p = 0.952
Difficult life circumstances	1	188	4.745, p = 0.031 *	8.317, p = 0.004 **	0.193, p = 0.661
PRQ social support	1	185	1.685, p = 0.196	0.020, p = 0.888	0.995, p = 0.320
PSQIII total satisfaction	1	187	1.403, p = 0.238	0.489, p = 0.485	1.526, p = 0.218
HIV self-management	1	187	12.954, p < 0.001 ***	0.094, p = 0.760	2.665, p = 0.104
BRCOPE—positive (≤18 vs >18)[a]	–		0.214, p = 0.643	0.665, p = 0.415	0.235, p = 0.628
BRCOPE—negative (≤2 vs>2)[a]	–		0.032, p = 0.859	0.227, p = 0.634	1.194, p = 0.275
Condom self-efficacy	1	150	0.002, p = 0.964	1.342, p = 0.249	0.922, p = 0.339
HIV medication self efficacy	1	188	10.702, p = 0.001 ***	0.000, p = 0.984	2.206, p = 0.139
Outcome expectancy for HIV adherence	1	188	0.026, p = 0.872	0.292, p = 0.589	0.993, p = 0.320
Condom outcome expectancy					
Partner reaction	1	183	2.847, p = 0.093 ~	1.937, p = 0.166	0.182, p = 0.670
Physical hedonism	1	188	0.119, p = 0.730	5.082, p = 0.025 *	0.057, p = 0.812
Positive self evaluation (≤30 vs >30)[a]	–		0.367, p = 0.545	4.476, p = 0.034 *	0.065, p = 0.799
Prevention efficacy (<10 vs =10)[a]	–		4.091, p = 0.043 *	0.653, p = 0.419	0.272, p = 0.602
Social approval (≤15 vs >15)[a]	–		0.576, p = 0.448	1.446, p = 0.229	1.109, p = 0.292
Negative self evaluation (≤11 vs >11)[a]	–		1.760, p = 0.185	12.682, p <0.001 ***	0.009, p = 0.924
Multidimensional desire for control					
Internal	1	186	0.302, p = 0.583	3.030, p = 0.083 ~	0.178, p = 0.674
External (≤24 vs >24)[a]	–		0.974, p = 0.324	0.345, p = 0.557	2.491, p = 0.115

F-statistic (df1, df2); p value	df1	df2	Main effects[b]		Interaction effect
Or Wald Chi square (df = 1)[a], p value			Adherence	Risk	Adherence-x-risk
Shared (<20 vs =20)[a]	–		0.202, p = 0.653	0.351, p = 0.553	1.929, p = 0.165
Safer sex motivation					
Internal (<91 vs =91)[a,c]	–		1.686, p = 0.194	5.998, p = 0.014 *	1.182, p = 0.277
External	1	183	1.188, p = 0.277	0.125, p = 0.724	0.752, p = 0.387
HIV adherence motivation					
Internal (<84 vs =84)[a]	–		2.969, p = 0.085 ~	0.001, p = 0.975	4.570, p = 0.033 *
External	1	189	4.149, p = 0.043 *	0.663, p = 0.416	0.085, p = 0.771
HIV status disclosure to main partner[a] (yes vs no, dk, rta, na)	–		2.521, p = 0.112	7.183, p = 0.007 **	0.006, p = 0.936

dk don't know, *rta* refused to answer, *na* not applicable

~ p <0.10

* p <0.05

** p <0.01

*** p <0.001

[a] 2-x-2 factorial Generalized Linear Model was performed for these dichotomous outcome measures Using a Binomial Response with a Logit link function (i.e. logistic regression); Wald Chi square tests (df = 1) are reported

[b] Adherence and risk are associated ($\chi^2(1) = 7.845$, p = 0.005). Both main effects and interaction effect reported for completeness

[c] Model fit was uncertain for internal safer sex motivation (The maximum number of step-halvings was reached but the log-likelihood value cannot be further improved. Output for the last iteration was displayed)