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A randomized trial of yoga for stress and substance use among people living with HIV in reentry

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Abstract

Background: People in reentry from prison or jail (returning citizens) living with HIV and substance use problems often experience numerous stressors and are at high risk for resumed substance use. Interventions are needed to manage stress as a pathway to reduced substance use.

Objective: This study explored the effect of a Hatha yoga intervention as compared to treatment as usual on stress and substance use among returning citizens living with HIV and substance use problems.

Methods: Participants were randomized to either a 12-session, 90-minute weekly yoga intervention or treatment as usual. All participants were clients of a service provider for returning citizens that offered case management, health care, and educational classes. Outcomes included stress as measured by the Perceived Stress Scale at the completion of the yoga intervention (three-months) and substance use as measured by the Timeline Followback at one-month, two-months, and three-months.

Author's Note:

For details regarding the yoga protocol and modifications, email Alexandra Wimberly at awimberly@ssw.umaryland.edu.

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Results: Seventy-five people were enrolled, two of whom were withdrawn from the study because they did not have HIV. Of the 73 remaining participants, 85% participated in the three-month assessment. At three-months, yoga participants reported less stress than participants in treatment as usual [$F(1,59)=9.24, p<.05$]. Yoga participants reported less days of substance use than participants in treatment as usual at one-month, two-months, and three-months [$X^2(1)=11.13, p<.001$].

Conclusion: Yoga interventions for returning citizens living with HIV and substance use problems may reduce stress and substance use. This finding is tentative because the control group did not receive an intervention of equal time and intensity.

Keywords

reentry; returning citizens; drugs; substance use; HIV; yoga

1. Introduction

1.1. Background

Incarcerated people in the United States experience rates of HIV that are five times higher than the general population (Center for Disease Control and Prevention, 2012; Maruschak, 2015). They also experience high prevalence of substance use disorders (approximately 50–66%; Karberg & James, 2005; Mumola & Karberg, 2006). People exiting incarceration (returning citizens) are at high risk of resuming substance use (Mallik-Kane & Visser, 2008). Drug use during reentry can lead to dire health consequences, including rates of death in the first two weeks following release from prison that are 129 times that of other state residents (Binswanger et al., 2007) and interruptions in HIV care (Haley et al., 2014; Swan, 2015) which contributes to progression of HIV (Baum et al., 2009).

Substance use among returning citizens is unsurprising given the challenges of reentry (Western, Braga, Davis, & Sirois, 2015) and the known links between stress and substance use (Sinha, 2008). Stressors in reentry include reconnecting with social supports, accessing medical and behavioral health care (Mallik-Kane & Visser, 2008; Western et al., 2015), and experiencing discrimination (Pager, 2003); all in a world that has often changed since entering prison (Western et al., 2015). These stressors make it difficult to secure basic life needs including housing and employment (Mallik-Kane & Visser, 2008; Pager, 2003; Western et al., 2015).

For people with substance use disorders, stress during reentry is especially problematic because drug use may be their main coping mechanism (Sinha, 2008). Exposure to chronic stressors, in concert with other individual and genetic risks for substance use, affect neurobiological pathways, increasing both the risk of ineffective stress responses and the risk of substance use to cope with stress (Sinha, 2008). Stress-reduction interventions are crucial for returning citizens to manage this challenging time, in general, and to reduce substance use risk, more specifically (Sinha, 2008). One promising intervention that has been associated with stress reduction is yoga (Li & Goldsmith, 2012).

1.2. Yoga

Yoga is a spiritual, mental and physical practice that originated in India over 5,000 years ago. The predominant type of yoga practiced in the West is Hatha, which combines physical postures (asanas), breath control (pranayama) and meditation (dhyana) to facilitate relaxation. As yoga's popularity has grown in the United States, so have critiques of the Western yoga industry, including cultural appropriation, commercialization and marketing to White women with middle and high incomes (Nanda, 2011; Patankar, 2014). This study aimed to expand the reach of yoga to a racially diverse sample of people with low incomes, while assessing its potential to reduce stress and substance use among returning citizens.

1.3. Yoga and stress

It is believed that yoga corrects imbalances in one's stress response by decreasing sympathetic nervous system activity and increasing parasympathetic nervous system activity (Brown & Gerbarg, 2005; Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012). Yoga research has supported this assertion by demonstrating stress reduction among several populations, including people experiencing high levels of stress (Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Michalsen et al., 2012; Vadiraja et al., 2009). However, systematic reviews conclude that while yoga is a valuable ancillary approach to address stress, methodological limitations preclude broad conclusions regarding yoga as a stand-alone intervention for stress management (Li & Goldsmith, 2012; Macy, Jones, Graham, & Roach, 2015).

1.4. Yoga and substance use

There is limited research regarding the effects of yoga on substance use; yet yoga is often offered as a complementary intervention in substance use treatment facilities (de Miranda, 2016; Lohman, 1999), and the self-help group, Yoga of 12 Step Recovery, combines the group format of 12-step meetings with yoga (Y12SR, n.d.). Although limited, research demonstrates yoga's potential to reduce substance use (Bock et al., 2012; Khalsa, Khalsa, Khalsa, & Khalsa, 2008; Posadzki, Choi, Lee, & Ernst, 2014; Shaffer, LaSalvia, & Stein, 1997). For example, in one randomized controlled trial, Hatha yoga and group psychotherapy were both associated with reductions in reported drug use and law-breaking activity among people in methadone treatment (Shaffer et al., 1997).

More studied than yoga, the closely-related practice of mindfulness meditation has been associated with substance use reductions (Chiesa & Serretti, 2014; Li, Howard, Garland, McGovern, & Lazar, 2017). While similar in ultimate aim and philosophy, Hatha yoga incorporates more physical postures, and mindfulness interventions incorporate more meditation (Bowen, Chawla, & Marlatt, 2011). Despite their demonstrated efficacy in reducing substance use, mindfulness interventions face limitations that are potentially addressed through yoga, including difficulty with meditation due to negative thoughts or concentration difficulties (Uebelacker et al., 2010) and difficulty with meditation due to excessive thoughts and worries among people experiencing severe substance use problems (Chen, Comerford, Shinnick, & Ziedonis, 2010). Further, participants in mindfulness interventions have suggested incorporating more yoga in them (Vallejo & Amaro, 2009; Zgierska et al., 2008). Yoga, with its emphasis on physical postures and breathing, may be

more accessible than sitting meditation for people experiencing acute stress, and can have immediate stress-reduction benefits by providing a distraction from negative thoughts. Additionally, the physical postures themselves can reduce stress associated with body aches and pain, which may be particularly valuable for people living with HIV who experience bodily discomfort (Bonadies, 2004). As the lone autonomic function voluntarily regulated with ease, breathing exercises may be a key component to yoga's impact on stress (Brown & Gerbarg, 2005; Streeter et al., 2012). Multiple studies have demonstrated how various forms of yoga breathing can increase parasympathetic nervous system activity (Streeter et al., 2012).

1.5. Rationale

This study responds to the need for stress-reduction interventions during the challenging time of reentry. With the stress-reduction potential of yoga and the known links between stress and substance use, this study tests whether yoga produces stress and substance use reductions among returning citizens living with HIV and substance use problems. This study addresses limitations of existing yoga research by utilizing random assignment and a sufficiently powered sample size (Li & Goldsmith, 2012; Macy et al., 2015).

This study's value also lies in the potential public health impact for a population that is highly stigmatized, underserved, and at risk for significant negative health consequences due to resumed substance use. Finally, this study responds to critiques of yoga's exclusivity by testing the intervention among people who are underrepresented in U.S. yoga studios.

1.6. Hypothesis

We hypothesized that returning citizens living with HIV and substance use problems who participated in a 12-session, 90-minute weekly Hatha yoga intervention (yoga) would experience less stress and less substance use than participants in treatment as usual (TAU). A purposive sample was drawn from a Philadelphia service provider for returning citizens, which is part of an HIV/AIDS service organization that offers primary care, case management, and consumer education. Recruiting from this organization ensured the sample met the eligibility criteria.

2. Methods

2.1. Design

This study utilized a parallel research design with an allocation ratio of 1:1, randomizing participants to either yoga or TAU at four recruitment periods. These recruitment periods were 3.5 months apart and lasted three weeks, ensuring that there was a sufficient number of people to create a yoga class of at least eight people. Study enrollment began in December 2015, and data collection ended in February 2016. Institutional Review Boards from a university and the service provider approved the study.

2.2. Participants and Setting

All study activities occurred at the service provider location. Approximately 80% of clients recently returned from jail and approximately 20% of clients recently returned from prison.

Eligibility criteria included: 18 years of age, English-speaking ability, a client of the service provider, HIV diagnosis, problematic substance use or dependence at baseline or prior to their most recent incarceration (as determined by the Texas Christian University Drug Screen II), released from prison or jail in the previous 12 months, verbal agreement to the screening assessments, and written informed consent.

The target sample size was 80, based on an anticipated effect size of $d=.85$ for stress found in a yoga intervention study that used the same measure for stress (Michalsen et al., 2012). Power was set at .80 ($\beta=.20$). To find an effect size of .85 between yoga and TAU with a power of 80% ($\alpha=5\%$) and a two-tailed test, a sample size of 46 was calculated using Cohen's power table (Cohen, 1988). Because we anticipated 30% loss to follow-up and low yoga attendance, we increased the target sample size to 80.

2.3. Study Flow

Referral.—Participants were recruited by study fliers and by case manager referral.

Screening.—Upon recruitment, potential participants completed verbal informed consent and confirmed eligibility criteria. To establish substance dependence, participants completed the Texas Christian University Drug Screen II (Institute of Behavioral Research, 2007), focusing on their substance use in the past year and the year prior to their most recent incarceration. Of the 108 people who completed screenings, 75 people were enrolled (see Figure 1). One participant withdrew after attending one yoga class because he found the class boring and experienced back pain due to a prior injury; this person was included in analysis. Two people were withdrawn and not included in the analysis because they did not have an HIV diagnosis. The final sample size was 73.

Baseline Assessments.—These assessments were administered following screening and informed consent procedures.

Stress.—The 10-item Perceived Stress Scale (PSS) measured self-reported stress. The 10-item PSS has demonstrated good internal consistency and validity across multiple studies (Lee, 2012). In particular, Cronbach's alpha and test-retest reliability were found to be greater than $>.70$ (Lee, 2012). The PSS ranges from 0–40, with higher scores indicating more stress. National surveys have found average PSS scores ranging between 12–16 (Cohen & Janicki-Deverts, 2012).

Substance use.—The Timeline Followback (TLFB) assessed frequency of drug and alcohol use in the 90 days prior to baseline and the 90 days prior to incarceration. The TLFB has strong test-retest reliability (.80 or greater), and TLFB reports of days of cocaine use have been highly correlated with percentage of urine screens positive for cocaine (Ehrman & Robbins, 1994; Fals-Stewart, O'Farrell, Freitas, McFarlin, & Rutigliano, 2000).

Background Information.—A study-designed questionnaire collected demographic information, experience with yoga, current substance use treatment, and previous criminal justice system involvement.

Randomization.—The principal investigator used a computerized random number generator ([Random.org](https://www.random.org)) to generate the randomization scheme. Randomization was stratified to ensure a similar number of people from prison and jail were in TAU and yoga. The principal investigator placed treatment condition assignments in envelopes that were marked with the recruitment number. Participants opened the envelope indicating their treatment assignment after completing the baseline assessments. The principal investigator and a research assistant completed the assessments via interviews and were not blinded to treatment assignment.

Treatment conditions.

TAU. Participants were engaged in programming with the service provider, including some or all of the following activities: case management, recreational or GED classes, and free healthcare.

Yoga. In addition to receiving the same services as TAU, participants engaged in a 12-session, weekly 90-minute Hatha yoga intervention. Classes were guided by a curriculum developed by the principal investigator, including discussion of yoga philosophy, breathing exercises, physical postures and meditation. The intervention aimed to teach coping skills, including breathing techniques and physical postures, to enhance adaptive responses to stressful situations and reduce the risk of substance use as a stress-management strategy. Curriculum development was informed by the principal investigator's experience as a volunteer yoga instructor at the service provider location and feedback from two interviews that she conducted with yoga students at the service provider location. Yoga participants were also given a handout regarding yoga poses and meditations for home use at weeks four and eight.

Classes took place at the service provider location when drop-in services were closed in order to protect participant privacy and ensure that no non-study participants joined the classes. Class times were Wednesdays from 6:00–7:30 PM for the first cohort and Mondays from 12:00–1:30 PM for the second, third and fourth cohorts.

Two certified yoga instructors provided the instruction. A 30-year old woman with nine years of regular yoga practice and six years of experience teaching Vinyasa and Yin yoga taught the first cohort. She also worked in a public health capacity at a jail. A 29-year old man who is the co-owner of a yoga studio in Philadelphia with 12 years of regular yoga practice and six years of experience teaching Vinyasa, restorative and therapeutic yoga taught the second, third and fourth cohorts. Instructors were provided with the curriculum, but were encouraged to adjust the curriculum to respond to needs of students. Instructors provided written and verbal feedback regarding adherence to the curriculum.

Follow-up Assessments.—After four and eight yoga sessions were completed, TLFB data were collected to assess substance use in the previous month for all study participants. These one-month and two-month assessments aimed to improve recall of substance use and strengthen continued participation rates.

After completion of the yoga intervention, approximately three months post-baseline, stress and substance use were measured. At three-months, the TLFB assessed substance use between the eighth yoga class and the final yoga class. The TLFB time periods varied for the four yoga cohorts due to holidays that caused schedule interruptions. Because of this variation, days of substance use were operationalized as percentage of days of substance use.

Reimbursement.—Participants were compensated \$35 at baseline, \$40 at three-months, and an additional \$10 if they completed the one- and two-month substance use assessments. Participants received tokens for public transportation travel for each assessment and yoga class attended.

2.4. Data Analysis

Baseline differences between the yoga and TAU groups were assessed with chi-square tests and ANOVA tests. Following the intent to treat principle, we compared the stress and substance use of participants in yoga in comparison to TAU. Using analysis of covariance (ANCOVA; SAS PROC GLM), we compared yoga and TAU on the PSS at three-months, controlling for the baseline PSS score. Using generalized estimating equations (GEE; SAS PROC GENMOD), we compared yoga and TAU on the percentage of days of drug use at one-, two-, and three-months controlling for percentage of days of drug use within the previous 90 days of baseline, month, and the effect of time on treatment with a treatment x month interaction term. GEE was utilized because it takes into account the dependence of variables in repeated measure designs by generating unbiased estimates of standard errors (Ghisletta & Spini, 2004). Further, with GEE, all available pairs of data are used (Sainani, n.d.). Missing data points were treated as missing at random. To address potential bias from missing data, we performed sensitivity analyses using multiple imputation with ten imputed data sets.

To determine the effect size of yoga on stress and substance use, we calculated Cohen's *d* by dividing the difference in mean values between the yoga and TAU groups from baseline to the respective follow-up assessment by the baseline pooled standard deviation (Friedmann et al., 2008). We used the predicted values from the GEE and ANCOVA analyses (i.e., not the actual mean) for the follow-up mean values for stress and substance use. We used the baseline means and standard deviations only for the participants who completed the respective follow-up assessments.

3. Results

3.1. Sample Characteristics

Participants in yoga and TAU shared similar demographic characteristics (Table 1); however, yoga participants had about one additional year of education than TAU participants. The most problematic drug for participants was crack, followed by heroin. About half of the participants were in substance use treatment at baseline (not necessarily provided by the reentry service provider). Yoga participants had PSS scores that were a few points lower than TAU participants at baseline, trending towards statistical significance ($p < .07$). Stress levels for both groups were higher than national averages (Cohen & Janicki-Deverts, 2012).

The yoga and TAU groups did not differ significantly in the percentage of days of substance use at baseline.

Three-month assessment rates were 92% among TAU participants and 78% among yoga participants (see Figure 1 for loss to follow-up reasons). Between baseline and three-month assessments, three TAU participants and two yoga participants were in inpatient substance use treatment; nine TAU participants and seven yoga participants were incarcerated.

3.2. Yoga Class Attendance

The mean yoga attendance was 4.22 classes ($SD=3.77$). Twenty-two percent ($n=8$) of participants never attended a class, 35 % ($n=13$) attended one-four classes, 24 % ($n=9$) attended five-eight classes, and 19 % ($n=7$) attended nine-12 classes. Participants reported the following barriers to attendance: incarceration (n [total number of classes missed]=48), illness ($n=34$), employment ($n=24$), medical or parole appointments ($n=10$), inpatient substance use treatment ($n=8$), lack of transportation ($n=4$), caretaking for ill family member ($n=3$), overslept ($n=2$), forgot ($n=1$), and involvement in a fight ($n=1$).

3.3. Protocol Modifications

The yoga teachers reported that the physical postures in the protocol were advanced for many of the students, making preparatory stretches particularly helpful. Teachers adjusted the protocol by adding more restorative poses. In the first yoga cohort, classes six and nine were substituted with a restorative class. In the second through fourth yoga cohorts, the teacher included restorative poses in each class and adjusted the sequencing of poses.

3.4. Effects of Yoga on Stress and Substance Use

There was a significant effect of treatment condition on PSS at three-months, controlling for baseline PSS [$F(1,59)=9.24$, $p<.05$, see Table 2]. The ANCOVA model identified a mean PSS for yoga participants that was 4.37 points lower than the PSS for TAU participants (including the 29 yoga participants and 33 TAU participants who completed the three-month assessment). The mean baseline PSS was 18.86 ($SD=9.43$) for the yoga group and 22.12 ($SD=7.02$) for the TAU group. Controlling for these baseline values, ANCOVA identified a PSS of 15.82 among yoga participants and 20.19 among TAU participants, representing a small effect size of $d=0.13$. The unadjusted PSS scores at the three-month assessment were 15.24 ($SD=7.99$) for the yoga group and 20.70 ($SD=7.07$) for the TAU group.

There was a significant effect of treatment condition on percentage days of substance use at one-month, two-months and three-months, controlling for baseline substance use, month, and month x treatment condition [$X^2(1)=11.13$, $p<.001$, see Table 3]. The GEE model estimated that yoga participants used substances on 20% of the days between baseline and three-months and TAU participants used substances on 41% of those days, with substance use declining slightly after baseline for yoga and increasing for TAU (see Figure 2). The least square mean percentage of days of substance use at one-month was 17.16% for yoga and 44.27% for TAU; at two-months it was 20.34% for yoga and 47.52% for TAU; and at three-months, it was 20.27% for yoga and 31.01% for TAU. The effect size between yoga and TAU for percentage of days of substance use was medium from baseline to one-month

($d=0.61$), medium from baseline to two- months ($d=0.63$), and small from baseline to three- months ($d=0.07$). Time ($p<.053$) was significant and treatment condition x time effects ($p<.06$) were trending towards significance. We can therefore conclude that the treatment effect was not dependent on time. Multiple imputation to address missing data did not change the results for stress or substance use.

Because the baseline PSS score was slightly lower in the yoga group, we also completed GEE analysis to examine the effect of treatment condition on percentage of days of substance use at one-, two- and three-month(s), controlling for baseline PSS. We found that baseline PSS was not a statistically significant predictor of substance use [$X^2(1)=1.69$, $p=.19$] and did not change the results of the overall analysis.

4. Discussion

Among this study's sample of returning citizens living with HIV and substance use problems, participants who were randomly assigned to a 12-week yoga intervention experienced greater reductions in stress than participants randomly assigned to TAU. Yoga participants moved from a mean PSS at baseline that was higher than the national average to a mean PSS at three-months that was comparable to national averages. TAU participants also experienced a slight reduction in PSS from baseline to three-months; however, it was still higher than the national average. The average percentage of any substance use across the 90-day follow-up among TAU participants was twice the average of yoga participants (41% versus 20% of days). Yoga participants experienced slight reductions in substance use while TAU participants experienced sizeable increases at one- and two-month(s), yielding effect sizes that were medium from baseline to one- and two-month(s). At three-months, substance use for the TAU group was still greater than substance use at baseline, but only slightly, yielding a small effect size from baseline to three-months. While we did not find a time-by-treatment-interaction (likely due to the sample size), it was trending towards significance with a treatment effect on substance use that was larger at one- and two-month(s) than at three-months.

This study's findings are consistent with research that demonstrates reductions in stress among people who practice yoga (Li & Goldsmith, 2012; Macy et al., 2015). It adds to this literature by addressing previous methodological limitations through random assignment and a larger sample size. The study findings differ from previous yoga studies that demonstrated considerably larger effect sizes on stress (Michalsen et al., 2012). This study's smaller effect size may have been related to low attendance rates and the numerous challenges this population faces. Examining ways to improve attendance and/or increase the duration of the intervention would be helpful in future yoga intervention research in this context. This study's findings are also consistent with an emerging body of research that suggests yoga can facilitate reductions in substance use (Bock et al., 2012; Khalsa et al., 2008; Posadzki et al., 2014; Shaffer et al., 1997). As such, it can be considered part of foundational studies that support yoga as a complementary treatment for substance use and as a novel study of yoga's benefits in community return following incarceration.

This study did not determine the mechanism behind yoga's effects on stress and substance use. It may be that strengthening stress-related coping skills regulated the body's stress response, improved mood, and helped participants manage stressful situations, which in turn, may have reduced substance use-related coping responses. However, as suggested by Uebelacker et al. (2010), there are likely other mechanisms at play. In particular, the social support from the teacher and other participants in the yoga classes may have been a factor. Because TAU did not receive an intervention of equal time and attention, it may have been that the stress and substance use reductions were related to the supportive climate of the yoga classes.

Another potential explanation regarding this study's findings is that yoga participants experienced fewer challenges at baseline, which supported better outcomes. At baseline, yoga participants had one more year of education than TAU participants (12 versus 11 years). Yoga participants also had slightly lower scores on the PSS (trending towards statistical significance). While important to consider, these baseline differences were limited in scope. Additionally, the stress and substance use analyses controlled for respective baseline measures and still found a statistically significant effect. Controlling for baseline PSS also did not impact substance use outcomes at one-, two-, and three-month(s), which is unsurprising given that the PSS assesses situational stress in the past month. Future research can build on this study by contemporaneously and longitudinally assessing stress and substance use to further examine associations between current stress and substance use.

Finally, follow-up rates were lower in yoga than TAU. It is possible that participants who had more challenges did not attend the three-month assessment, potentially skewing the results in favor of yoga. However, reasons for loss to follow-up were mostly known. Additionally, a similar percentage of yoga and TAU participants were incarcerated and spent time at inpatient substance use treatment from baseline to three months, suggesting that the two groups faced similar challenges. In sum, even if baseline differences between the two groups partially contributed to the findings, it is unlikely that they fully accounted for them.

This study provides initial evidence of the role that yoga can play in supporting reduced stress and substance use among a vulnerable group of people who are at high risk for substance use. Strengths include the randomized design, high follow-up rates, and multiple cohorts, demonstrating that the findings endure at different time periods.

This study faces several limitations. Self-reported substance use may not have been accurate. However, the TLFB periods were short so that recall was enhanced for participants. Another limitation was that without a control group that received an intervention of equal intensity, we cannot rule out that the extra time and attention that yoga participants received affected the results. An additional limitation was that with the low yoga class attendance rates, we do not have a clear picture of the potential intervention dosage effects. A further limitation is that enrollment periods lasted three weeks. While this time frame was necessary to enroll a sufficient number of people for each class, several participants did not attend a yoga class because they were re-incarcerated during the enrollment period. Another limitation is that we did not factor in cohort membership. Examining ways in which different group dynamics and teachers influence outcomes would be helpful in future research. Finally, with very

specific eligibility criteria, the generalizability of these findings is limited to returning citizens experiencing HIV and substance use problems.

6. Conclusion

Yoga, a low-cost and feasible intervention, can be offered during reentry from prison or jail to support reduced stress and substance use among people living with HIV and substance use problems. While more studies are needed to understand the mechanism behind the effects and to replicate the results, these findings are promising. At the same time, it is important to note that yoga will not fully address problematic substance use and stress for this population, who confronts many barriers that require both individual and structural interventions. Further, yoga may not be a fit for everyone who practices it. Taking these limitations into consideration, yoga can provide a complementary treatment option for returning citizens experiencing HIV and substance use problems.

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Highlights

- Compared stress and substance use outcomes of yoga versus treatment as usual.
- Participants included returning citizens with HIV and substance use problems.
- At three-months, the yoga group had reduced stress and slightly reduced substance use.
- Future research with this population can compare yoga with an active intervention.

Figure 1.

Consort Diagram. * Individuals withdrawn due to not having an HIV diagnosis were excluded from analysis.

Figure 2.

Percentage days of substance use by treatment condition and month. ³ Baseline=Previous 90 days. Month 1=Previous 22 days. Month 2=Previous 28–35 days. Month, 3=Previous 28 days. Error bars represent standard error. At baseline, scores represent 37 people from yoga and 36 people from TAU. At month one, scores represent 31 people from yoga and 34 people from TAU. At month two, scores represent 28 people from yoga and 32 people from TAU. At month three, scores represent 29 people from yoga and 33 people from TAU.

Table 1

Baseline Characteristics of People Randomized to Yoga versus TAU

	Yoga (n = 37)		TAU (n = 36)		p-value*
Gender, n (%)					0.17
Male	29	(78.38)	21	(58.33)	
Female	7	(18.92)	14	(38.89)	
Transgender	1	(2.70)	1	(2.78)	
Race/Ethnicity, n (%)					0.62
Black	31	(83.78)	26	(72.22)	
White	2	(5.41)	4	(11.11)	
Multiracial	2	(5.41)	4	(11.11)	
Latino/a	2	(5.41)	2	(5.56)	
Age, M (SD)	43.30	(10.59)	45.61	(10.33)	0.35
Monthly Income, M (SD)	780.24	(956.70)	655.31	(589.99)	0.51
Years of Education, M (SD)	12.18	(2.03)	10.97	(1.84)	0.01
Marital Status, n (%)					0.82
Single	32	(86.49)	31	(86.11)	
Married	2	(5.41)	3	(8.33)	
Engaged/ primary intimate relationship	3	(8.11)	2	(5.56)	
Employment, n (%)					0.31
Receive disability	15	(40.54)	19	(52.78)	
Unemployed	18	(48.65)	16	(44.44)	
Employed	4	(10.81)	1	(2.78)	
Correctional facility of recent release, n (%)					0.80
Jail	30	(81.08)	30	(83.33)	
Prison	7	(19.44)	6	(16.67)	
Days in reentry, M (SD)	177.03	(100.53)	145.64	(122.73)	0.24
Months last incarcerated, M (SD)	16.28	(35.16)	9.06	(23.75)	0.31
Current drug treatment, n (%)					0.90
Yes	19	(51.35)	18	(50.00)	
No	18	(48.65)	18	(50.00)	
Drug Treatment Type, n (%)					0.38
Intensive outpatient	10	(52.63)	11	(61.11)	
Methadone/suboxone	3	(15.79)	2	(11.11)	
Inpatient/recovery house	1	(5.26)	3	(16.67)	
Outpatient	2	(10.53)	2	(11.11)	
NA/AA	3	(15.79)	0	(0.00)	
Most problematic drug, n (%)					0.72
Crack	15	(40.54)	14	(38.89)	
Heroin	7	(18.92)	8	(22.22)	
Alcohol	6	(16.22)	5	(13.89)	

	Yoga (n = 37)		TAU (n = 36)		p-value*
Cocaine	5	(13.51)	5	(13.89)	
Heroin & crack/cocaine	0	(0.00)	2	(5.56)	
Marijuana & K2	1	(2.70)	1	(2.78)	
Ecstasy	1	(2.70)	0	(0.00)	
Crystal Meth	1	(2.70)	0	(0.00)	
Heroin & Xanax	0	(0.00)	1	(2.78)	
Crack & alcohol	1	(2.70)	0	(0.00)	
Perceived Stress Scale, M(SD)	18.43	(8.78)	21.81	(6.87)	0.07
Substance use days, past 90 days at baseline, M (SD)	24.14	(28.99)	29.09	(32.96)	0.50
Years living with HIV, M (SD)	15.70	(8.49)	13.08	(7.96)	0.18
Previous yoga classes, n (%)					0.39
None	24	(64.86)	26	(72.22)	
0–1 years (1–5 classes)	9	(24.32)	9	(25.00)	
1–3 years (1–4 classes per month)	4	(10.82)	1	(2.78)	

* Chi-square tests completed for categorical variables and ANOVA tests completed for continuous variables.

Table 2

Analysis of Covariance Summary for the Perceived Stress Scale Score at Three-Months

Source	Sum of Squares	df	Mean Square	F
Treatment Condition	459.41	1	459.41	9.24 [*]
Baseline PSS score	455.80	1	455.80	9.17 [*]

^{*} = < 0.05

Table 3

GEE Analysis for Variables Predicting Substance Use

Variables	B	Standard error	Wald	df
Intercept	3.76	4.50		
Treatment Condition (reference = yoga)			11.13 ***	1
TAU	10.75	6.43		
Baseline TLFB score	.62	.09	15.07 ***	1
Month			5.90	2
Treatment condition x month			5.74	2

***= < .001